

# CoinUtils

2.8

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## Contents

<b>1</b>	<b>Module Index</b>	<b>1</b>
1.1	Modules . . . . .	1
<b>2</b>	<b>Namespace Index</b>	<b>1</b>
2.1	Namespace List . . . . .	1
<b>3</b>	<b>Class Index</b>	<b>1</b>
3.1	Class Hierarchy . . . . .	2
<b>4</b>	<b>Class Index</b>	<b>7</b>
4.1	Class List . . . . .	7
<b>5</b>	<b>File Index</b>	<b>12</b>
5.1	File List . . . . .	12
<b>6</b>	<b>Module Documentation</b>	<b>14</b>
6.1	Presolve Matrix Manipulation Functions . . . . .	14
6.1.1	Detailed Description . . . . .	16
6.1.2	Function Documentation . . . . .	16
6.2	Presolve Utility Functions . . . . .	19
6.2.1	Detailed Description . . . . .	19
6.2.2	Function Documentation . . . . .	19
6.3	Presolve Debug Functions . . . . .	20
6.3.1	Detailed Description . . . . .	21
6.3.2	Function Documentation . . . . .	21
<b>7</b>	<b>Namespace Documentation</b>	<b>22</b>
7.1	CoinParamUtils Namespace Reference . . . . .	23
7.1.1	Detailed Description . . . . .	24
7.1.2	Function Documentation . . . . .	24
<b>8</b>	<b>Class Documentation</b>	<b>27</b>
8.1	_EKKfactinfo Struct Reference . . . . .	28
8.1.1	Detailed Description . . . . .	28
8.2	forcing_constraint_action::action Struct Reference . . . . .	29

---

8.2.1	Detailed Description	29
8.3	tripleton_action::action Struct Reference	30
8.3.1	Detailed Description	30
8.4	doubleton_action::action Struct Reference	31
8.4.1	Detailed Description	31
8.5	remove_fixed_action::action Struct Reference	31
8.5.1	Detailed Description	32
8.6	BitVector128 Class Reference	33
8.6.1	Detailed Description	33
8.7	CoinAbsFltEq Class Reference	33
8.7.1	Detailed Description	34
8.7.2	Constructor & Destructor Documentation	34
8.8	CoinArrayWithLength Class Reference	35
8.8.1	Detailed Description	37
8.8.2	Constructor & Destructor Documentation	38
8.8.3	Member Function Documentation	38
8.9	CoinBaseModel Class Reference	38
8.9.1	Detailed Description	41
8.9.2	Member Data Documentation	41
8.10	CoinBigIndexArrayWithLength Class Reference	41
8.10.1	Detailed Description	43
8.10.2	Constructor & Destructor Documentation	43
8.10.3	Member Function Documentation	43
8.11	CoinBuild Class Reference	43
8.11.1	Detailed Description	45
8.11.2	Constructor & Destructor Documentation	46
8.12	CoinDenseFactorization Class Reference	46
8.12.1	Detailed Description	49
8.12.2	Member Function Documentation	49
8.13	CoinDenseVector< T > Class Template Reference	50
8.13.1	Detailed Description	52
8.13.2	Member Function Documentation	53
8.14	CoinDoubleArrayWithLength Class Reference	53
8.14.1	Detailed Description	55

8.14.2	Constructor & Destructor Documentation	55
8.14.3	Member Function Documentation	55
8.15	CoinError Class Reference	55
8.15.1	Detailed Description	57
8.15.2	Friends And Related Function Documentation	57
8.16	CoinExternalVectorFirstGreater_2< S, T, V > Class Template Reference	58
8.16.1	Detailed Description	58
8.17	CoinExternalVectorFirstGreater_3< S, T, U, V > Class Template Reference	58
8.17.1	Detailed Description	59
8.18	CoinExternalVectorFirstLess_2< S, T, V > Class Template Reference	59
8.18.1	Detailed Description	60
8.19	CoinExternalVectorFirstLess_3< S, T, U, V > Class Template Reference	60
8.19.1	Detailed Description	61
8.20	CoinFactorization Class Reference	61
8.20.1	Detailed Description	74
8.20.2	Member Function Documentation	75
8.20.3	Member Data Documentation	78
8.21	CoinFactorizationDoubleArrayWithLength Class Reference	78
8.21.1	Detailed Description	80
8.21.2	Constructor & Destructor Documentation	80
8.21.3	Member Function Documentation	80
8.22	CoinFileInput Class Reference	81
8.22.1	Detailed Description	83
8.22.2	Constructor & Destructor Documentation	83
8.22.3	Member Function Documentation	83
8.22.4	Friends And Related Function Documentation	84
8.23	CoinFileIOBase Class Reference	85
8.23.1	Detailed Description	86
8.23.2	Constructor & Destructor Documentation	86
8.24	CoinFileOutput Class Reference	87
8.24.1	Detailed Description	89
8.24.2	Member Enumeration Documentation	89
8.24.3	Constructor & Destructor Documentation	89

---

8.24.4	Member Function Documentation	89
8.25	CoinFirstAbsGreater_2< S, T > Class Template Reference	91
8.25.1	Detailed Description	91
8.26	CoinFirstAbsGreater_3< S, T, U > Class Template Reference	91
8.26.1	Detailed Description	91
8.27	CoinFirstAbsLess_2< S, T > Class Template Reference	92
8.27.1	Detailed Description	92
8.28	CoinFirstAbsLess_3< S, T, U > Class Template Reference	92
8.28.1	Detailed Description	93
8.29	CoinFirstGreater_2< S, T > Class Template Reference	93
8.29.1	Detailed Description	93
8.30	CoinFirstGreater_3< S, T, U > Class Template Reference	93
8.30.1	Detailed Description	94
8.31	CoinFirstLess_2< S, T > Class Template Reference	94
8.31.1	Detailed Description	94
8.32	CoinFirstLess_3< S, T, U > Class Template Reference	94
8.32.1	Detailed Description	95
8.33	CoinMpsIO::CoinHashLink Struct Reference	95
8.33.1	Detailed Description	95
8.34	CoinLpIO::CoinHashLink Struct Reference	96
8.34.1	Detailed Description	96
8.35	CoinIndexedVector Class Reference	96
8.35.1	Detailed Description	101
8.35.2	Constructor & Destructor Documentation	102
8.35.3	Member Function Documentation	103
8.35.4	Friends And Related Function Documentation	105
8.36	CoinIntArrayWithLength Class Reference	105
8.36.1	Detailed Description	107
8.36.2	Constructor & Destructor Documentation	107
8.36.3	Member Function Documentation	107
8.37	CoinLpIO Class Reference	108
8.37.1	Detailed Description	115
8.37.2	Member Function Documentation	116
8.37.3	Member Data Documentation	124

---

8.38	CoinMessage Class Reference . . . . .	125
8.38.1	Detailed Description . . . . .	126
8.38.2	Constructor & Destructor Documentation . . . . .	127
8.39	CoinMessageHandler Class Reference . . . . .	127
8.39.1	Detailed Description . . . . .	131
8.39.2	Member Function Documentation . . . . .	132
8.39.3	Friends And Related Function Documentation . . . . .	136
8.40	CoinMessages Class Reference . . . . .	136
8.40.1	Detailed Description . . . . .	139
8.40.2	Member Enumeration Documentation . . . . .	139
8.40.3	Constructor & Destructor Documentation . . . . .	139
8.40.4	Member Function Documentation . . . . .	139
8.40.5	Member Data Documentation . . . . .	140
8.41	CoinModel Class Reference . . . . .	140
8.41.1	Detailed Description . . . . .	151
8.41.2	Constructor & Destructor Documentation . . . . .	152
8.41.3	Member Function Documentation . . . . .	152
8.42	CoinModelHash Class Reference . . . . .	158
8.42.1	Detailed Description . . . . .	159
8.42.2	Constructor & Destructor Documentation . . . . .	159
8.43	CoinModelHash2 Class Reference . . . . .	160
8.43.1	Detailed Description . . . . .	161
8.43.2	Constructor & Destructor Documentation . . . . .	161
8.44	CoinModelHashLink Struct Reference . . . . .	161
8.44.1	Detailed Description . . . . .	162
8.45	CoinModelInfo2 Struct Reference . . . . .	162
8.45.1	Detailed Description . . . . .	163
8.46	CoinModelLink Class Reference . . . . .	163
8.46.1	Detailed Description . . . . .	165
8.46.2	Constructor & Destructor Documentation . . . . .	165
8.47	CoinModelLinkedList Class Reference . . . . .	166
8.47.1	Detailed Description . . . . .	168
8.47.2	Constructor & Destructor Documentation . . . . .	168
8.47.3	Member Function Documentation . . . . .	168

---

8.48	CoinModelTriple Struct Reference . . . . .	169
8.48.1	Detailed Description . . . . .	169
8.49	CoinMpsCardReader Class Reference . . . . .	169
8.49.1	Detailed Description . . . . .	173
8.49.2	Member Function Documentation . . . . .	173
8.50	CoinMpsIO Class Reference . . . . .	173
8.50.1	Detailed Description . . . . .	182
8.50.2	Member Function Documentation . . . . .	182
8.50.3	Friends And Related Function Documentation . . . . .	186
8.50.4	Member Data Documentation . . . . .	187
8.51	CoinOneMessage Class Reference . . . . .	187
8.51.1	Detailed Description . . . . .	188
8.51.2	Constructor & Destructor Documentation . . . . .	189
8.51.3	Member Function Documentation . . . . .	189
8.52	CoinOsIFactorization Class Reference . . . . .	189
8.52.1	Detailed Description . . . . .	193
8.52.2	Member Function Documentation . . . . .	193
8.53	CoinOtherFactorization Class Reference . . . . .	194
8.53.1	Detailed Description . . . . .	199
8.53.2	Member Function Documentation . . . . .	199
8.53.3	Member Data Documentation . . . . .	200
8.54	CoinPackedMatrix Class Reference . . . . .	200
8.54.1	Detailed Description . . . . .	208
8.54.2	Constructor & Destructor Documentation . . . . .	209
8.54.3	Member Function Documentation . . . . .	210
8.54.4	Friends And Related Function Documentation . . . . .	222
8.54.5	Member Data Documentation . . . . .	223
8.55	CoinPackedVector Class Reference . . . . .	224
8.55.1	Detailed Description . . . . .	228
8.55.2	Constructor & Destructor Documentation . . . . .	229
8.55.3	Member Function Documentation . . . . .	230
8.55.4	Friends And Related Function Documentation . . . . .	231
8.56	CoinPackedVectorBase Class Reference . . . . .	232
8.56.1	Detailed Description . . . . .	235

8.56.2	Constructor & Destructor Documentation	236
8.56.3	Member Function Documentation	236
8.57	CoinPair< S, T > Struct Template Reference	237
8.57.1	Detailed Description	238
8.58	CoinParam Class Reference	238
8.58.1	Detailed Description	242
8.58.2	Member Typedef Documentation	243
8.58.3	Member Enumeration Documentation	243
8.58.4	Constructor & Destructor Documentation	244
8.58.5	Member Function Documentation	245
8.58.6	Friends And Related Function Documentation	246
8.59	CoinPostsolveMatrix Class Reference	249
8.59.1	Detailed Description	252
8.59.2	Constructor & Destructor Documentation	252
8.59.3	Member Function Documentation	253
8.59.4	Member Data Documentation	253
8.60	CoinPrePostsolveMatrix Class Reference	254
8.60.1	Detailed Description	261
8.60.2	Member Enumeration Documentation	262
8.60.3	Constructor & Destructor Documentation	262
8.60.4	Member Function Documentation	263
8.60.5	Member Data Documentation	263
8.61	CoinPresolveAction Class Reference	264
8.61.1	Detailed Description	267
8.61.2	Constructor & Destructor Documentation	268
8.61.3	Member Function Documentation	269
8.61.4	Member Data Documentation	269
8.62	CoinPresolveMatrix Class Reference	269
8.62.1	Detailed Description	276
8.62.2	Constructor & Destructor Documentation	277
8.62.3	Member Function Documentation	277
8.62.4	Friends And Related Function Documentation	279
8.62.5	Member Data Documentation	279
8.63	CoinRelFltEq Class Reference	281

---

8.63.1 Detailed Description . . . . .	282
8.63.2 Constructor & Destructor Documentation . . . . .	282
8.64 CoinSearchTree< Comp > Class Template Reference . . . . .	283
8.64.1 Detailed Description . . . . .	285
8.65 CoinSearchTreeBase Class Reference . . . . .	285
8.65.1 Detailed Description . . . . .	287
8.65.2 Member Function Documentation . . . . .	287
8.66 CoinSearchTreeCompareBest Struct Reference . . . . .	287
8.66.1 Detailed Description . . . . .	287
8.67 CoinSearchTreeCompareBreadth Struct Reference . . . . .	287
8.67.1 Detailed Description . . . . .	287
8.68 CoinSearchTreeCompareDepth Struct Reference . . . . .	287
8.68.1 Detailed Description . . . . .	288
8.69 CoinSearchTreeComparePreferred Struct Reference . . . . .	288
8.69.1 Detailed Description . . . . .	288
8.70 CoinSearchTreeManager Class Reference . . . . .	289
8.70.1 Detailed Description . . . . .	289
8.71 CoinSet Class Reference . . . . .	290
8.71.1 Detailed Description . . . . .	291
8.72 CoinShallowPackedVector Class Reference . . . . .	292
8.72.1 Detailed Description . . . . .	294
8.72.2 Constructor & Destructor Documentation . . . . .	295
8.72.3 Member Function Documentation . . . . .	296
8.72.4 Friends And Related Function Documentation . . . . .	296
8.73 CoinSimpFactorization Class Reference . . . . .	297
8.73.1 Detailed Description . . . . .	305
8.73.2 Member Function Documentation . . . . .	305
8.74 CoinSnapshot Class Reference . . . . .	306
8.74.1 Detailed Description . . . . .	311
8.74.2 Member Function Documentation . . . . .	311
8.75 CoinSosSet Class Reference . . . . .	312
8.75.1 Detailed Description . . . . .	313
8.76 CoinStructuredModel Class Reference . . . . .	314
8.76.1 Detailed Description . . . . .	317

---

8.76.2	Constructor & Destructor Documentation	318
8.76.3	Member Function Documentation	318
8.77	CoinThreadRandom Class Reference	319
8.77.1	Detailed Description	320
8.77.2	Constructor & Destructor Documentation	320
8.77.3	Member Function Documentation	321
8.78	CoinTimer Class Reference	321
8.78.1	Detailed Description	322
8.79	CoinTreeNode Class Reference	322
8.79.1	Detailed Description	323
8.80	CoinTreeSiblings Class Reference	324
8.80.1	Detailed Description	324
8.81	CoinTriple< S, T, U > Class Template Reference	325
8.81.1	Detailed Description	325
8.82	CoinUnsignedIntArrayWithLength Class Reference	326
8.82.1	Detailed Description	327
8.82.2	Constructor & Destructor Documentation	327
8.82.3	Member Function Documentation	328
8.83	CoinWarmStart Class Reference	328
8.83.1	Detailed Description	329
8.84	CoinWarmStartBasis Class Reference	329
8.84.1	Detailed Description	333
8.84.2	Member Enumeration Documentation	333
8.84.3	Constructor & Destructor Documentation	333
8.84.4	Member Function Documentation	334
8.84.5	Member Data Documentation	336
8.85	CoinWarmStartBasisDiff Class Reference	336
8.85.1	Detailed Description	338
8.85.2	Constructor & Destructor Documentation	338
8.86	CoinWarmStartDiff Class Reference	339
8.86.1	Detailed Description	339
8.87	CoinWarmStartDual Class Reference	340
8.87.1	Detailed Description	342
8.87.2	Member Function Documentation	342

---

8.88	CoinWarmStartDualDiff Class Reference . . . . .	342
8.88.1	Detailed Description . . . . .	344
8.88.2	Constructor & Destructor Documentation . . . . .	344
8.89	CoinWarmStartPrimalDual Class Reference . . . . .	345
8.89.1	Detailed Description . . . . .	347
8.89.2	Member Function Documentation . . . . .	347
8.90	CoinWarmStartPrimalDualDiff Class Reference . . . . .	348
8.90.1	Detailed Description . . . . .	350
8.90.2	Constructor & Destructor Documentation . . . . .	350
8.90.3	Member Function Documentation . . . . .	350
8.91	CoinWarmStartVector< T > Class Template Reference . . . . .	351
8.91.1	Detailed Description . . . . .	352
8.91.2	Member Function Documentation . . . . .	353
8.92	CoinWarmStartVectorDiff< T > Class Template Reference . . . . .	353
8.92.1	Detailed Description . . . . .	355
8.92.2	Constructor & Destructor Documentation . . . . .	355
8.92.3	Member Function Documentation . . . . .	355
8.93	CoinWarmStartVectorPair< T, U > Class Template Reference . . . . .	356
8.93.1	Detailed Description . . . . .	357
8.94	CoinWarmStartVectorPairDiff< T, U > Class Template Reference . . . . .	358
8.94.1	Detailed Description . . . . .	359
8.95	CoinYacc Class Reference . . . . .	359
8.95.1	Detailed Description . . . . .	359
8.96	do_tighten_action Class Reference . . . . .	360
8.96.1	Detailed Description . . . . .	361
8.96.2	Member Function Documentation . . . . .	361
8.97	doubleton_action Class Reference . . . . .	361
8.97.1	Detailed Description . . . . .	363
8.97.2	Member Function Documentation . . . . .	363
8.98	drop_empty_cols_action Class Reference . . . . .	363
8.98.1	Detailed Description . . . . .	365
8.98.2	Member Function Documentation . . . . .	365
8.99	drop_empty_rows_action Class Reference . . . . .	365
8.99.1	Detailed Description . . . . .	367

---

8.99.2 Member Function Documentation . . . . .	367
8.100drop_zero_coefficients_action Class Reference . . . . .	367
8.100.1 Detailed Description . . . . .	369
8.100.2 Member Function Documentation . . . . .	369
8.101dropped_zero Struct Reference . . . . .	369
8.101.1 Detailed Description . . . . .	370
8.102dupcol_action Class Reference . . . . .	370
8.102.1 Detailed Description . . . . .	372
8.102.2 Member Function Documentation . . . . .	372
8.103duprow_action Class Reference . . . . .	372
8.103.1 Detailed Description . . . . .	374
8.103.2 Member Function Documentation . . . . .	374
8.104EKKHlink Struct Reference . . . . .	374
8.104.1 Detailed Description . . . . .	375
8.105FactorPointers Class Reference . . . . .	375
8.105.1 Detailed Description . . . . .	376
8.106forcing_constraint_action Class Reference . . . . .	376
8.106.1 Detailed Description . . . . .	378
8.106.2 Member Function Documentation . . . . .	378
8.107gubrow_action Class Reference . . . . .	378
8.107.1 Detailed Description . . . . .	380
8.107.2 Member Function Documentation . . . . .	380
8.108implied_free_action Class Reference . . . . .	380
8.108.1 Detailed Description . . . . .	382
8.108.2 Member Function Documentation . . . . .	382
8.109isolated_constraint_action Class Reference . . . . .	383
8.109.1 Detailed Description . . . . .	384
8.109.2 Member Function Documentation . . . . .	384
8.110make_fixed_action Class Reference . . . . .	384
8.110.1 Detailed Description . . . . .	386
8.110.2 Member Function Documentation . . . . .	386
8.110.3 Friends And Related Function Documentation . . . . .	386
8.111presolvehlink Class Reference . . . . .	387
8.111.1 Detailed Description . . . . .	387

8.111.2 Friends And Related Function Documentation . . . . .	388
8.112Coin::ReferencedObject Class Reference . . . . .	388
8.112.1 Detailed Description . . . . .	389
8.113remove_dual_action Class Reference . . . . .	391
8.113.1 Detailed Description . . . . .	392
8.113.2 Member Function Documentation . . . . .	393
8.114remove_fixed_action Class Reference . . . . .	393
8.114.1 Detailed Description . . . . .	395
8.114.2 Member Function Documentation . . . . .	396
8.114.3 Friends And Related Function Documentation . . . . .	396
8.115slack_doubleton_action Class Reference . . . . .	396
8.115.1 Detailed Description . . . . .	398
8.115.2 Member Function Documentation . . . . .	398
8.116slack_singleton_action Class Reference . . . . .	398
8.116.1 Detailed Description . . . . .	400
8.116.2 Member Function Documentation . . . . .	400
8.117Coin::SmartPtr< T > Class Template Reference . . . . .	400
8.117.1 Detailed Description . . . . .	402
8.117.2 Constructor & Destructor Documentation . . . . .	404
8.117.3 Member Function Documentation . . . . .	405
8.117.4 Friends And Related Function Documentation . . . . .	405
8.118subst_constraint_action Class Reference . . . . .	406
8.118.1 Detailed Description . . . . .	407
8.118.2 Member Function Documentation . . . . .	407
8.119symrec Struct Reference . . . . .	408
8.119.1 Detailed Description . . . . .	408
8.120tripleton_action Class Reference . . . . .	408
8.120.1 Detailed Description . . . . .	411
8.120.2 Member Function Documentation . . . . .	411
8.121useless_constraint_action Class Reference . . . . .	411
8.121.1 Detailed Description . . . . .	412
8.121.2 Member Function Documentation . . . . .	412
<b>9 File Documentation . . . . .</b>	<b>413</b>

9.1	CoinFloatEqual.hpp File Reference	413
9.1.1	Detailed Description	414
9.2	CoinMessage.hpp File Reference	414
9.2.1	Detailed Description	415
9.3	CoinMessageHandler.hpp File Reference	415
9.3.1	Detailed Description	417
9.3.2	Define Documentation	417
9.3.3	Function Documentation	417
9.4	CoinParam.hpp File Reference	418
9.4.1	Detailed Description	419
9.5	CoinPresolveDupcol.hpp File Reference	419
9.5.1	Detailed Description	420
9.6	CoinPresolveEmpty.hpp File Reference	420
9.6.1	Detailed Description	421
9.7	CoinPresolveForcing.hpp File Reference	421
9.7.1	Detailed Description	422
9.8	CoinPresolveImpliedFree.hpp File Reference	422
9.8.1	Detailed Description	422
9.9	CoinPresolveMatrix.hpp File Reference	422
9.9.1	Detailed Description	424
9.9.2	Variable Documentation	424
9.10	CoinPresolveSingleton.hpp File Reference	424
9.10.1	Detailed Description	425
9.11	CoinPresolveZeros.hpp File Reference	425
9.11.1	Detailed Description	425
9.12	CoinWarmStart.hpp File Reference	425
9.12.1	Detailed Description	426

## 1 Module Index

### 1.1 Modules

Here is a list of all modules:

**Presolve Matrix Manipulation Functions**

**14**

<b>Presolve Utility Functions</b>	<b>19</b>
<b>Presolve Debug Functions</b>	<b>20</b>

## 2 Namespace Index

### 2.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

<b>CoinParamUtils (Utility functions for processing CoinParam parameters )</b>	<b>23</b>
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## 3 Class Index

### 3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

<b>_EKKfactinfo</b>	<b>28</b>
<b>forcing_constraint_action::action</b>	<b>29</b>
<b>tripleton_action::action</b>	<b>30</b>
<b>doubleton_action::action</b>	<b>31</b>
<b>remove_fixed_action::action</b>	<b>31</b>
std::basic_fstream< char >	
std::basic_fstream< wchar_t >	
std::basic_ifstream< char >	
std::basic_ifstream< wchar_t >	
std::basic_ios< char >	
std::basic_ios< wchar_t >	
std::basic_iostream< char >	
std::basic_iostream< wchar_t >	
std::basic_istream< char >	
std::basic_istream< wchar_t >	
std::basic_istreamstream< char >	
std::basic_istreamstream< wchar_t >	
std::basic_ofstream< char >	
std::basic_ofstream< wchar_t >	
std::basic_ostream< char >	
std::basic_ostream< wchar_t >	
std::basic_ostringstream< char >	
std::basic_ostringstream< wchar_t >	
std::basic_string< char >	
std::basic_string< wchar_t >	

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std::basic_stringstream< char >	
std::basic_stringstream< wchar_t >	
<b>BitVector128</b>	<b>33</b>
<b>CoinAbsFitEq</b>	<b>33</b>
<b>CoinArrayWithLength</b>	<b>35</b>
<b>CoinBigIndexArrayWithLength</b>	<b>41</b>
<b>CoinDoubleArrayWithLength</b>	<b>53</b>
<b>CoinFactorizationDoubleArrayWithLength</b>	<b>78</b>
<b>CoinIntArrayWithLength</b>	<b>105</b>
<b>CoinUnsignedIntArrayWithLength</b>	<b>326</b>
<b>CoinBaseModel</b>	<b>38</b>
<b>CoinModel</b>	<b>140</b>
<b>CoinStructuredModel</b>	<b>314</b>
<b>CoinBuild</b>	<b>43</b>
<b>CoinDenseVector&lt; T &gt;</b>	<b>50</b>
<b>CoinError</b>	<b>55</b>
<b>CoinExternalVectorFirstGreater_2&lt; S, T, V &gt;</b>	<b>58</b>
<b>CoinExternalVectorFirstGreater_3&lt; S, T, U, V &gt;</b>	<b>58</b>
<b>CoinExternalVectorFirstLess_2&lt; S, T, V &gt;</b>	<b>59</b>
<b>CoinExternalVectorFirstLess_3&lt; S, T, U, V &gt;</b>	<b>60</b>
<b>CoinFactorization</b>	<b>61</b>
<b>CoinFileIOBase</b>	<b>85</b>
<b>CoinFileInput</b>	<b>81</b>
<b>CoinFileOutput</b>	<b>87</b>
<b>CoinFirstAbsGreater_2&lt; S, T &gt;</b>	<b>91</b>
<b>CoinFirstAbsGreater_3&lt; S, T, U &gt;</b>	<b>91</b>
<b>CoinFirstAbsLess_2&lt; S, T &gt;</b>	<b>92</b>
<b>CoinFirstAbsLess_3&lt; S, T, U &gt;</b>	<b>92</b>

---

<b>CoinFirstGreater_2&lt; S, T &gt;</b>	<b>93</b>
<b>CoinFirstGreater_3&lt; S, T, U &gt;</b>	<b>93</b>
<b>CoinFirstLess_2&lt; S, T &gt;</b>	<b>94</b>
<b>CoinFirstLess_3&lt; S, T, U &gt;</b>	<b>94</b>
<b>CoinMpsIO::CoinHashLink</b>	<b>95</b>
<b>CoinLpIO::CoinHashLink</b>	<b>96</b>
<b>CoinIndexedVector</b>	<b>96</b>
<b>CoinLpIO</b>	<b>108</b>
<b>CoinMessageHandler</b>	<b>127</b>
<b>CoinMessages</b>	<b>136</b>
<b>CoinMessage</b>	<b>125</b>
<b>CoinModelHash</b>	<b>158</b>
<b>CoinModelHash2</b>	<b>160</b>
<b>CoinModelHashLink</b>	<b>161</b>
<b>CoinModelInfo2</b>	<b>162</b>
<b>CoinModelLink</b>	<b>163</b>
<b>CoinModelLinkedList</b>	<b>166</b>
<b>CoinModelTriple</b>	<b>169</b>
<b>CoinMpsCardReader</b>	<b>169</b>
<b>CoinMpsIO</b>	<b>173</b>
<b>CoinOneMessage</b>	<b>187</b>
<b>CoinOtherFactorization</b>	<b>194</b>
<b>CoinDenseFactorization</b>	<b>46</b>
<b>CoinOsIFactorization</b>	<b>189</b>
<b>CoinSimpFactorization</b>	<b>297</b>
<b>CoinPackedMatrix</b>	<b>200</b>
<b>CoinPackedVectorBase</b>	<b>232</b>

---

CoinPackedVector	224
CoinShallowPackedVector	292
CoinPair< S, T >	237
CoinParam	238
CoinPrePostsolveMatrix	254
CoinPostsolveMatrix	249
CoinPresolveMatrix	269
CoinPresolveAction	264
do_tighten_action	360
doubleton_action	361
drop_empty_cols_action	363
drop_empty_rows_action	365
drop_zero_coefficients_action	367
dupcol_action	370
duprow_action	372
forcing_constraint_action	376
gubrow_action	378
implied_free_action	380
isolated_constraint_action	383
make_fixed_action	384
remove_dual_action	391
remove_fixed_action	393
slack_doubleton_action	396
slack_singleton_action	398
subst_constraint_action	406
tripleton_action	408
useless_constraint_action	411

---

<b>CoinRelFltEq</b>	<b>281</b>
<b>CoinSearchTreeBase</b>	<b>285</b>
<b>CoinSearchTree&lt; Comp &gt;</b>	<b>283</b>
<b>CoinSearchTreeCompareBest</b>	<b>287</b>
<b>CoinSearchTreeCompareBreadth</b>	<b>287</b>
<b>CoinSearchTreeCompareDepth</b>	<b>287</b>
<b>CoinSearchTreeComparePreferred</b>	<b>288</b>
<b>CoinSearchTreeManager</b>	<b>289</b>
<b>CoinSet</b>	<b>290</b>
<b>CoinSosSet</b>	<b>312</b>
<b>CoinSnapshot</b>	<b>306</b>
<b>CoinThreadRandom</b>	<b>319</b>
<b>CoinTimer</b>	<b>321</b>
<b>CoinTreeNode</b>	<b>322</b>
<b>CoinTreeSiblings</b>	<b>324</b>
<b>CoinTriple&lt; S, T, U &gt;</b>	<b>325</b>
<b>CoinWarmStart</b>	<b>328</b>
<b>CoinWarmStartBasis</b>	<b>329</b>
<b>CoinWarmStartDual</b>	<b>340</b>
<b>CoinWarmStartPrimalDual</b>	<b>345</b>
<b>CoinWarmStartVector&lt; T &gt;</b>	<b>351</b>
<b>CoinWarmStartVectorPair&lt; T, U &gt;</b>	<b>356</b>
<b>CoinWarmStartDiff</b>	<b>339</b>
<b>CoinWarmStartBasisDiff</b>	<b>336</b>
<b>CoinWarmStartDualDiff</b>	<b>342</b>
<b>CoinWarmStartPrimalDualDiff</b>	<b>348</b>
<b>CoinWarmStartVectorDiff&lt; T &gt;</b>	<b>353</b>

<a href="#">CoinWarmStartVectorPairDiff&lt; T, U &gt;</a>	358
<a href="#">CoinYacc</a>	359
<a href="#">dropped_zero</a>	369
<a href="#">EKKHlink</a>	374
<a href="#">FactorPointers</a>	375
<a href="#">presolvehlink</a>	387
<a href="#">Coin::ReferencedObject</a>	388
<a href="#">Coin::SmartPtr&lt; T &gt;</a>	400
<a href="#">symrec</a>	408

## 4 Class Index

### 4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<a href="#">_EKKfactinfo</a>	28
<a href="#">forcing_constraint_action::action</a>	29
<a href="#">tripleton_action::action</a>	30
<a href="#">doubleton_action::action</a>	31
<a href="#">remove_fixed_action::action</a> (Structure to hold information necessary to reintroduce a column into the problem representation )	31
<a href="#">BitVector128</a>	33
<a href="#">CoinAbsFitEq</a> (Equality to an absolute tolerance )	33
<a href="#">CoinArrayWithLength</a> (Pointer with length in bytes )	35
<a href="#">CoinBaseModel</a>	38
<a href="#">CoinBigIndexArrayWithLength</a> (CoinBigIndex * version )	41
<a href="#">CoinBuild</a> (In many cases it is natural to build a model by adding one row at a time )	43
<a href="#">CoinDenseFactorization</a> (This deals with Factorization and Updates This is a simple dense version so other people can write a better one )	46

---

<a href="#">CoinDenseVector&lt; T &gt; (Dense Vector )</a>	50
<a href="#">CoinDoubleArrayWithLength (Double * version )</a>	53
<a href="#">CoinError (Error Class thrown by an exception )</a>	55
<a href="#">CoinExternalVectorFirstGreater_2&lt; S, T, V &gt; (Function operator )</a>	58
<a href="#">CoinExternalVectorFirstGreater_3&lt; S, T, U, V &gt; (Function operator )</a>	58
<a href="#">CoinExternalVectorFirstLess_2&lt; S, T, V &gt; (Function operator )</a>	59
<a href="#">CoinExternalVectorFirstLess_3&lt; S, T, U, V &gt; (Function operator )</a>	60
<a href="#">CoinFactorization (This deals with Factorization and Updates )</a>	61
<a href="#">CoinFactorizationDoubleArrayWithLength (CoinFactorizationDouble * version )</a>	78
<a href="#">CoinFileInput (Abstract base class for file input classes )</a>	81
<a href="#">CoinFileIOBase (Base class for FileIO classes )</a>	85
<a href="#">CoinFileOutput (Abstract base class for file output classes )</a>	87
<a href="#">CoinFirstAbsGreater_2&lt; S, T &gt; (Function operator )</a>	91
<a href="#">CoinFirstAbsGreater_3&lt; S, T, U &gt; (Function operator )</a>	91
<a href="#">CoinFirstAbsLess_2&lt; S, T &gt; (Function operator )</a>	92
<a href="#">CoinFirstAbsLess_3&lt; S, T, U &gt; (Function operator )</a>	92
<a href="#">CoinFirstGreater_2&lt; S, T &gt; (Function operator )</a>	93
<a href="#">CoinFirstGreater_3&lt; S, T, U &gt; (Function operator )</a>	93
<a href="#">CoinFirstLess_2&lt; S, T &gt; (Function operator )</a>	94
<a href="#">CoinFirstLess_3&lt; S, T, U &gt; (Function operator )</a>	94
<a href="#">CoinMpsIO::CoinHashLink</a>	95
<a href="#">CoinLpIO::CoinHashLink</a>	96
<a href="#">CoinIndexedVector (Indexed Vector )</a>	96
<a href="#">CoinIntArrayWithLength (Int * version )</a>	105
<a href="#">CoinLpIO (Class to read and write Lp files )</a>	108
<a href="#">CoinMessage (The standard set of Coin messages )</a>	125
<a href="#">CoinMessageHandler (Base class for message handling )</a>	127

---

<a href="#">CoinMessages</a> (Class to hold and manipulate an array of massaged messages )	136
<a href="#">CoinModel</a> (This is a simple minded model which is stored in a format which makes it easier to construct and modify but not efficient for algorithms )	140
<a href="#">CoinModelHash</a>	158
<a href="#">CoinModelHash2</a> (For int,int hashing )	160
<a href="#">CoinModelHashLink</a> (For names and hashing )	161
<a href="#">CoinModelInfo2</a> (This is a model which is made up of Coin(Structured)Model blocks )	162
<a href="#">CoinModelLink</a> (This is for various structures/classes needed by <a href="#">CoinModel</a> )	163
<a href="#">CoinModelLinkedList</a>	166
<a href="#">CoinModelTriple</a> (For linked lists )	169
<a href="#">CoinMpsCardReader</a> (Very simple code for reading MPS data )	169
<a href="#">CoinMpsIO</a> (MPS IO Interface )	173
<a href="#">CoinOneMessage</a> (Class for one massaged message )	187
<a href="#">CoinOslFactorization</a>	189
<a href="#">CoinOtherFactorization</a> (Abstract base class which also has some scalars so can be used from Dense or Simp )	194
<a href="#">CoinPackedMatrix</a> (Sparse Matrix Base Class )	200
<a href="#">CoinPackedVector</a> (Sparse Vector )	224
<a href="#">CoinPackedVectorBase</a> (Abstract base class for various sparse vectors )	232
<a href="#">CoinPair&lt; S, T &gt;</a> (An ordered pair )	237
<a href="#">CoinParam</a> (A base class for 'keyword value' command line parameters )	238
<a href="#">CoinPostsolveMatrix</a> (Augments <a href="#">CoinPrePostsolveMatrix</a> with information about the problem that is only needed during postsolve )	249
<a href="#">CoinPrePostsolveMatrix</a> (Collects all the information about the problem that is needed in both presolve and postsolve )	254
<a href="#">CoinPresolveAction</a> (Abstract base class of all presolve routines )	264

---

<a href="#">CoinPresolveMatrix</a> (Augments <a href="#">CoinPrePostsolveMatrix</a> with information about the problem that is only needed during presolve )	269
<a href="#">CoinRelFltEq</a> (Equality to a scaled tolerance )	281
<a href="#">CoinSearchTree&lt; Comp &gt;</a>	283
<a href="#">CoinSearchTreeBase</a>	285
<a href="#">CoinSearchTreeCompareBest</a> (Best first search )	287
<a href="#">CoinSearchTreeCompareBreadth</a>	287
<a href="#">CoinSearchTreeCompareDepth</a> (Depth First Search )	287
<a href="#">CoinSearchTreeComparePreferred</a> (Function objects to compare search tree nodes )	288
<a href="#">CoinSearchTreeManager</a>	289
<a href="#">CoinSet</a> (Very simple class for containing data on set )	290
<a href="#">CoinShallowPackedVector</a> (Shallow Sparse Vector )	292
<a href="#">CoinSimpFactorization</a>	297
<a href="#">CoinSnapshot</a> (NON Abstract Base Class for interfacing with cut generators or branching code or )	306
<a href="#">CoinSosSet</a> (Very simple class for containing SOS set )	312
<a href="#">CoinStructuredModel</a>	314
<a href="#">CoinThreadRandom</a> (Class for thread specific random numbers )	319
<a href="#">CoinTimer</a> (This class implements a timer that also implements a tracing functionality )	321
<a href="#">CoinTreeNode</a> (A class from which the real tree nodes should be derived from )	322
<a href="#">CoinTreeSiblings</a>	324
<a href="#">CoinTriple&lt; S, T, U &gt;</a>	325
<a href="#">CoinUnsignedIntArrayWithLength</a> (Unsigned int * version )	326
<a href="#">CoinWarmStart</a> (Abstract base class for warm start information )	328
<a href="#">CoinWarmStartBasis</a> (The default COIN simplex (basis-oriented) warm start class )	329

---

<a href="#">CoinWarmStartBasisDiff</a> (A 'diff' between two <a href="#">CoinWarmStartBasis</a> objects )	336
<a href="#">CoinWarmStartDiff</a> (Abstract base class for warm start 'diff' objects )	339
<a href="#">CoinWarmStartDual</a> (WarmStart information that is only a dual vector )	340
<a href="#">CoinWarmStartDualDiff</a> (A 'diff' between two <a href="#">CoinWarmStartDual</a> objects )	342
<a href="#">CoinWarmStartPrimalDual</a> (WarmStart information that is only a dual vector )	345
<a href="#">CoinWarmStartPrimalDualDiff</a> (A 'diff' between two <a href="#">CoinWarmStartPrimalDual</a> objects )	348
<a href="#">CoinWarmStartVector&lt; T &gt;</a> (WarmStart information that is only a vector )	351
<a href="#">CoinWarmStartVectorDiff&lt; T &gt;</a> (A 'diff' between two <a href="#">CoinWarmStartVector</a> objects )	353
<a href="#">CoinWarmStartVectorPair&lt; T, U &gt;</a>	356
<a href="#">CoinWarmStartVectorPairDiff&lt; T, U &gt;</a>	358
<a href="#">CoinYacc</a>	359
<a href="#">do_tighten_action</a>	360
<a href="#">doubleton_action</a> (Solve $ax+by=c$ for $y$ and substitute $y$ out of the problem )	361
<a href="#">drop_empty_cols_action</a> (Physically removes empty columns in presolve, and reinserts empty columns in postsolve )	363
<a href="#">drop_empty_rows_action</a> (Physically removes empty rows in presolve, and reinserts empty rows in postsolve )	365
<a href="#">drop_zero_coefficients_action</a> (Removal of explicit zeros )	367
<a href="#">dropped_zero</a> (Tracking information for an explicit zero coefficient )	369
<a href="#">dupcol_action</a> (Detect and remove duplicate columns )	370
<a href="#">duprow_action</a> (Detect and remove duplicate rows )	372
<a href="#">EKKHlink</a> (This deals with Factorization and Updates This is ripped off from OSL!!!!!!!!!! )	374
<a href="#">FactorPointers</a> (Pointers used during factorization )	375
<a href="#">forcing_constraint_action</a> (Detect and process forcing constraints and useless constraints )	376

<a href="#">gubrow_action</a> (Detect and remove entries whose sum is known )	378
<a href="#">implied_free_action</a> (Detect and process implied free variables )	380
<a href="#">isolated_constraint_action</a>	383
<a href="#">make_fixed_action</a> (Fix a variable at a specified bound )	384
<a href="#">presolvehlink</a> (Links to aid in packed matrix modification )	387
<a href="#">Coin::ReferencedObject</a> ( <a href="#">ReferencedObject</a> class )	388
<a href="#">remove_dual_action</a> (Attempt to fix variables by bounding reduced costs )	391
<a href="#">remove_fixed_action</a> (Excise fixed variables from the model )	393
<a href="#">slack_doubleton_action</a> (Convert an explicit bound constraint to a column bound )	396
<a href="#">slack_singleton_action</a> (For variables with one entry )	398
<a href="#">Coin::SmartPtr&lt; T &gt;</a> (Template class for Smart Pointers )	400
<a href="#">subst_constraint_action</a>	406
<a href="#">symrec</a> (For string evaluation )	408
<a href="#">tripleton_action</a> (We are only going to do this if it does not increase number of elements? )	408
<a href="#">useless_constraint_action</a>	411

## 5 File Index

### 5.1 File List

Here is a list of all documented files with brief descriptions:

<a href="#">Coin_C_defines.h</a>	??
<a href="#">CoinAlloc.hpp</a>	??
<a href="#">CoinBuild.hpp</a>	??
<a href="#">CoinDenseFactorization.hpp</a>	??
<a href="#">CoinDenseVector.hpp</a>	??
<a href="#">CoinDistance.hpp</a>	??
<a href="#">CoinError.hpp</a>	??

---

CoinFactorization.hpp	??
CoinFileIO.hpp	??
CoinFinite.hpp	??
<a href="#">CoinFloatEqual.hpp</a> (Function objects for testing equality of real numbers )	<a href="#">413</a>
CoinHelperFunctions.hpp	??
CoinIndexedVector.hpp	??
CoinLpIO.hpp	??
<a href="#">CoinMessage.hpp</a> (This file contains the enum for the standard set of Coin messages and a class definition whose sole purpose is to supply a constructor )	<a href="#">414</a>
<a href="#">CoinMessageHandler.hpp</a> (This is a first attempt at a message handler )	<a href="#">415</a>
CoinModel.hpp	??
CoinModelUseful.hpp	??
CoinMpsIO.hpp	??
CoinOslC.h	??
CoinOslFactorization.hpp	??
CoinPackedMatrix.hpp	??
CoinPackedVector.hpp	??
CoinPackedVectorBase.hpp	??
<a href="#">CoinParam.hpp</a> (Declaration of a class for command line parameters )	<a href="#">418</a>
CoinPragma.hpp	??
CoinPresolveDoubleton.hpp	??
CoinPresolveDual.hpp	??
<a href="#">CoinPresolveDupcol.hpp</a>	<a href="#">419</a>
<a href="#">CoinPresolveEmpty.hpp</a> (Drop/reinsert empty rows/columns )	<a href="#">420</a>
CoinPresolveFixed.hpp	??
<a href="#">CoinPresolveForcing.hpp</a>	<a href="#">421</a>
<a href="#">CoinPresolveImpliedFree.hpp</a>	<a href="#">422</a>

---

CoinPresolveIsolated.hpp	??
<a href="#">CoinPresolveMatrix.hpp</a> (Declarations for <a href="#">CoinPresolveMatrix</a> and <a href="#">Coin-PostsolveMatrix</a> and their common base class <a href="#">CoinPrePostsolveMatrix</a> )	422
CoinPresolvePsdebug.hpp	??
<a href="#">CoinPresolveSingleton.hpp</a>	424
CoinPresolveSubst.hpp	??
CoinPresolveTighten.hpp	??
CoinPresolveTripletion.hpp	??
CoinPresolveUseless.hpp	??
<a href="#">CoinPresolveZeros.hpp</a> (Drop/reintroduce explicit zeros )	425
CoinSearchTree.hpp	??
CoinShallowPackedVector.hpp	??
CoinSignal.hpp	??
CoinSimpFactorization.hpp	??
CoinSmartPtr.hpp	??
CoinSnapshot.hpp	??
CoinSort.hpp	??
CoinStructuredModel.hpp	??
CoinTime.hpp	??
CoinTypes.hpp	??
CoinUtility.hpp	??
CoinUtilsConfig.h	??
<a href="#">CoinWarmStart.hpp</a> (Copyright (C) 2000 -- 2003, International Business Machines Corporation and others )	425
CoinWarmStartBasis.hpp	??
CoinWarmStartDual.hpp	??
CoinWarmStartPrimalDual.hpp	??
CoinWarmStartVector.hpp	??

<b>config.h</b>	??
<b>config_coinutils.h</b>	??
<b>config_coinutils_default.h</b>	??
<b>config_default.h</b>	??

## 6 Module Documentation

### 6.1 Presolve Matrix Manipulation Functions

Functions to work with the loosely packed and threaded packed matrix structures used during presolve and postsolve.

#### Functions

- void [CoinPrePostsolveMatrix::presolve\\_make\\_memlists](#) (int \*lengths, [presolvehlink](#) \*link, int n)  
*Initialise linked list for major vector order in bulk storage.*
- bool [CoinPrePostsolveMatrix::presolve\\_expand\\_major](#) (CoinBigIndex \*majstrts, double \*majels, int \*minndx, int \*majlens, [presolvehlink](#) \*majlinks, int nmaj, int k)  
*Make sure a major-dimension vector k has room for one more coefficient.*
- bool [CoinPrePostsolveMatrix::presolve\\_expand\\_col](#) (CoinBigIndex \*mcstrt, double \*colels, int \*hrow, int \*hincol, [presolvehlink](#) \*clink, int ncols, int colx)  
*Make sure a column (colx) in a column-major matrix has room for one more coefficient.*
- bool [CoinPrePostsolveMatrix::presolve\\_expand\\_row](#) (CoinBigIndex \*mrstrt, double \*rowels, int \*hcol, int \*hinrow, [presolvehlink](#) \*rlink, int nrow, int rowx)  
*Make sure a row (rowx) in a row-major matrix has room for one more coefficient.*
- CoinBigIndex [CoinPrePostsolveMatrix::presolve\\_find\\_minor](#) (int tgt, CoinBigIndex ks, CoinBigIndex ke, const int \*minndx)  
*Find position of a minor index in a major vector.*
- CoinBigIndex [CoinPrePostsolveMatrix::presolve\\_find\\_row](#) (int row, CoinBigIndex kcs, CoinBigIndex kce, const int \*hrow)  
*Find position of a row in a column in a column-major matrix.*
- CoinBigIndex [CoinPostsolveMatrix::presolve\\_find\\_col](#) (int col, CoinBigIndex krs, CoinBigIndex kre, const int \*hcol)  
*Find position of a column in a row in a row-major matrix.*
- CoinBigIndex [CoinPrePostsolveMatrix::presolve\\_find\\_minor1](#) (int tgt, CoinBigIndex ks, CoinBigIndex ke, const int \*minndx)  
*Find position of a minor index in a major vector.*
- CoinBigIndex [CoinPrePostsolveMatrix::presolve\\_find\\_row1](#) (int row, CoinBigIndex kcs, CoinBigIndex kce, const int \*hrow)  
*Find position of a row in a column in a column-major matrix.*

- CoinBigIndex [CoinPrePostsolveMatrix::presolve\\_find\\_col1](#) (int col, CoinBigIndex krs, CoinBigIndex kre, const int \*hcol)
 

*Find position of a column in a row in a row-major matrix.*
- CoinBigIndex [CoinPostsolveMatrix::presolve\\_find\\_minor2](#) (int tgt, CoinBigIndex ks, int majlen, const int \*minndx, const CoinBigIndex \*majlinks)
 

*Find position of a minor index in a major vector in a threaded matrix.*
- CoinBigIndex [CoinPostsolveMatrix::presolve\\_find\\_row2](#) (int row, CoinBigIndex kcs, int collen, const int \*hrow, const CoinBigIndex \*clinks)
 

*Find position of a row in a column in a column-major threaded matrix.*
- CoinBigIndex [CoinPostsolveMatrix::presolve\\_find\\_minor3](#) (int tgt, CoinBigIndex ks, int majlen, const int \*minndx, const CoinBigIndex \*majlinks)
 

*Find position of a minor index in a major vector in a threaded matrix.*
- CoinBigIndex [CoinPostsolveMatrix::presolve\\_find\\_row3](#) (int row, CoinBigIndex kcs, int collen, const int \*hrow, const CoinBigIndex \*clinks)
 

*Find position of a row in a column in a column-major threaded matrix.*
- void [CoinPrePostsolveMatrix::presolve\\_delete\\_from\\_major](#) (int majndx, int minndx, const CoinBigIndex \*majstrts, int \*majlens, int \*minndx, double \*els)
 

*Delete the entry for a minor index from a major vector.*
- void [CoinPrePostsolveMatrix::presolve\\_delete\\_from\\_col](#) (int row, int col, const CoinBigIndex \*mcstrt, int \*hincol, int \*hrow, double \*colels)
 

*Delete the entry for row row from column col in a column-major matrix.*
- void [CoinPrePostsolveMatrix::presolve\\_delete\\_from\\_row](#) (int row, int col, const CoinBigIndex \*mrstrt, int \*hinrow, int \*hcol, double \*rowels)
 

*Delete the entry for column col from row row in a row-major matrix.*
- void [CoinPostsolveMatrix::presolve\\_delete\\_from\\_major2](#) (int majndx, int minndx, CoinBigIndex \*majstrts, int \*majlens, int \*minndx, int \*majlinks, CoinBigIndex \*free\_listp)
 

*Delete the entry for a minor index from a major vector in a threaded matrix.*
- void [CoinPostsolveMatrix::presolve\\_delete\\_from\\_col2](#) (int row, int col, CoinBigIndex \*mcstrt, int \*hincol, int \*hrow, int \*clinks, CoinBigIndex \*free\_listp)
 

*Delete the entry for row row from column col in a column-major threaded matrix.*

### 6.1.1 Detailed Description

Functions to work with the loosely packed and threaded packed matrix structures used during presolve and postsolve.

### 6.1.2 Function Documentation

- 6.1.2.1 `bool presolve_expand_major ( CoinBigIndex * majstrts, double * majels, int * minndx, int * majlens, presolvehlink * majlinks, int nmaj, int k ) [related]`

Make sure a major-dimension vector k has room for one more coefficient.

You can use this directly, or use the inline wrappers `presolve_expand_col` and `presolve_expand_row`

**6.1.2.2** `CoinBigIndex presolve_find_minor ( int tgt, CoinBigIndex ks, CoinBigIndex ke, const int * minndx )` [related]

Find position of a minor index in a major vector.

The routine returns the position *k* in *minndx* for the specified minor index *tgt*. It will abort if the entry does not exist. Can be used directly or via the inline wrappers `presolve_find_row` and `presolve_find_col`.

Definition at line 1500 of file `CoinPresolveMatrix.hpp`.

**6.1.2.3** `CoinBigIndex presolve_find_row ( int row, CoinBigIndex kcs, CoinBigIndex kce, const int * hrow )` [related]

Find position of a row in a column in a column-major matrix.

The routine returns the position *k* in *hrow* for the specified *row*. It will abort if the entry does not exist.

Definition at line 1523 of file `CoinPresolveMatrix.hpp`.

**6.1.2.4** `CoinBigIndex presolve_find_col ( int col, CoinBigIndex krs, CoinBigIndex kre, const int * hcol )` [related]

Find position of a column in a row in a row-major matrix.

The routine returns the position *k* in *hcol* for the specified *col*. It will abort if the entry does not exist.

Definition at line 1533 of file `CoinPresolveMatrix.hpp`.

**6.1.2.5** `CoinBigIndex presolve_find_minor1 ( int tgt, CoinBigIndex ks, CoinBigIndex ke, const int * minndx )` [related]

Find position of a minor index in a major vector.

The routine returns the position *k* in *minndx* for the specified minor index *tgt*. A return value of *ke* means the entry does not exist. Can be used directly or via the inline wrappers `presolve_find_row1` and `presolve_find_col1`.

**6.1.2.6** `CoinBigIndex presolve_find_row1 ( int row, CoinBigIndex kcs, CoinBigIndex kce, const int * hrow )` [related]

Find position of a row in a column in a column-major matrix.

The routine returns the position *k* in *hrow* for the specified *row*. A return value of *kce* means the entry does not exist.

Definition at line 1555 of file `CoinPresolveMatrix.hpp`.

**6.1.2.7** `CoinBigIndex presolve_find_col1 ( int col, CoinBigIndex krs, CoinBigIndex kre, const int * hcol )` [related]

Find position of a column in a row in a row-major matrix.

The routine returns the position *k* in *hcol* for the specified *col*. A return value of *kre*

means the entry does not exist.

Definition at line 1565 of file CoinPresolveMatrix.hpp.

**6.1.2.8** `CoinBigIndex presolve_find_minor2 ( int tgt, CoinBigIndex ks, int majlen, const int * minndxs, const CoinBigIndex * majlinks )` [related]

Find position of a minor index in a major vector in a threaded matrix.

The routine returns the position *k* in *minndx*s for the specified minor index *tgt*. It will abort if the entry does not exist. Can be used directly or via the inline wrapper `presolve_find_row2`.

**6.1.2.9** `CoinBigIndex presolve_find_row2 ( int row, CoinBigIndex kcs, int collen, const int * hrow, const CoinBigIndex * clinks )` [related]

Find position of a row in a column in a column-major threaded matrix.

The routine returns the position *k* in *hrow* for the specified *row*. It will abort if the entry does not exist.

Definition at line 1588 of file CoinPresolveMatrix.hpp.

**6.1.2.10** `CoinBigIndex presolve_find_minor3 ( int tgt, CoinBigIndex ks, int majlen, const int * minndxs, const CoinBigIndex * majlinks )` [related]

Find position of a minor index in a major vector in a threaded matrix.

The routine returns the position *k* in *minndx*s for the specified minor index *tgt*. It will return -1 if the entry does not exist. Can be used directly or via the inline wrappers `presolve_find_row3`.

**6.1.2.11** `CoinBigIndex presolve_find_row3 ( int row, CoinBigIndex kcs, int collen, const int * hrow, const CoinBigIndex * clinks )` [related]

Find position of a row in a column in a column-major threaded matrix.

The routine returns the position *k* in *hrow* for the specified *row*. It will return -1 if the entry does not exist.

Definition at line 1612 of file CoinPresolveMatrix.hpp.

**6.1.2.12** `void presolve_delete_from_major ( int majndx, int minndx, const CoinBigIndex * majstrs, int * majlens, int * minndxs, double * els )` [related]

Delete the entry for a minor index from a major vector.

Deletes the entry for *minndx* from the major vector *majndx*. Specifically, the relevant entries are removed from the minor index (*minndx*s) and coefficient (*els*) arrays and the vector length (*majlens*) is decremented. Loose packing is maintained by swapping the last entry in the row into the position occupied by the deleted entry.

Definition at line 1626 of file CoinPresolveMatrix.hpp.

6.1.2.13 `void presolve_delete_from_col ( int row, int col, const CoinBigIndex * mcstrt, int * hincol, int * hrow, double * colels )` [related]

Delete the entry for row `row` from column `col` in a column-major matrix.

Deletes the entry for `row` from the major vector for `col`. Specifically, the relevant entries are removed from the row index (`hrow`) and coefficient (`colels`) arrays and the vector length (`hincol`) is decremented. Loose packing is maintained by swapping the last entry in the row into the position occupied by the deleted entry.

Definition at line 1670 of file `CoinPresolveMatrix.hpp`.

6.1.2.14 `void presolve_delete_from_row ( int row, int col, const CoinBigIndex * mrstrt, int * hinrow, int * hcol, double * rowels )` [related]

Delete the entry for column `col` from row `row` in a row-major matrix.

Deletes the entry for `col` from the major vector for `row`. Specifically, the relevant entries are removed from the column index (`hcol`) and coefficient (`rowels`) arrays and the vector length (`hinrow`) is decremented. Loose packing is maintained by swapping the last entry in the column into the position occupied by the deleted entry.

Definition at line 1685 of file `CoinPresolveMatrix.hpp`.

6.1.2.15 `void presolve_delete_from_major2 ( int majndx, int minndx, CoinBigIndex * majstrts, int * majlens, int * minndxs, int * majlinks, CoinBigIndex * free_listp )` [related]

Delete the entry for a minor index from a major vector in a threaded matrix.

Deletes the entry for `minndx` from the major vector `majndx`. Specifically, the relevant entries are removed from the minor index (`minndx`) and coefficient (`els`) arrays and the vector length (`majlens`) is decremented. The thread for the major vector is relinked around the deleted entry and the space is returned to the free list.

6.1.2.16 `void presolve_delete_from_col2 ( int row, int col, CoinBigIndex * mcstrt, int * hincol, int * hrow, int * clinks, CoinBigIndex * free_listp )` [related]

Delete the entry for row `row` from column `col` in a column-major threaded matrix.

Deletes the entry for `row` from the major vector for `col`. Specifically, the relevant entries are removed from the row index (`hrow`) and coefficient (`colels`) arrays and the vector length (`hincol`) is decremented. The thread for the major vector is relinked around the deleted entry and the space is returned to the free list.

Definition at line 1715 of file `CoinPresolveMatrix.hpp`.

## 6.2 Presolve Utility Functions

Utilities used by multiple presolve transform objects.

### Functions

- double \* [presolve\\_dupmajor](#) (const double \*elems, const int \*indices, int length, CoinBigIndex offset, int tgt=-1)  
*Duplicate a major-dimension vector; optionally omit the entry with minor index tgt.*
- void [coin\\_init\\_random\\_vec](#) (double \*work, int n)  
*Initialize an array with random numbers.*

#### 6.2.1 Detailed Description

Utilities used by multiple presolve transform objects.

#### 6.2.2 Function Documentation

##### 6.2.2.1 double\* presolve\_dupmajor ( const double \* elems, const int \* indices, int length, CoinBigIndex offset, int tgt = -1 )

Duplicate a major-dimension vector; optionally omit the entry with minor index `tgt`.

Designed to copy a major-dimension vector from the paired coefficient (`elems`) and minor index (`indices`) arrays used in the standard packed matrix representation. Copies `length` entries starting at `offset`.

If `tgt` is specified, the entry with minor index == `tgt` is omitted from the copy.

### 6.3 Presolve Debug Functions

These functions implement consistency checks on data structures involved in presolve and postsolve and on the components of the lp solution.

### Functions

- void [CoinPresolveMatrix::presolve\\_no\\_dups](#) (const [CoinPresolveMatrix](#) \*preObj, bool doCol=true, bool doRow=true)  
*Check column-major and/or row-major matrices for duplicate entries in the major vectors.*
- void [CoinPresolveMatrix::presolve\\_links\\_ok](#) (const [CoinPresolveMatrix](#) \*preObj, bool doCol=true, bool doRow=false)  
*Check the links which track storage order for major vectors in the bulk storage area.*
- void [CoinPresolveMatrix::presolve\\_no\\_zeros](#) (const [CoinPresolveMatrix](#) \*preObj, bool doCol=true, bool doRow=true)  
*Check for explicit zeros in the column- and/or row-major matrices.*
- void [CoinPresolveMatrix::presolve\\_consistent](#) (const [CoinPresolveMatrix](#) \*preObj, bool chkvals=true)  
*Checks for equivalence of the column- and row-major matrices.*

- void `CoinPostsolveMatrix::presolve_check_threads` (const `CoinPostsolveMatrix` \*obj)
  - Checks that column threads agree with column lengths.*
- void `CoinPostsolveMatrix::presolve_check_free_list` (const `CoinPostsolveMatrix` \*obj, bool `chkElemCnt=false`)
  - Checks the free list.*
- void `CoinPostsolveMatrix::presolve_check_reduced_costs` (const `CoinPostsolveMatrix` \*obj)
  - Check stored reduced costs for accuracy and consistency with variable status.*
- void `CoinPostsolveMatrix::presolve_check_duals` (const `CoinPostsolveMatrix` \*postObj)
  - Check the dual variables for consistency with row activity.*
- void `CoinPresolveMatrix::presolve_check_sol` (const `CoinPresolveMatrix` \*preObj, int `chkColSol=2`, int `chkRowAct=1`, int `chkStatus=1`)
  - Check primal solution and architectural variable status.*
- void `CoinPostsolveMatrix::presolve_check_sol` (const `CoinPostsolveMatrix` \*postObj, int `chkColSol=2`, int `chkRowAct=2`, int `chkStatus=1`)
  - Check primal solution and architectural variable status.*
- void `CoinPresolveMatrix::presolve_check_nbasic` (const `CoinPresolveMatrix` \*preObj)
  - Check for the proper number of basic variables.*
- void `CoinPostsolveMatrix::presolve_check_nbasic` (const `CoinPostsolveMatrix` \*postObj)
  - Check for the proper number of basic variables.*

### 6.3.1 Detailed Description

These functions implement consistency checks on data structures involved in presolve and postsolve and on the components of the lp solution. To use these functions, include `CoinPresolvePsdebug.hpp` in your file and define the compile-time constants `PRESOLVE_SUMMARY`, `PRESOLVE_DEBUG`, and `PRESOLVE_CONSISTENCY` (either in individual files or in `Coin/Makefile`). A value is needed (*i.e.*, `PRESOLVE_DEBUG=1`) but not at present used to control debug level. Be sure that the definition occurs before any `CoinPresolve*.hpp` file is processed.

### 6.3.2 Function Documentation

**6.3.2.1** void `presolve_no_dups` ( const `CoinPresolveMatrix` \* *preObj*, bool *doCol* = true, bool *doRow* = true ) [related]

Check column-major and/or row-major matrices for duplicate entries in the major vectors.

By default, scans both the column- and row-major matrices. Set `doCol` (`doRow`) to false to suppress one or the other.

**6.3.2.2** `void presolve_links_ok ( const CoinPresolveMatrix * preObj, bool doCol = true, bool doRow = false ) [related]`

Check the links which track storage order for major vectors in the bulk storage area.

By default, scans only the column-major matrix. Set `doCol = false` to suppress the scan. Set `doRow = false` to scan the row-major links. But be warned, the row-major links are not maintained with the same zeal as the column-major links.

**6.3.2.3** `void presolve_no_zeros ( const CoinPresolveMatrix * preObj, bool doCol = true, bool doRow = true ) [related]`

Check for explicit zeros in the column- and/or row-major matrices.

By default, scans both the column- and row-major matrices. Set `doCol` (`doRow`) to `false` to suppress one or the other.

**6.3.2.4** `void presolve_consistent ( const CoinPresolveMatrix * preObj, bool chkvals = true ) [related]`

Checks for equivalence of the column- and row-major matrices.

Normally the routine will test for coefficient presence and value. Set `chkvals` to `false` to suppress the check for equal value.

**6.3.2.5** `void presolve_check_free_list ( const CoinPostsolveMatrix * obj, bool chkElemCnt = false ) [related]`

Checks the free list.

Scans the thread of free locations in the bulk store and checks that all entries are reasonable ( $0 \leq \text{index} < \text{bulk0}_-$ ). If `chkElemCnt` is true, it Also checks that the total number of entries in the matrix plus the locations on the free list total to the size of the bulk store. Postsolve routines do not maintain an accurate element count, but this is useful for checking a newly constructed postsolve matrix.

**6.3.2.6** `void presolve_check_reduced_costs ( const CoinPostsolveMatrix * obj ) [related]`

Check stored reduced costs for accuracy and consistency with variable status.

The routine will check the value of the reduced costs for architectural variables (`CoinPrePostsolveMatrix::rcosts_`). It performs an accuracy check by recalculating the reduced cost from scratch. It will also check the value for consistency with the status information in `CoinPrePostsolveMatrix::colstat_`.

**6.3.2.7** `void presolve_check_duals ( const CoinPostsolveMatrix * postObj ) [related]`

Check the dual variables for consistency with row activity.

The routine checks that the value of the dual variable is consistent with the state of the constraint (loose, tight at lower bound, or tight at upper bound).

**6.3.2.8** `void presolve_check_sol ( const CoinPresolveMatrix * preObj, int chkColSol = 2, int chkRowAct = 1, int chkStatus = 1 )` [related]

Check primal solution and architectural variable status.

The architectural variables can be checked for bogus values, feasibility, and valid status. The row activity is checked for bogus values, accuracy, and feasibility. By default, row activity is not checked (presolve is sloppy about maintaining it). See the definitions in `CoinPresolvePsdebug.cpp` for more information.

**6.3.2.9** `void presolve_check_sol ( const CoinPostsolveMatrix * postObj, int chkColSol = 2, int chkRowAct = 2, int chkStatus = 1 )` [related]

Check primal solution and architectural variable status.

The architectural variables can be checked for bogus values, feasibility, and valid status. The row activity is checked for bogus values, accuracy, and feasibility. See the definitions in `CoinPresolvePsdebug.cpp` for more information.

## 7 Namespace Documentation

### 7.1 CoinParamUtils Namespace Reference

Utility functions for processing [CoinParam](#) parameters.

#### Functions

- void [setInputSrc](#) (FILE \*src)  
*Take command input from the file specified by src.*
- bool [isCommandLine](#) ()  
*Returns true if command line parameters are being processed.*
- bool [isInteractive](#) ()  
*Returns true if parameters are being obtained from stdin.*
- std::string [getStringField](#) (int argc, const char \*argv[], int \*valid)  
*Attempt to read a string from the input.*
- int [getIntField](#) (int argc, const char \*argv[], int \*valid)  
*Attempt to read an integer from the input.*
- double [getDoubleField](#) (int argc, const char \*argv[], int \*valid)  
*Attempt to read a real (double) from the input.*
- int [matchParam](#) (const CoinParamVec &paramVec, std::string name, int &matchNdx, int &shortCnt)  
*Scan a parameter vector for parameters whose keyword (name) string matches name using minimal match rules.*
- std::string [getCommand](#) (int argc, const char \*argv[], const std::string prompt, std::string \*pfx=0)  
*Get the next command keyword (name)*

- int `lookupParam` (std::string name, CoinParamVec &paramVec, int \*matchCnt=0, int \*shortCnt=0, int \*queryCnt=0)  
*Look up the command keyword (name) in the parameter vector. Print help if requested.*
- void `printIt` (const char \*msg)  
*Utility to print a long message as filled lines of text.*
- void `shortOrHelpOne` (CoinParamVec &paramVec, int matchNdx, std::string name, int numQuery)  
*Utility routine to print help given a short match or explicit request for help.*
- void `shortOrHelpMany` (CoinParamVec &paramVec, std::string name, int numQuery)  
*Utility routine to print help given multiple matches.*
- void `printGenericHelp` ()  
*Print a generic 'how to use the command interface' help message.*
- void `printHelp` (CoinParamVec &paramVec, int firstParam, int lastParam, std::string prefix, bool shortHelp, bool longHelp, bool hidden)  
*Utility routine to print help messages for one or more parameters.*

### 7.1.1 Detailed Description

Utility functions for processing `CoinParam` parameters. The functions in `CoinParamUtils` support command line or interactive parameter processing and a help facility. Consult the 'Related Functions' section of the `CoinParam` class documentation for individual function documentation.

### 7.1.2 Function Documentation

#### 7.1.2.1 void CoinParamUtils::setInputSrc ( FILE \* src )

Take command input from the file specified by `src`.

Use `stdin` for `src` to specify interactive prompting for commands.

#### 7.1.2.2 std::string CoinParamUtils::getStringField ( int argc, const char \* argv[], int \* valid )

Attempt to read a string from the input.

`argc` and `argv` are used only if `isCommandLine()` would return true. If `valid` is supplied, it will be set to 0 if a string is parsed without error, 2 if no field is present.

#### 7.1.2.3 int CoinParamUtils::getIntField ( int argc, const char \* argv[], int \* valid )

Attempt to read an integer from the input.

`argc` and `argv` are used only if `isCommandLine()` would return true. If `valid` is supplied, it will be set to 0 if an integer is parsed without error, 1 if there's a parse error, and 2 if no field is present.

#### 7.1.2.4 double CoinParamUtils::getDoubleField ( int argc, const char \* argv[], int \* valid )

Attempt to read a real (double) from the input.

`argc` and `argv` are used only if `isCommandLine()` would return true. If `valid` is supplied, it will be set to 0 if a real number is parsed without error, 1 if there's a parse error, and 2 if no field is present.

#### 7.1.2.5 int CoinParamUtils::matchParam ( const CoinParamVec & paramVec, std::string name, int & matchNdx, int & shortCnt )

Scan a parameter vector for parameters whose keyword (name) string matches `name` using minimal match rules.

`matchNdx` is set to the index of the last parameter that meets the minimal match criteria (but note there should be at most one matching parameter if the parameter vector is properly configured). `shortCnt` is set to the number of short matches (should be zero for a properly configured parameter vector if a minimal match is found). The return value is the number of matches satisfying the minimal match requirement (should be 0 or 1 in a properly configured vector).

#### 7.1.2.6 std::string CoinParamUtils::getCommand ( int argc, const char \* argv[], const std::string prompt, std::string \* pfx = 0 )

Get the next command keyword (name)

To be precise, return the next field from the current command input source, after a bit of processing. In command line mode (`isCommandLine()` returns true) the next field will normally be of the form '-keyword' or '--keyword' (*i.e.*, a parameter keyword), and the string returned would be 'keyword'. In interactive mode (`isInteractive()` returns true), the user will be prompted if necessary. It is assumed that the user knows not to use the '-' or '--' prefixes unless specifying parameters on the command line.

There are a number of special cases if we're in command line mode. The order of processing of the raw string goes like this:

- A stand-alone '-' is forced to 'stdin'.
- A stand-alone '--' is returned as a word; interpretation is up to the client.
- A prefix of '-' or '--' is stripped from the string.

If the result is the string 'stdin', command processing shifts to interactive mode and the user is immediately prompted for a new command.

Whatever results from the above sequence is returned to the user as the return value of the function. An empty string indicates end of input.

`prompt` will be used only if it's necessary to prompt the user in interactive mode.

#### 7.1.2.7 int CoinParamUtils::lookupParam ( std::string name, CoinParamVec & paramVec, int \* matchCnt = 0, int \* shortCnt = 0, int \* queryCnt = 0 )

Look up the command keyword (name) in the parameter vector. Print help if requested.

In the most straightforward use, `name` is a string without '?', and the value returned is the index in `paramVec` of the single parameter that matched `name`. One or more '?' characters at the end of `name` is a query for information. The routine prints short (one '?') or long (more than one '?') help messages for a query. Help is also printed in the case where the name is ambiguous (some of the matches did not meet the minimal match length requirement).

Note that multiple matches meeting the minimal match requirement is a configuration error. The minimal match length for the parameters involved is too short.

If provided as parameters, on return

- `matchCnt` will be set to the number of matches meeting the minimal match requirement
- `shortCnt` will be set to the number of matches that did not meet the minimal match requirement
- `queryCnt` will be set to the number of '?' characters at the end of the name

The return values are:

- >0: index in `paramVec` of the single unique match for `name`
- -1: a query was detected (one or more '?' characters at the end of `name`)
- -2: one or more short matches, not a query
- -3: no matches, not a query
- -4: multiple matches meeting the minimal match requirement (configuration error)

#### 7.1.2.8 void CoinParamUtils::printlt ( const char \* *msg* )

Utility to print a long message as filled lines of text.

The routine makes a best effort to break lines without exceeding the standard 80 character line length. Explicit newlines in `msg` will be obeyed.

#### 7.1.2.9 void CoinParamUtils::shortOrHelpOne ( CoinParamVec & *paramVec*, int *matchNdx*, std::string *name*, int *numQuery* )

Utility routine to print help given a short match or explicit request for help.

The two really are related, in that a query (a string that ends with one or more '?' characters) will often result in a short match. The routine expects that `name` matches a single parameter, and does not look for multiple matches.

If called with `matchNdx < 0`, the routine will look up `name` in `paramVec` and print the full name from the parameter. If called with `matchNdx > 0`, it just prints the name from the specified parameter. If the name is a query, short (one '?') or long (more than one '?') help is printed.

7.1.2.10 `void CoinParamUtils::shortOrHelpMany ( CoinParamVec & paramVec, std::string name, int numQuery )`

Utility routine to print help given multiple matches.

If the name is not a query, or asks for short help (*i.e.*, contains zero or one '?' characters), the list of matching names is printed. If the name asks for long help (contains two or more '?' characters), short help is printed for each matching name.

7.1.2.11 `void CoinParamUtils::printGenericHelp ( )`

Print a generic 'how to use the command interface' help message.

The message is hard coded to match the behaviour of the parsing utilities.

7.1.2.12 `void CoinParamUtils::printHelp ( CoinParamVec & paramVec, int firstParam, int lastParam, std::string prefix, bool shortHelp, bool longHelp, bool hidden )`

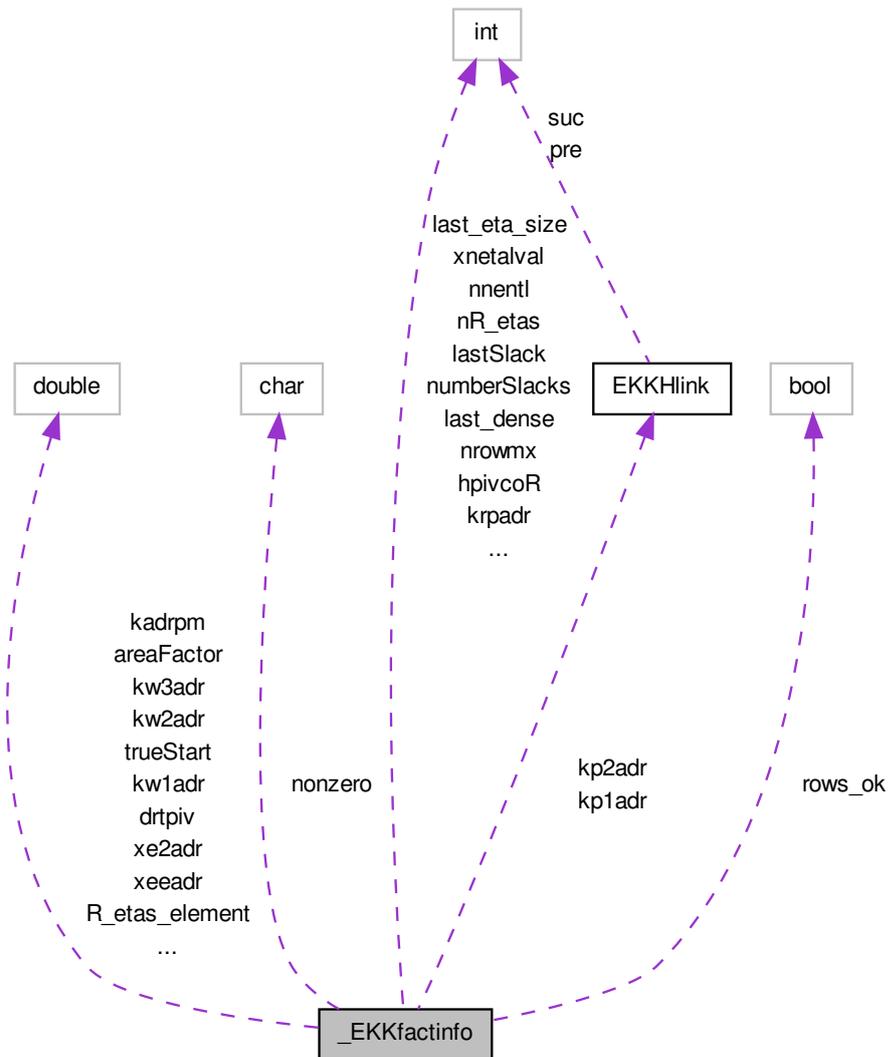
Utility routine to print help messages for one or more parameters.

Intended as a utility to implement explicit 'help' commands. Help will be printed for all parameters in `paramVec` from `firstParam` to `lastParam`, inclusive. If `shortHelp` is true, short help messages will be printed. If `longHelp` is true, long help messages are printed. `shortHelp` overrules `longHelp`. If neither is true, only command keywords are printed. `prefix` is printed before each line; it's an imperfect attempt at indentation.

## 8 Class Documentation

8.1 `_EKKfactinfo` Struct Reference

Collaboration diagram for `_EKKfactinfo`:



8.1.1 Detailed Description

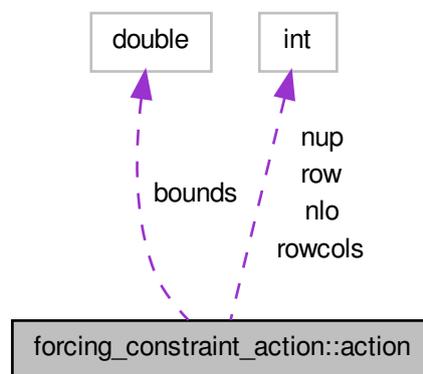
Definition at line 29 of file `CoinOsiFactorization.hpp`.

The documentation for this struct was generated from the following file:

- [CoinOslFactorization.hpp](#)

## 8.2 forcing\_constraint\_action::action Struct Reference

Collaboration diagram for forcing\_constraint\_action::action:



### 8.2.1 Detailed Description

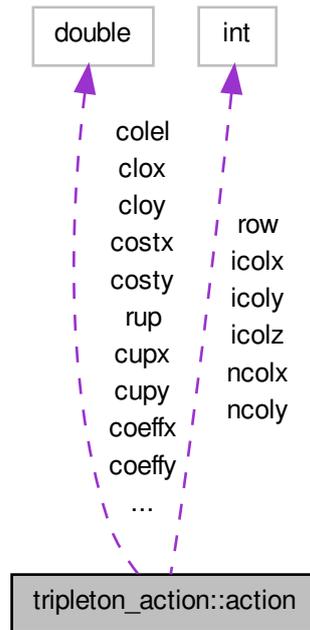
Definition at line 32 of file `CoinPresolveForcing.hpp`.

The documentation for this struct was generated from the following file:

- [CoinPresolveForcing.hpp](#)

### 8.3 tripleton\_action::action Struct Reference

Collaboration diagram for tripleton\_action::action:



#### 8.3.1 Detailed Description

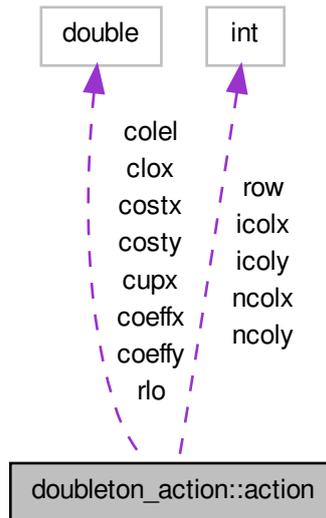
Definition at line 17 of file `CoinPresolveTripleton.hpp`.

The documentation for this struct was generated from the following file:

- `CoinPresolveTripleton.hpp`

## 8.4 doubleton\_action::action Struct Reference

Collaboration diagram for doubleton\_action::action:



### 8.4.1 Detailed Description

Definition at line 28 of file `CoinPresolveDoubleton.hpp`.

The documentation for this struct was generated from the following file:

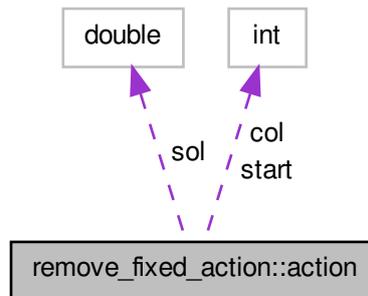
- `CoinPresolveDoubleton.hpp`

## 8.5 remove\_fixed\_action::action Struct Reference

Structure to hold information necessary to reintroduce a column into the problem representation.

```
#include <CoinPresolveFixed.hpp>
```

Collaboration diagram for `remove_fixed_action::action`:



#### Public Attributes

- int `col`  
*column index of variable*
- int `start`  
*start of coefficients in `colegs_` and `colrows_`*
- double `sol`  
*value of variable*

#### 8.5.1 Detailed Description

Structure to hold information necessary to reintroduce a column into the problem representation.

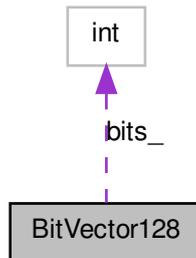
Definition at line 30 of file `CoinPresolveFixed.hpp`.

The documentation for this struct was generated from the following file:

- `CoinPresolveFixed.hpp`

## 8.6 BitVector128 Class Reference

Collaboration diagram for BitVector128:



### 8.6.1 Detailed Description

Definition at line 21 of file `CoinSearchTree.hpp`.

The documentation for this class was generated from the following file:

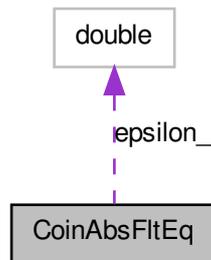
- `CoinSearchTree.hpp`

## 8.7 CoinAbsFitEq Class Reference

Equality to an absolute tolerance.

```
#include <CoinFloatEqual.hpp>
```

Collaboration diagram for CoinAbsFltEq:



#### Public Member Functions

- `bool operator()` (const double f1, const double f2) const  
*Compare function.*

#### Constructors and destructors

- `CoinAbsFltEq ()`  
*Default constructor.*
- `CoinAbsFltEq (const double epsilon)`  
*Alternate constructor with epsilon as a parameter.*
- `virtual ~CoinAbsFltEq ()`  
*Destructor.*
- `CoinAbsFltEq (const CoinAbsFltEq &src)`  
*Copy constructor.*
- `CoinAbsFltEq & operator= (const CoinAbsFltEq &rhs)`  
*Assignment.*

#### 8.7.1 Detailed Description

Equality to an absolute tolerance.

Operands are considered equal if their difference is within an epsilon ; the test does not consider the relative magnitude of the operands.

Definition at line 46 of file CoinFloatEqual.hpp.

#### 8.7.2 Constructor & Destructor Documentation

### 8.7.2.1 CoinAbsFltEq::CoinAbsFltEq ( ) [inline]

Default constructor.

Default tolerance is 1.0e-10.

Definition at line 66 of file CoinFloatEqual.hpp.

The documentation for this class was generated from the following file:

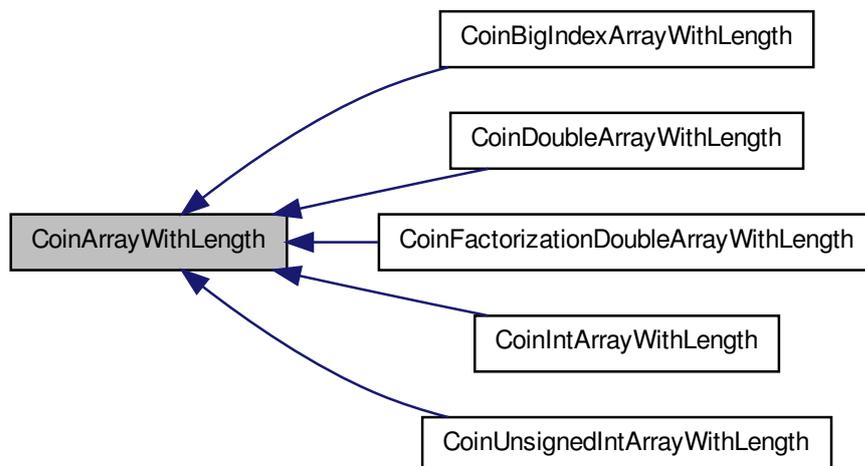
- [CoinFloatEqual.hpp](#)

## 8.8 CoinArrayWithLength Class Reference

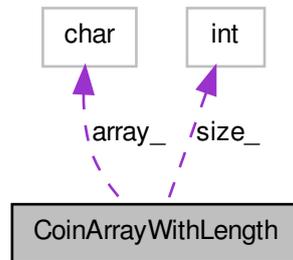
Pointer with length in bytes.

```
#include <CoinIndexedVector.hpp>
```

Inheritance diagram for CoinArrayWithLength:



Collaboration diagram for CoinArrayWithLength:



#### Public Member Functions

##### Get methods.

- int [getSize](#) () const  
*Get the size.*
- int [rawSize](#) () const  
*Get the size.*
- bool [switchedOn](#) () const  
*See if persistence already on.*
- int [getCapacity](#) () const  
*Get the capacity.*
- void [setCapacity](#) ()  
*Set the capacity to  $\geq 0$  if  $\leq -2$ .*
- const char \* [array](#) () const  
*Get Array.*

##### Set methods

- void [setSize](#) (int value)  
*Set the size.*
- void [switchOff](#) ()  
*Set the size to -1.*
- void [setPersistence](#) (int flag, int currentLength)  
*Does what is needed to set persistence.*
- void [clear](#) ()  
*Zero out array.*
- void [swap](#) (CoinArrayWithLength &other)  
*Swaps memory between two members.*
- void [extend](#) (int newSize)  
*Extend a persistent array keeping data (size in bytes)*

**Condition methods**

- char \* [conditionalNew](#) (long sizeWanted)  
*Conditionally gets new array.*
- void [conditionalDelete](#) ()  
*Conditionally deletes.*

**Constructors and destructors**

- [CoinArrayWithLength](#) ()  
*Default constructor - NULL.*
- [CoinArrayWithLength](#) (int size)  
*Alternate Constructor - length in bytes - size\_ -1.*
- [CoinArrayWithLength](#) (int size, int mode)  
*Alternate Constructor - length in bytes mode - 0 size\_ set to size 1 size\_ set to size and zeroed.*
- [CoinArrayWithLength](#) (const [CoinArrayWithLength](#) &rhs)  
*Copy constructor.*
- [CoinArrayWithLength](#) (const [CoinArrayWithLength](#) \*rhs)  
*Copy constructor.2.*
- [CoinArrayWithLength](#) & [operator=](#) (const [CoinArrayWithLength](#) &rhs)  
*Assignment operator.*
- void [copy](#) (const [CoinArrayWithLength](#) &rhs, int numberBytes=-1)  
*Assignment with length (if -1 use internal length)*
- void [allocate](#) (const [CoinArrayWithLength](#) &rhs, int numberBytes)  
*Assignment with length - does not copy.*
- [~CoinArrayWithLength](#) ()  
*Destructor.*

**Protected Attributes****Private member data**

- char \* [array\\_](#)  
*Array.*
- int [size\\_](#)  
*Size of array in bytes.*

**8.8.1 Detailed Description**

Pointer with length in bytes.

This has a pointer to an array and the number of bytes in array. If number of bytes== -1 then CoinConditionalNew deletes existing pointer and returns new pointer of correct size (and number bytes still -1). CoinConditionalDelete deletes existing pointer and NULLs it. So behavior is as normal (apart from New deleting pointer which will have no effect with good coding practices. If number of bytes >=0 then CoinConditionalNew just returns existing pointer if array big enough otherwise deletes existing pointer, allocates array with spare 1%+64 bytes and updates number of bytes CoinConditionalDelete sets number of bytes = -size-2 and then array returns NULL

Definition at line 496 of file CoinIndexedVector.hpp.

### 8.8.2 Constructor & Destructor Documentation

#### 8.8.2.1 CoinArrayWithLength::CoinArrayWithLength ( const CoinArrayWithLength & rhs )

Copy constructor.

### 8.8.3 Member Function Documentation

#### 8.8.3.1 CoinArrayWithLength& CoinArrayWithLength::operator= ( const CoinArrayWithLength & rhs )

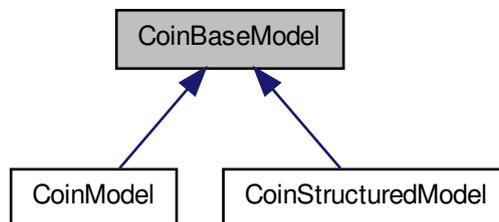
Assignment operator.

The documentation for this class was generated from the following file:

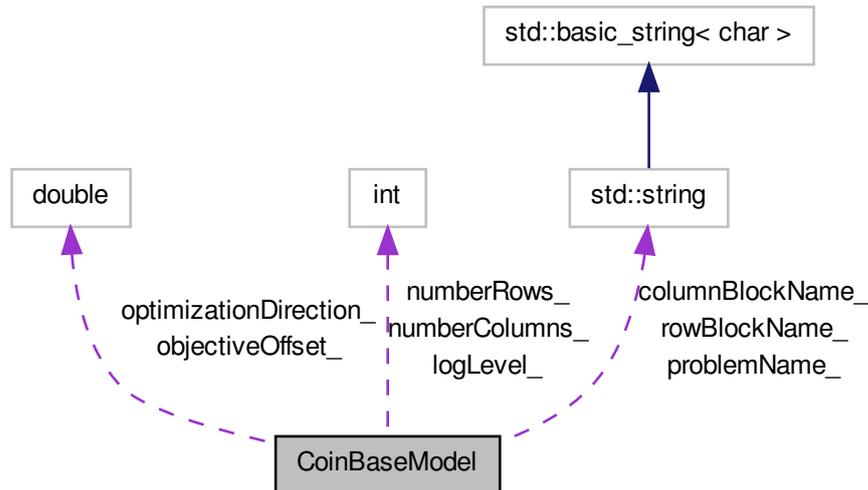
- CoinIndexedVector.hpp

## 8.9 CoinBaseModel Class Reference

Inheritance diagram for CoinBaseModel:



Collaboration diagram for CoinBaseModel:



### Public Member Functions

#### Constructors, destructor

- [CoinBaseModel](#) ()  
*Default Constructor.*
- [CoinBaseModel](#) (const [CoinBaseModel](#) &rhs)  
*Copy constructor.*
- [CoinBaseModel](#) & [operator=](#) (const [CoinBaseModel](#) &rhs)  
*Assignment operator.*
- virtual [CoinBaseModel](#) \* [clone](#) () const =0  
*Clone.*
- virtual [~CoinBaseModel](#) ()  
*Destructor.*

#### For getting information

- int [numberOfRows](#) () const  
*Return number of rows.*
- int [numberOfColumns](#) () const  
*Return number of columns.*
- virtual [CoinBigIndex](#) [numberOfElements](#) () const =0

- Return number of elements.*

  - double [objectiveOffset](#) () const

*Returns the (constant) objective offset This is the RHS entry for the objective row.*
- void [setObjectiveOffset](#) (double value)

*Set objective offset.*
- double [optimizationDirection](#) () const

*Direction of optimization (1 - minimize, -1 - maximize, 0 - ignore).*
- void [setOptimizationDirection](#) (double value)

*Set direction of optimization (1 - minimize, -1 - maximize, 0 - ignore).*
- int [logLevel](#) () const

*Get print level 0 - off, 1 - errors, 2 - more.*
- void [setLogLevel](#) (int value)

*Set print level 0 - off, 1 - errors, 2 - more.*
- const char \* [getProblemName](#) () const

*Return the problem name.*
- void [setProblemName](#) (const char \*name)

*Set problem name.*
- void [setProblemName](#) (const std::string &name)

*Set problem name.*
- const std::string & [getRowBlock](#) () const

*Return the row block name.*
- void [setRowBlock](#) (const std::string &name)

*Set row block name.*
- const std::string & [getColumnBlock](#) () const

*Return the column block name.*
- void [setColumnBlock](#) (const std::string &name)

*Set column block name.*

### Protected Attributes

#### Data members

- int [numberRows\\_](#)
- Current number of rows.*
- int [numberColumns\\_](#)
- Current number of columns.*
- double [optimizationDirection\\_](#)
- Direction of optimization (1 - minimize, -1 - maximize, 0 - ignore).*
- double [objectiveOffset\\_](#)
- Objective offset to be passed on.*
- std::string [problemName\\_](#)
- Problem name.*
- std::string [rowBlockName\\_](#)
- Rowblock name.*
- std::string [columnBlockName\\_](#)
- Columnblock name.*
- int [logLevel\\_](#)
- Print level.*

### 8.9.1 Detailed Description

Definition at line 12 of file CoinModel.hpp.

### 8.9.2 Member Data Documentation

#### 8.9.2.1 int CoinBaseModel::logLevel\_ [protected]

Print level.

I could have gone for full message handling but this should normally be silent and lightweight. I can always change. 0 - no output 1 - on errors 2 - more detailed

Definition at line 110 of file CoinModel.hpp.

The documentation for this class was generated from the following file:

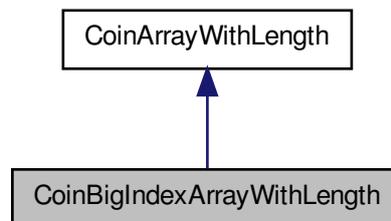
- CoinModel.hpp

## 8.10 CoinBigIndexArrayWithLength Class Reference

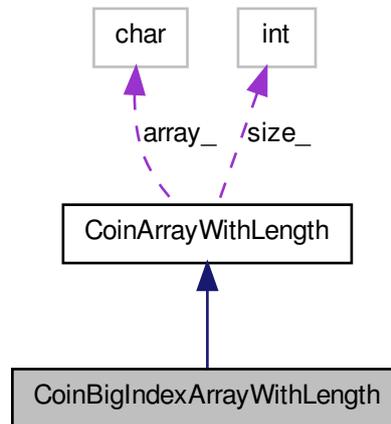
CoinBigIndex \* version.

```
#include <CoinIndexedVector.hpp>
```

Inheritance diagram for CoinBigIndexArrayWithLength:



Collaboration diagram for CoinBigIndexArrayWithLength:



#### Public Member Functions

##### Get methods.

- `int` [getSize](#) () const  
*Get the size.*
- `CoinBigIndex * array` () const  
*Get Array.*

##### Set methods

- `void` [setSize](#) (int value)  
*Set the size.*

##### Condition methods

- `CoinBigIndex * conditionalNew` (int sizeWanted)  
*Conditionally gets new array.*

##### Constructors and destructors

- `CoinBigIndexArrayWithLength` ()  
*Default constructor - NULL.*
- `CoinBigIndexArrayWithLength` (int size)  
*Alternate Constructor - length in bytes - size\_ -1.*

- [CoinBigIndexArrayWithLength](#) (int size, int mode)  
*Alternate Constructor - length in bytes mode - 0 size\_ set to size 1 size\_ set to size and zeroed.*
- [CoinBigIndexArrayWithLength](#) (const [CoinBigIndexArrayWithLength](#) &rhs)  
*Copy constructor.*
- [CoinBigIndexArrayWithLength](#) (const [CoinBigIndexArrayWithLength](#) \*rhs)  
*Copy constructor.2.*
- [CoinBigIndexArrayWithLength](#) & operator= (const [CoinBigIndexArrayWithLength](#) &rhs)  
*Assignment operator.*

### 8.10.1 Detailed Description

CoinBigIndex \* version.

Definition at line 750 of file CoinIndexedVector.hpp.

### 8.10.2 Constructor & Destructor Documentation

8.10.2.1 [CoinBigIndexArrayWithLength::CoinBigIndexArrayWithLength \( const \[CoinBigIndexArrayWithLength\]\(#\) & rhs \)](#) `[inline]`

Copy constructor.

Definition at line 792 of file CoinIndexedVector.hpp.

### 8.10.3 Member Function Documentation

8.10.3.1 [CoinBigIndexArrayWithLength& CoinBigIndexArrayWithLength::operator= \( const \[CoinBigIndexArrayWithLength\]\(#\) & rhs \)](#) `[inline]`

Assignment operator.

Definition at line 798 of file CoinIndexedVector.hpp.

The documentation for this class was generated from the following file:

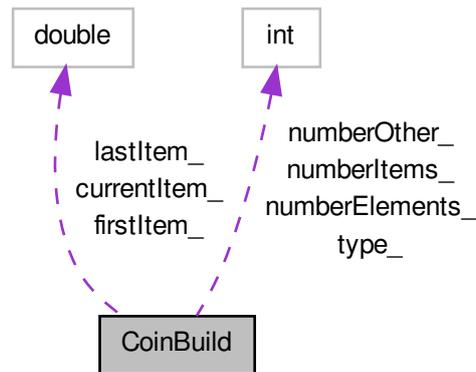
- CoinIndexedVector.hpp

## 8.11 CoinBuild Class Reference

In many cases it is natural to build a model by adding one row at a time.

```
#include <CoinBuild.hpp>
```

Collaboration diagram for CoinBuild:



## Public Member Functions

### Useful methods

- void [addRow](#) (int numberInRow, const int \*columns, const double \*elements, double rowLower=-COIN\_DBL\_MAX, double rowUpper=COIN\_DBL\_MAX)  
*add a row*
- void [addColumn](#) (int numberInColumn, const int \*rows, const double \*elements, double columnLower=0.0, double columnUpper=COIN\_DBL\_MAX, double objectiveValue=0.0)  
*add a column*
- void [addCol](#) (int numberInColumn, const int \*rows, const double \*elements, double columnLower=0.0, double columnUpper=COIN\_DBL\_MAX, double objectiveValue=0.0)  
*add a column*
- int [numberOfRows](#) () const  
*Return number of rows or maximum found so far.*
- int [numberOfColumns](#) () const  
*Return number of columns or maximum found so far.*
- CoinBigIndex [numberOfElements](#) () const  
*Return number of elements.*
- int [getRow](#) (int whichRow, double &rowLower, double &rowUpper, const int \*&indices, const double \*&elements) const  
*Returns number of elements in a row and information in row.*
- int [getCurrentRow](#) (double &rowLower, double &rowUpper, const int \*&indices, const double \*&elements) const

*Returns number of elements in current row and information in row Used as rows may be stored in a chain.*

- void [setCurrentRow](#) (int whichRow)

*Set current row.*

- int [currentRow](#) () const

*Returns current row number.*

- int [column](#) (int whichColumn, double &columnLower, double &columnUpper, double &objectiveValue, const int \*&indices, const double \*&elements) const

*Returns number of elements in a column and information in column.*

- int [currentColumn](#) (double &columnLower, double &columnUpper, double &objectiveValue, const int \*&indices, const double \*&elements) const

*Returns number of elements in current column and information in column Used as columns may be stored in a chain.*

- void [setCurrentColumn](#) (int whichColumn)

*Set current column.*

- int [currentColumn](#) () const

*Returns current column number.*

- int [type](#) () const

*Returns type.*

#### Constructors, destructor

- [CoinBuild](#) ()

*Default constructor.*

- [CoinBuild](#) (int type)

*Constructor with type 0==for addRow, 1== for addColumn.*

- [~CoinBuild](#) ()

*Destructor.*

#### Copy method

- [CoinBuild](#) (const [CoinBuild](#) &)

*The copy constructor.*

- [CoinBuild](#) & [operator=](#) (const [CoinBuild](#) &)

=

#### 8.11.1 Detailed Description

In many cases it is natural to build a model by adding one row at a time.

In Coin this is inefficient so this class gives some help. An instance of [CoinBuild](#) can be built up more efficiently and then added to the Clp/OsiModel in one go.

It may be more efficient to have fewer arrays and re-allocate them but this should give a large gain over addRow.

I have now extended it to columns.

Definition at line 27 of file CoinBuild.hpp.

### 8.11.2 Constructor & Destructor Documentation

#### 8.11.2.1 CoinBuild::CoinBuild ( )

Default constructor.

#### 8.11.2.2 CoinBuild::CoinBuild ( int *type* )

Constructor with type 0==for addRow, 1== for addColumn.

#### 8.11.2.3 CoinBuild::CoinBuild ( const CoinBuild & )

The copy constructor.

The documentation for this class was generated from the following file:

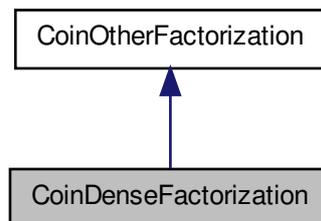
- CoinBuild.hpp

## 8.12 CoinDenseFactorization Class Reference

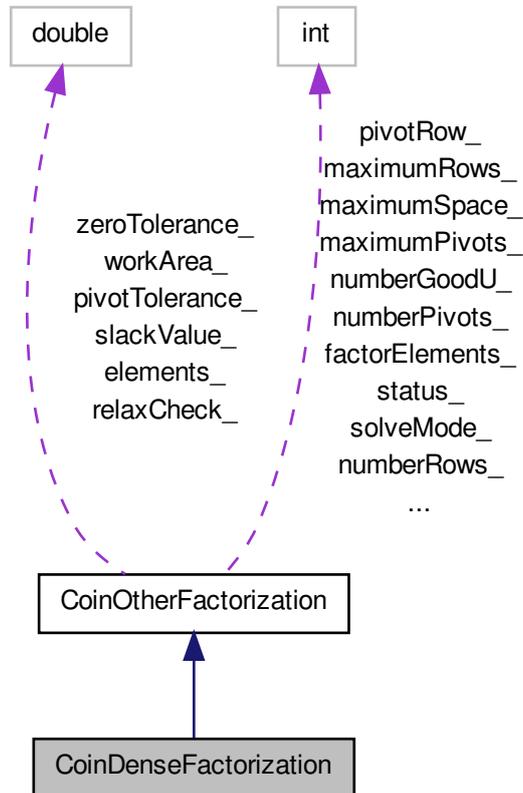
This deals with Factorization and Updates This is a simple dense version so other people can write a better one.

```
#include <CoinDenseFactorization.hpp>
```

Inheritance diagram for CoinDenseFactorization:



Collaboration diagram for CoinDenseFactorization:



#### Public Member Functions

- void [gutsOfDestructor](#) ()  
*The real work of desstructor.*
- void [gutsOfInitialize](#) ()  
*The real work of constructor.*
- void [gutsOfCopy](#) (const [CoinDenseFactorization](#) &other)  
*The real work of copy.*

#### Constructors and destructor and copy

- [CoinDenseFactorization](#) ()  
*Default constructor.*

- [CoinDenseFactorization](#) (const [CoinDenseFactorization](#) &other)  
*Copy constructor.*
- virtual [~CoinDenseFactorization](#) ()  
*Destructor.*
- [CoinDenseFactorization](#) & operator= (const [CoinDenseFactorization](#) &other)  
*= copy*
- virtual [CoinOtherFactorization](#) \* clone () const  
*Clone.*

#### Do factorization - public

- virtual void [getAreas](#) (int numberOfRows, int numberColumns, CoinBigIndex maximumL, CoinBigIndex maximumU)  
*Gets space for a factorization.*
- virtual void [preProcess](#) ()  
*PreProcesses column ordered copy of basis.*
- virtual int [factor](#) ()  
*Does most of factorization returning status 0 - OK.*
- virtual void [postProcess](#) (const int \*sequence, int \*pivotVariable)  
*Does post processing on valid factorization - putting variables on correct rows.*
- virtual void [makeNonSingular](#) (int \*sequence, int numberColumns)  
*Makes a non-singular basis by replacing variables.*

#### general stuff such as number of elements

- virtual int [numberElements](#) () const  
*Total number of elements in factorization.*
- double [maximumCoefficient](#) () const  
*Returns maximum absolute value in factorization.*

#### rank one updates which do exist

- virtual int [replaceColumn](#) ([CoinIndexedVector](#) \*regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying=false, double acceptablePivot=1.0e-8)  
*Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.*

#### various uses of factorization (return code number elements)

which user may want to know about

- virtual int [updateColumnFT](#) ([CoinIndexedVector](#) \*regionSparse, [CoinIndexedVector](#) \*regionSparse2, bool=false)  
*Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.*
- virtual int [updateColumn](#) ([CoinIndexedVector](#) \*regionSparse, [CoinIndexedVector](#) \*regionSparse2, bool noPermute=false) const

*This version has same effect as above with FTUpdate==false so number returned is always  $\geq 0$ .*

- virtual int [updateTwoColumnsFT](#) (CoinIndexedVector \*regionSparse1, CoinIndexedVector \*regionSparse2, CoinIndexedVector \*regionSparse3, bool noPermute=false)

*does FTRAN on two columns*

- virtual int [updateColumnTranspose](#) (CoinIndexedVector \*regionSparse, CoinIndexedVector \*regionSparse2) const

*Updates one column (BTRAN) from regionSparse2 regionSparse starts as zero and is zero at end Note - if regionSparse2 packed on input - will be packed on output.*

#### various uses of factorization

\*\*\* Below this user may not want to know about

which user may not want to know about (left over from my LP code)

- void [clearArrays](#) ()  
*Get rid of all memory.*
- virtual int \* [indices](#) () const  
*Returns array to put basis indices in.*
- virtual int \* [permute](#) () const  
*Returns permute in.*

#### Protected Member Functions

- int [checkPivot](#) (double saveFromU, double oldPivot) const  
*Returns accuracy status of replaceColumn returns 0=OK, 1=Probably OK, 2=singular.*

#### 8.12.1 Detailed Description

This deals with Factorization and Updates This is a simple dense version so other people can write a better one.

I am assuming that 32 bits is enough for number of rows or columns, but CoinBigIndex may be redefined to get 64 bits.

Definition at line 282 of file CoinDenseFactorization.hpp.

#### 8.12.2 Member Function Documentation

##### 8.12.2.1 virtual int CoinDenseFactorization::factor ( ) [virtual]

Does most of factorization returning status 0 - OK.

-99 - needs more memory -1 - singular - use numberGoodColumns and redo

Implements [CoinOtherFactorization](#).

8.12.2.2 `virtual int CoinDenseFactorization::replaceColumn ( CoinIndexedVector * regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying = false, double acceptablePivot = 1.0e-8 ) [virtual]`

Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.

Whether to set this depends on speed considerations. You could just do this on first iteration after factorization and thereafter re-factorize partial update already in U

Implements [CoinOtherFactorization](#).

8.12.2.3 `virtual int CoinDenseFactorization::updateColumnFT ( CoinIndexedVector * regionSparse, CoinIndexedVector * regionSparse2, bool = false ) [inline, virtual]`

Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.

Note - if regionSparse2 packed on input - will be packed on output

Implements [CoinOtherFactorization](#).

Definition at line 360 of file CoinDenseFactorization.hpp.

The documentation for this class was generated from the following file:

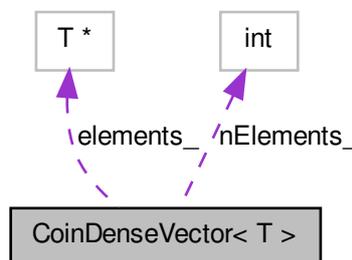
- CoinDenseFactorization.hpp

### 8.13 CoinDenseVector< T > Class Template Reference

Dense Vector.

```
#include <CoinDenseVector.hpp>
```

Collaboration diagram for CoinDenseVector< T >:



## Public Member Functions

## Get methods.

- int `getNumElements` () const  
*Get the size.*
- int `size` () const
- const T \* `getElements` () const  
*Get element values.*
- T \* `getElements` ()  
*Get element values.*

## Set methods

- void `clear` ()  
*Reset the vector (i.e. set all elements to zero)*
- `CoinDenseVector` & `operator=` (const `CoinDenseVector` &)  
*Assignment operator.*
- T & `operator[]` (int index) const  
*Member of array operator.*
- void `setVector` (int size, const T \*elems)  
*Set vector size, and elements.*
- void `setConstant` (int size, T elems)  
*Elements set to have the same scalar value.*
- void `setElement` (int index, T element)  
*Set an existing element in the dense vector The first argument is the "index" into the elements() array.*
- void `resize` (int newSize, T fill=T())  
*Resize the dense vector to be the first newSize elements.*
- void `append` (const `CoinDenseVector` &)  
*Append a dense vector to this dense vector.*

## norms, sum and scale

- T `oneNorm` () const  
*1-norm of vector*
- double `twoNorm` () const  
*2-norm of vector*
- T `infNorm` () const  
*infinity-norm of vector*
- T `sum` () const  
*sum of vector elements*
- void `scale` (T factor)  
*scale vector elements*

## Arithmetic operators.

- void `operator+=` (T value)  
*add value to every entry*
- void `operator-=` (T value)  
*subtract value from every entry*
- void `operator*=` (T value)  
*multiply every entry by value*
- void `operator/=` (T value)  
*divide every entry by value*

**Constructors and destructors**

- [CoinDenseVector](#) ()  
*Default constructor.*
- [CoinDenseVector](#) (int size, const T \*elems)  
*Alternate Constructors - set elements to vector of Ts.*
- [CoinDenseVector](#) (int size, T element=T())  
*Alternate Constructors - set elements to same scalar value.*
- [CoinDenseVector](#) (const [CoinDenseVector](#) &)  
*Copy constructors.*
- [~CoinDenseVector](#) ()  
*Destructor.*

**8.13.1 Detailed Description**

```
template<typename T>class CoinDenseVector< T >
```

Dense Vector.

Stores a dense (or expanded) vector of floating point values. Type of vector elements is controlled by templating. (Some working quantities such as accumulated sums are explicitly declared of type double). This allows the components of the vector integer, single or double precision.

Here is a sample usage:

```
const int ne = 4;
double el[ne] = { 10., 40., 1., 50. }

// Create vector and set its value
CoinDenseVector<double> r(ne,el);

// access each element
assert( r.getElements()[0]==10. );
assert( r.getElements()[1]==40. );
assert( r.getElements()[2]== 1. );
assert( r.getElements()[3]==50. );

// Test for equality
CoinDenseVector<double> r1;
r1=r;

// Add dense vectors.
// Similarly for subtraction, multiplication,
// and division.
CoinDenseVector<double> add = r + r1;
assert( add[0] == 10.+10. );
assert( add[1] == 40.+40. );
assert( add[2] == 1.+ 1. );
assert( add[3] == 50.+50. );

assert( r.sum() == 10.+40.+1.+50. );
```

Definition at line 67 of file CoinDenseVector.hpp.

### 8.13.2 Member Function Documentation

**8.13.2.1** `template<typename T> void CoinDenseVector< T >::setVector ( int size, const T * elems )`

Set vector size, and elements.

Size is the length of the elements vector. The element vector is copied into this class instance's member data.

**8.13.2.2** `template<typename T> void CoinDenseVector< T >::resize ( int newSize, T fill = T ( ) )`

Resize the dense vector to be the first *newSize* elements.

If length is decreased, vector is truncated. If increased new entries, set to new default element

The documentation for this class was generated from the following file:

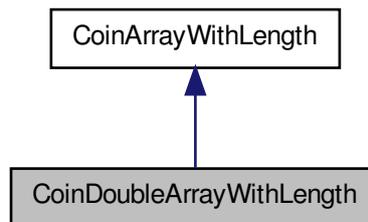
- CoinDenseVector.hpp

## 8.14 CoinDoubleArrayWithLength Class Reference

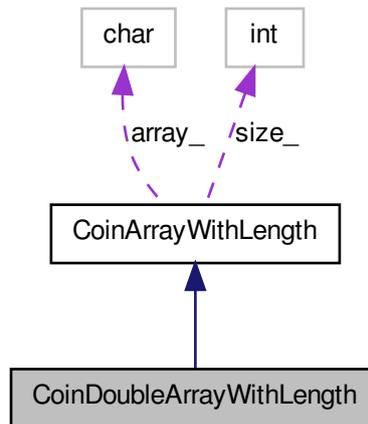
double \* version

```
#include <CoinIndexedVector.hpp>
```

Inheritance diagram for CoinDoubleArrayWithLength:



Collaboration diagram for CoinDoubleArrayWithLength:



#### Public Member Functions

##### Get methods.

- int [getSize](#) () const  
*Get the size.*
- double \* [array](#) () const  
*Get Array.*

##### Set methods

- void [setSize](#) (int value)  
*Set the size.*

##### Condition methods

- double \* [conditionalNew](#) (int sizeWanted)  
*Conditionally gets new array.*

##### Constructors and destructors

- [CoinDoubleArrayWithLength](#) ()  
*Default constructor - NULL.*
- [CoinDoubleArrayWithLength](#) (int size)  
*Alternate Constructor - length in bytes - size\_ -1.*

- [CoinDoubleArrayWithLength](#) (int size, int mode)  
*Alternate Constructor - length in bytes mode - 0 size\_ set to size 1 size\_ set to size and zeroed.*
- [CoinDoubleArrayWithLength](#) (const [CoinDoubleArrayWithLength](#) &rhs)  
*Copy constructor.*
- [CoinDoubleArrayWithLength](#) (const [CoinDoubleArrayWithLength](#) \*rhs)  
*Copy constructor.2.*
- [CoinDoubleArrayWithLength](#) & `operator=` (const [CoinDoubleArrayWithLength](#) &rhs)  
*Assignment operator.*

#### 8.14.1 Detailed Description

double \* version

Definition at line 588 of file CoinIndexedVector.hpp.

#### 8.14.2 Constructor & Destructor Documentation

8.14.2.1 `CoinDoubleArrayWithLength::CoinDoubleArrayWithLength ( const CoinDoubleArrayWithLength & rhs )` `[inline]`

Copy constructor.

Definition at line 630 of file CoinIndexedVector.hpp.

#### 8.14.3 Member Function Documentation

8.14.3.1 `CoinDoubleArrayWithLength& CoinDoubleArrayWithLength::operator= ( const CoinDoubleArrayWithLength & rhs )` `[inline]`

Assignment operator.

Definition at line 636 of file CoinIndexedVector.hpp.

The documentation for this class was generated from the following file:

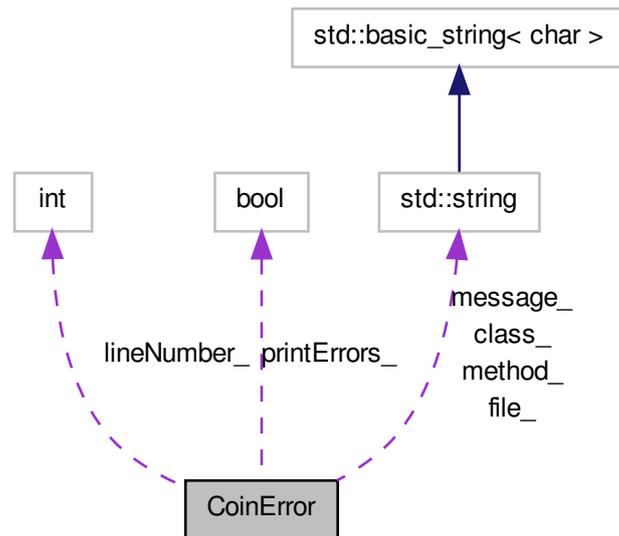
- CoinIndexedVector.hpp

## 8.15 CoinError Class Reference

Error Class thrown by an exception.

```
#include <CoinError.hpp>
```

Collaboration diagram for CoinError:



### Public Member Functions

#### Get error attributes

- const std::string & [message](#) () const  
*get message text*
- const std::string & [methodName](#) () const  
*get name of method instantiating error*
- const std::string & [className](#) () const  
*get name of class instantiating error (or hint for assert)*
- const std::string & [fileName](#) () const  
*get name of file for assert*
- int [lineNumber](#) () const  
*get line number of assert (-1 if not assert)*
- void [print](#) (bool doPrint=true) const  
*Just print (for asserts)*

#### Constructors and destructors

- [CoinError](#) (std::string message\_, std::string methodName\_, std::string className\_-, std::string fileName\_=std::string(), int line=-1)

- Alternate Constructor.*
- [CoinError](#) (const [CoinError](#) &source)
- Copy constructor.*
- [CoinError](#) & [operator=](#) (const [CoinError](#) &rhs)
- Assignment operator.*
- virtual [~CoinError](#) ()
- Destructor.*

#### Static Public Attributes

- static bool [printErrors\\_](#)  
*Whether to print every error.*

#### Friends

- void [CoinErrorUnitTest](#) ()  
*A function that tests the methods in the [CoinError](#) class.*

#### 8.15.1 Detailed Description

Error Class thrown by an exception.

This class is used when exceptions are thrown. It contains:

- message text
- name of method throwing exception
- name of class throwing exception or hint
- name of file if assert
- line number

For asserts class=> optional hint

Definition at line 42 of file [CoinError.hpp](#).

#### 8.15.2 Friends And Related Function Documentation

##### 8.15.2.1 void [CoinErrorUnitTest](#) ( ) [[friend](#)]

A function that tests the methods in the [CoinError](#) class.

The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging.

The documentation for this class was generated from the following file:

- [CoinError.hpp](#)

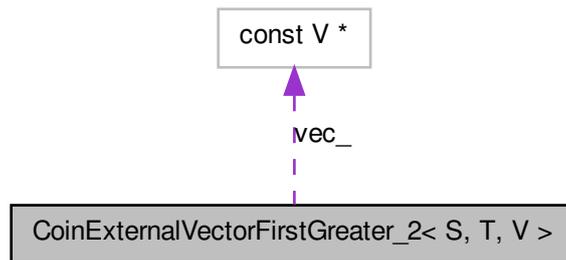
## 8.16 CoinExternalVectorFirstGreater\_2< S, T, V > Class Template Reference 58

### 8.16 CoinExternalVectorFirstGreater\_2< S, T, V > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

Collaboration diagram for CoinExternalVectorFirstGreater\_2< S, T, V >:



#### 8.16.1 Detailed Description

```
template<class S, class T, class V>class CoinExternalVectorFirstGreater_2< S, T, V >
```

Function operator.

Compare based on the entries of an external vector, i.e., returns true if `vec[t1.first > vec[t2.first]` (i.e., decreasing wrt. `vec`). Note that to use this comparison operator `.first` must be a data type automatically convertible to `int`.

Definition at line 120 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

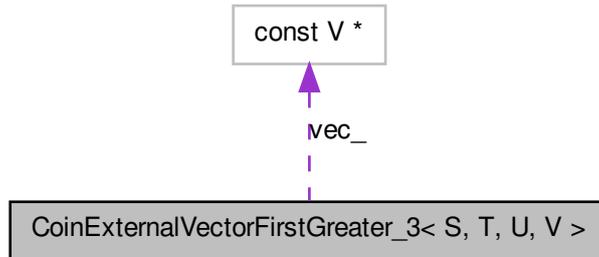
- `CoinSort.hpp`

### 8.17 CoinExternalVectorFirstGreater\_3< S, T, U, V > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

Collaboration diagram for CoinExternalVectorFirstGreater\_3< S, T, U, V >:



### 8.17.1 Detailed Description

```
template<class S, class T, class U, class V>class CoinExternalVectorFirstGreater_3< S, T, U, V >
```

Function operator.

Compare based on the entries of an external vector, i.e., returns true if `vec[t1.first > vec[t2.first]` (i.e., decreasing wrt. `vec`). Note that to use this comparison operator `.first` must be a data type automatically convertible to `int`.

Definition at line 452 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

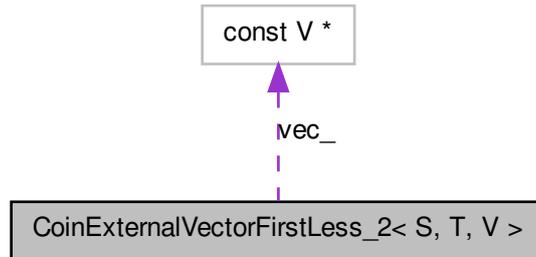
## 8.18 CoinExternalVectorFirstLess\_2< S, T, V > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

## 8.19 CoinExternalVectorFirstLess\_3< S, T, U, V > Class Template Reference 60

Collaboration diagram for CoinExternalVectorFirstLess\_2< S, T, V >:



### 8.18.1 Detailed Description

```
template<class S, class T, class V>class CoinExternalVectorFirstLess_2< S, T, V >
```

Function operator.

Compare based on the entries of an external vector, i.e., returns true if `vec[t1.first] < vec[t2.first]` (i.e., increasing wrt. `vec`). Note that to use this comparison operator `.first` must be a data type automatically convertible to `int`.

Definition at line 102 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

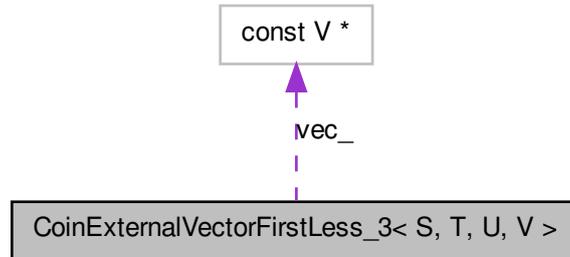
- `CoinSort.hpp`

## 8.19 CoinExternalVectorFirstLess\_3< S, T, U, V > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

Collaboration diagram for CoinExternalVectorFirstLess\_3< S, T, U, V >:



### 8.19.1 Detailed Description

```
template<class S, class T, class U, class V>class CoinExternalVectorFirstLess_3< S, T, U, V >
```

Function operator.

Compare based on the entries of an external vector, i.e., returns true if `vec[t1.first < vec[t2.first]` (i.e., increasing wrt. `vec`). Note that to use this comparison operator `.first` must be a data type automatically convertible to `int`.

Definition at line 434 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

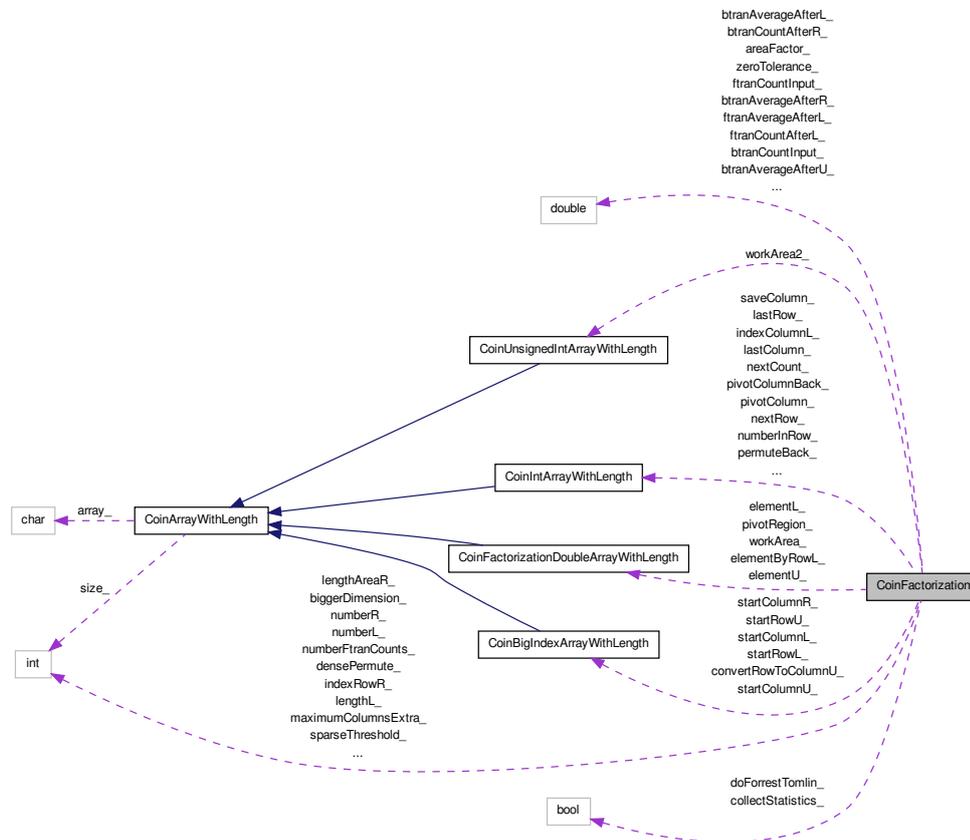
- `CoinSort.hpp`

## 8.20 CoinFactorization Class Reference

This deals with Factorization and Updates.

```
#include <CoinFactorization.hpp>
```

Collaboration diagram for CoinFactorization:



## Public Member Functions

### Constructors and destructor and copy

- [CoinFactorization](#) ()  
*Default constructor.*
- [CoinFactorization](#) (const [CoinFactorization](#) &other)  
*Copy constructor.*
- [~CoinFactorization](#) ()  
*Destructor.*
- void [almostDestructor](#) ()  
*Delete all stuff (leaves as after [CoinFactorization\(\)](#))*
- void [show\\_self](#) () const  
*Debug show object (shows one representation)*
- int [saveFactorization](#) (const char \*file) const

- Debug - save on file - 0 if no error.*
- int [restoreFactorization](#) (const char \*file, bool factor=false)
  - Debug - restore from file - 0 if no error on file.*
- void [sort](#) () const
  - Debug - sort so can compare.*
- [CoinFactorization](#) & [operator=](#) (const [CoinFactorization](#) &other)
  - = copy*

#### Do factorization

- int [factorize](#) (const [CoinPackedMatrix](#) &matrix, int rowsBasic[], int columnsBasic[], double areaFactor=0.0)
  - When part of LP - given by basic variables.*
- int [factorize](#) (int numberOfRows, int numberColumns, [CoinBigIndex](#) numberElements, [CoinBigIndex](#) maximumL, [CoinBigIndex](#) maximumU, const int indicesRow[], const int indicesColumn[], const double elements[], int permutation[], double areaFactor=0.0)
  - When given as triplets.*
- int [factorizePart1](#) (int numberOfRows, int numberColumns, [CoinBigIndex](#) estimateNumberElements, int \*indicesRow[], int \*indicesColumn[], [CoinFactorizationDouble](#) \*elements[], double areaFactor=0.0)
  - Two part version for maximum flexibility This part creates arrays for user to fill.*
- int [factorizePart2](#) (int permutation[], int exactNumberElements)
  - This is part two of factorization Arrays belong to factorization and were returned by part 1 If status okay, permutation has pivot rows - this is only needed If status is singular, then basic variables have pivot row and ones thrown out have -1 returns 0 -okay, -1 singular, -99 memory.*
- double [conditionNumber](#) () const
  - Condition number - product of pivots after factorization.*

#### general stuff such as permutation or status

- int [status](#) () const
  - Returns status.*
- void [setStatus](#) (int value)
  - Sets status.*
- int [pivots](#) () const
  - Returns number of pivots since factorization.*
- void [setPivots](#) (int value)
  - Sets number of pivots since factorization.*
- int \* [permute](#) () const
  - Returns address of permute region.*
- int \* [pivotColumn](#) () const
  - Returns address of pivotColumn region (also used for permuting)*
- [CoinFactorizationDouble](#) \* [pivotRegion](#) () const
  - Returns address of pivot region.*
- int \* [permuteBack](#) () const
  - Returns address of permuteBack region.*
- int \* [pivotColumnBack](#) () const

Returns address of `pivotColumnBack` region (also used for permuting) Now uses `firstCount` to save memory allocation.

- CoinBigIndex \* `startRowL` () const  
*Start of each row in L.*
- CoinBigIndex \* `startColumnL` () const  
*Start of each column in L.*
- int \* `indexColumnL` () const  
*Index of column in row for L.*
- int \* `indexRowL` () const  
*Row indices of L.*
- CoinFactorizationDouble \* `elementByRowL` () const  
*Elements in L (row copy)*
- int `numberRowsExtra` () const  
*Number of Rows after iterating.*
- void `setNumberRows` (int value)  
*Set number of Rows after factorization.*
- int `numberRows` () const  
*Number of Rows after factorization.*
- CoinBigIndex `numberL` () const  
*Number in L.*
- CoinBigIndex `baseL` () const  
*Base of L.*
- int `maximumRowsExtra` () const  
*Maximum of Rows after iterating.*
- int `numberColumns` () const  
*Total number of columns in factorization.*
- int `numberElements` () const  
*Total number of elements in factorization.*
- int `numberForrestTomlin` () const  
*Length of FT vector.*
- int `numberGoodColumns` () const  
*Number of good columns in factorization.*
- double `areaFactor` () const  
*Whether larger areas needed.*
- void `areaFactor` (double value)
- double `adjustedAreaFactor` () const  
*Returns areaFactor but adjusted for dense.*
- void `relaxAccuracyCheck` (double value)  
*Allows change of pivot accuracy check 1.0 == none > 1.0 relaxed.*
- double `getAccuracyCheck` () const
- int `messageLevel` () const  
*Level of detail of messages.*
- void `messageLevel` (int value)
- int `maximumPivots` () const  
*Maximum number of pivots between factorizations.*
- void `maximumPivots` (int value)
- int `denseThreshold` () const  
*Gets dense threshold.*

- void `setDenseThreshold` (int value)  
*Sets dense threshold.*
- double `pivotTolerance` () const  
*Pivot tolerance.*
- void `pivotTolerance` (double value)
- double `zeroTolerance` () const  
*Zero tolerance.*
- void `zeroTolerance` (double value)
- double `slackValue` () const  
*Whether slack value is +1 or -1.*
- void `slackValue` (double value)
- double `maximumCoefficient` () const  
*Returns maximum absolute value in factorization.*
- bool `forrestTomlin` () const  
*true if Forrest Tomlin update, false if PFI*
- void `setForrestTomlin` (bool value)
- bool `spaceForForrestTomlin` () const  
*True if FT update and space.*

#### some simple stuff

- int `numberDense` () const  
*Returns number of dense rows.*
- CoinBigIndex `numberElementsU` () const  
*Returns number in U area.*
- void `setNumberElementsU` (CoinBigIndex value)  
*Setss number in U area.*
- CoinBigIndex `lengthAreaU` () const  
*Returns length of U area.*
- CoinBigIndex `numberElementsL` () const  
*Returns number in L area.*
- CoinBigIndex `lengthAreaL` () const  
*Returns length of L area.*
- CoinBigIndex `numberElementsR` () const  
*Returns number in R area.*
- CoinBigIndex `numberCompressions` () const  
*Number of compressions done.*
- int \* `numberInRow` () const  
*Number of entries in each row.*
- int \* `numberInColumn` () const  
*Number of entries in each column.*
- CoinFactorizationDouble \* `elementU` () const  
*Elements of U.*
- int \* `indexRowU` () const  
*Row indices of U.*
- CoinBigIndex \* `startColumnU` () const  
*Start of each column in U.*
- int `maximumColumnsExtra` ()

- Maximum number of Columns after iterating.*
- int `biasLU` () const
  - L to U bias 0 - U bias, 1 - some U bias, 2 some L bias, 3 L bias.*
- void `setBiasLU` (int value)
- int `persistenceFlag` () const
  - Array persistence flag If 0 then as now (delete/new) 1 then only do arrays if bigger needed 2 as 1 but give a bit extra if bigger needed.*
- void `setPersistenceFlag` (int value)

#### rank one updates which do exist

- int `replaceColumn` (`CoinIndexedVector` \*regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying=false, double acceptablePivot=1.0e-8)
  - Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.*
- void `replaceColumnU` (`CoinIndexedVector` \*regionSparse, `CoinBigIndex` \*deleted, int internalPivotRow)
  - Combines BtranU and delete elements If deleted is NULL then delete elements otherwise store where elements are.*

#### various uses of factorization (return code number elements)

\*\*\* Below this user may not want to know about

which user may not want to know about (left over from my LP code)

- int `updateColumnFT` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*regionSparse2)
  - Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.*
- int `updateColumn` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*regionSparse2, bool noPermute=false) const
  - This version has same effect as above with FTUpdate==false so number returned is always >=0.*
- int `updateTwoColumnsFT` (`CoinIndexedVector` \*regionSparse1, `CoinIndexedVector` \*regionSparse2, `CoinIndexedVector` \*regionSparse3, bool noPermuteRegion3=false)
  - Updates one column (FTRAN) from region2 Tries to do FT update number returned is negative if no room.*
- int `updateColumnTranspose` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*regionSparse2) const
  - Updates one column (BTRAN) from regionSparse2 regionSparse starts as zero and is zero at end Note - if regionSparse2 packed on input - will be packed on output.*
- void `goSparse` ()
  - makes a row copy of L for speed and to allow very sparse problems*
- int `sparseThreshold` () const
  - get sparse threshold*
- void `sparseThreshold` (int value)
  - set sparse threshold*
- void `clearArrays` ()
  - Get rid of all memory.*

various updates - none of which have been written!

- int [add](#) (CoinBigIndex numberElements, int indicesRow[], int indicesColumn[], double elements[])  
*Adds given elements to Basis and updates factorization, can increase size of basis.*
- int [addColumn](#) (CoinBigIndex numberElements, int indicesRow[], double elements[])  
*Adds one Column to basis, can increase size of basis.*
- int [addRow](#) (CoinBigIndex numberElements, int indicesColumn[], double elements[])  
*Adds one Row to basis, can increase size of basis.*
- int [deleteColumn](#) (int Row)  
*Deletes one Column from basis, returns rank.*
- int [deleteRow](#) (int Row)  
*Deletes one Row from basis, returns rank.*
- int [replaceRow](#) (int whichRow, int numberElements, const int indicesColumn[], const double elements[])  
*Replaces one Row in basis, At present assumes just a singleton on row is in basis returns 0=OK, 1=Probably OK, 2=singular, 3 no space.*
- void [emptyRows](#) (int numberToEmpty, const int which[])  
*Takes out all entries for given rows.*

used by ClpFactorization

- void [checkSparse](#) ()  
*See if worth going sparse.*
- bool [collectStatistics](#) () const  
*For statistics.*
- void [setCollectStatistics](#) (bool onOff) const  
*For statistics.*
- void [gutsOfDestructor](#) (int type=1)  
*The real work of constructors etc 0 just scalars, 1 bit normal.*
- void [gutsOfInitialize](#) (int type)  
*1 bit - tolerances etc, 2 more, 4 dummy arrays*
- void [gutsOfCopy](#) (const [CoinFactorization](#) &other)
- void [resetStatistics](#) ()  
*Reset all sparsity etc statistics.*

Protected Attributes

data

- double [pivotTolerance\\_](#)  
*Pivot tolerance.*
- double [zeroTolerance\\_](#)  
*Zero tolerance.*
- double [slackValue\\_](#)  
*Whether slack value is +1 or -1.*
- double [areaFactor\\_](#)

- How much to multiply areas by.*

  - double [relaxCheck\\_](#)

*Relax check on accuracy in replaceColumn.*
- int [numberRows\\_](#)

*Number of Rows in factorization.*
- int [numberRowsExtra\\_](#)

*Number of Rows after iterating.*
- int [maximumRowsExtra\\_](#)

*Maximum number of Rows after iterating.*
- int [numberColumns\\_](#)

*Number of Columns in factorization.*
- int [numberColumnsExtra\\_](#)

*Number of Columns after iterating.*
- int [maximumColumnsExtra\\_](#)

*Maximum number of Columns after iterating.*
- int [numberGoodU\\_](#)

*Number factorized in U (not row singletons)*
- int [numberGoodL\\_](#)

*Number factorized in L.*
- int [maximumPivots\\_](#)

*Maximum number of pivots before factorization.*
- int [numberPivots\\_](#)

*Number pivots since last factorization.*
- CoinBigIndex [totalElements\\_](#)

*Number of elements in U (to go) or while iterating total overall.*
- CoinBigIndex [factorElements\\_](#)

*Number of elements after factorization.*
- CoinIntArrayWithLength [pivotColumn\\_](#)

*Pivot order for each Column.*
- CoinIntArrayWithLength [permute\\_](#)

*Permutation vector for pivot row order.*
- CoinIntArrayWithLength [permuteBack\\_](#)

*DePermutation vector for pivot row order.*
- CoinIntArrayWithLength [pivotColumnBack\\_](#)

*Inverse Pivot order for each Column.*
- int [status\\_](#)

*Status of factorization.*
- int [numberTrials\\_](#)

*0 - no increasing rows - no permutations, 1 - no increasing rows but permutations  
2 - increasing rows*
- CoinBigIndexArrayWithLength [startRowU\\_](#)

*Start of each Row as pointer.*
- CoinIntArrayWithLength [numberInRow\\_](#)

*Number in each Row.*
- CoinIntArrayWithLength [numberInColumn\\_](#)

*Number in each Column.*
- CoinIntArrayWithLength [numberInColumnPlus\\_](#)

- Number in each Column including pivoted.*

  - [CoinIntArrayWithLength firstCount\\_](#)  
*First Row/Column with count of k, can tell which by offset - Rows then Columns.*
  - [CoinIntArrayWithLength nextCount\\_](#)  
*Next Row/Column with count.*
  - [CoinIntArrayWithLength lastCount\\_](#)  
*Previous Row/Column with count.*
  - [CoinIntArrayWithLength nextColumn\\_](#)  
*Next Column in memory order.*
  - [CoinIntArrayWithLength lastColumn\\_](#)  
*Previous Column in memory order.*
  - [CoinIntArrayWithLength nextRow\\_](#)  
*Next Row in memory order.*
  - [CoinIntArrayWithLength lastRow\\_](#)  
*Previous Row in memory order.*
  - [CoinIntArrayWithLength saveColumn\\_](#)  
*Columns left to do in a single pivot.*
  - [CoinIntArrayWithLength markRow\\_](#)  
*Marks rows to be updated.*
  - int [messageLevel\\_](#)  
*Detail in messages.*
  - int [biggerDimension\\_](#)  
*Larger of row and column size.*
  - [CoinIntArrayWithLength indexColumnU\\_](#)  
*Base address for U (may change)*
  - [CoinIntArrayWithLength pivotRowL\\_](#)  
*Pivots for L.*
  - [CoinFactorizationDoubleArrayWithLength pivotRegion\\_](#)  
*Inverses of pivot values.*
  - int [numberSlacks\\_](#)  
*Number of slacks at beginning of U.*
  - int [numberU\\_](#)  
*Number in U.*
  - CoinBigIndex [maximumU\\_](#)  
*Maximum space used in U.*
  - CoinBigIndex [lengthU\\_](#)  
*Base of U is always 0.*
  - CoinBigIndex [lengthAreaU\\_](#)  
*Length of area reserved for U.*
  - [CoinFactorizationDoubleArrayWithLength elementU\\_](#)  
*Elements of U.*
  - [CoinIntArrayWithLength indexRowU\\_](#)  
*Row indices of U.*
  - [CoinBigIndexArrayWithLength startColumnU\\_](#)  
*Start of each column in U.*
  - [CoinBigIndexArrayWithLength convertRowToColumnU\\_](#)  
*Converts rows to columns in U.*

- CoinBigIndex [numberL\\_](#)  
*Number in L.*
- CoinBigIndex [baseL\\_](#)  
*Base of L.*
- CoinBigIndex [lengthL\\_](#)  
*Length of L.*
- CoinBigIndex [lengthAreaL\\_](#)  
*Length of area reserved for L.*
- [CoinFactorizationDoubleArrayWithLength](#) [elementL\\_](#)  
*Elements of L.*
- [CoinIntArrayWithLength](#) [indexRowL\\_](#)  
*Row indices of L.*
- [CoinBigIndexArrayWithLength](#) [startColumnL\\_](#)  
*Start of each column in L.*
- bool [doForrestTomlin\\_](#)  
*true if Forrest Tomlin update, false if PFI*
- int [numberR\\_](#)  
*Number in R.*
- CoinBigIndex [lengthR\\_](#)  
*Length of R stuff.*
- CoinBigIndex [lengthAreaR\\_](#)  
*length of area reserved for R*
- [CoinFactorizationDouble](#) \* [elementR\\_](#)  
*Elements of R.*
- int \* [indexRowR\\_](#)  
*Row indices for R.*
- [CoinBigIndexArrayWithLength](#) [startColumnR\\_](#)  
*Start of columns for R.*
- double \* [denseArea\\_](#)  
*Dense area.*
- int \* [densePermute\\_](#)  
*Dense permutation.*
- int [numberDense\\_](#)  
*Number of dense rows.*
- int [denseThreshold\\_](#)  
*Dense threshold.*
- [CoinFactorizationDoubleArrayWithLength](#) [workArea\\_](#)  
*First work area.*
- [CoinUnsignedIntArrayWithLength](#) [workArea2\\_](#)  
*Second work area.*
- CoinBigIndex [numberCompressions\\_](#)  
*Number of compressions done.*
- double [ftranCountInput\\_](#)  
*Below are all to collect.*
- double [ftranCountAfterL\\_](#)
- double [ftranCountAfterR\\_](#)
- double [ftranCountAfterU\\_](#)

- double **btranCountInput\_**
- double **btranCountAfterU\_**
- double **btranCountAfterR\_**
- double **btranCountAfterL\_**
- int **numberFtranCounts\_**  
*We can roll over factorizations.*
- int **numberBtranCounts\_**
- double **ftranAverageAfterL\_**  
*While these are average ratios collected over last period.*
- double **ftranAverageAfterR\_**
- double **ftranAverageAfterU\_**
- double **btranAverageAfterU\_**
- double **btranAverageAfterR\_**
- double **btranAverageAfterL\_**
- bool **collectStatistics\_**  
*For statistics.*
- int **sparseThreshold\_**  
*Below this use sparse technology - if 0 then no L row copy.*
- int **sparseThreshold2\_**  
*And one for "sparsish".*
- **CoinBigIndexArrayWithLength** **startRowL\_**  
*Start of each row in L.*
- **CoinIntArrayWithLength** **indexColumnL\_**  
*Index of column in row for L.*
- **CoinFactorizationDoubleArrayWithLength** **elementByRowL\_**  
*Elements in L (row copy)*
- **CoinIntArrayWithLength** **sparse\_**  
*Sparse regions.*
- int **biasLU\_**  
*L to U bias 0 - U bias, 1 - some U bias, 2 some L bias, 3 L bias.*
- int **persistenceFlag\_**  
*Array persistence flag If 0 then as now (delete/new) 1 then only do arrays if bigger needed 2 as 1 but give a bit extra if bigger needed.*

#### used by factorization

- void **getAreas** (int numberRows, int numberColumns, CoinBigIndex maximumL, CoinBigIndex maximumU)  
*Gets space for a factorization, called by constructors.*
- void **preProcess** (int state, int possibleDuplicates=-1)  
*PreProcesses raw triplet data.*
- int **factor** ()  
*Does most of factorization.*
- int **replaceColumnPFI** (**CoinIndexedVector** \*regionSparse, int pivotRow, double alpha)  
*Replaces one Column to basis for PFI returns 0=OK, 1=Probably OK, 2=singular, 3=no room.*
- int **factorSparse** ()

- Does sparse phase of factorization return code is <0 error, 0= finished.*

  - int [factorSparseSmall](#) ()
- Does sparse phase of factorization (for smaller problems) return code is <0 error, 0= finished.*

  - int [factorSparseLarge](#) ()
- Does sparse phase of factorization (for larger problems) return code is <0 error, 0= finished.*

  - int [factorDense](#) ()
- Does dense phase of factorization return code is <0 error, 0= finished.*

  - bool [pivotOneOtherRow](#) (int pivotRow, int pivotColumn)

*Pivots when just one other row so faster?*
- bool [pivotRowSingleton](#) (int pivotRow, int pivotColumn)

*Does one pivot on Row Singleton in factorization.*
- bool [pivotColumnSingleton](#) (int pivotRow, int pivotColumn)

*Does one pivot on Column Singleton in factorization.*
- bool [getColumnSpace](#) (int iColumn, int extraNeeded)

*Gets space for one Column with given length, may have to do compression (returns True if successful), also moves existing vector, extraNeeded is over and above present.*
- bool [reorderU](#) ()

*Reorders U so contiguous and in order (if there is space) Returns true if it could.*
- bool [getColumnSpaceIterateR](#) (int iColumn, double value, int iRow)

*getColumnSpaceIterateR.*
- CoinBigIndex [getColumnSpaceIterate](#) (int iColumn, double value, int iRow)

*getColumnSpaceIterate.*
- bool [getRowSpace](#) (int iRow, int extraNeeded)

*Gets space for one Row with given length, may have to do compression (returns True if successful), also moves existing vector.*
- bool [getRowSpaceIterate](#) (int iRow, int extraNeeded)

*Gets space for one Row with given length while iterating, may have to do compression (returns True if successful), also moves existing vector.*
- void [checkConsistency](#) ()

*Checks that row and column copies look OK.*
- void [addLink](#) (int index, int count)

*Adds a link in chain of equal counts.*
- void [deleteLink](#) (int index)

*Deletes a link in chain of equal counts.*
- void [separateLinks](#) (int count, bool rowsFirst)

*Separate out links with same row/column count.*
- void [cleanup](#) ()

*Cleans up at end of factorization.*
- void [updateColumnL](#) (CoinIndexedVector \*region, int \*indexIn) const

*Updates part of column (FTRANL)*
- void [updateColumnLDensish](#) (CoinIndexedVector \*region, int \*indexIn) const

*Updates part of column (FTRANL) when densish.*

- void `updateColumnLSpase` (`CoinIndexedVector` \*region, int \*indexIn) const  
*Updates part of column (FTRANL) when sparse.*
- void `updateColumnLSparsish` (`CoinIndexedVector` \*region, int \*indexIn) const  
*Updates part of column (FTRANL) when sparsish.*
- void `updateColumnR` (`CoinIndexedVector` \*region) const  
*Updates part of column (FTRANR) without FT update.*
- void `updateColumnRFT` (`CoinIndexedVector` \*region, int \*indexIn)  
*Updates part of column (FTRANR) with FT update.*
- void `updateColumnU` (`CoinIndexedVector` \*region, int \*indexIn) const  
*Updates part of column (FTRANU)*
- void `updateColumnUSpase` (`CoinIndexedVector` \*regionSparse, int \*indexIn) const  
  
*Updates part of column (FTRANU) when sparse.*
- void `updateColumnUSparsish` (`CoinIndexedVector` \*regionSparse, int \*indexIn) const  
  
*Updates part of column (FTRANU) when sparsish.*
- int `updateColumnUDensish` (double \*COIN\_RESTRICT region, int \*COIN\_RESTRICT regionIndex) const  
  
*Updates part of column (FTRANU)*
- void `updateTwoColumnsUDensish` (int &numberNonZero1, double \*COIN\_RESTRICT region1, int \*COIN\_RESTRICT index1, int &numberNonZero2, double \*COIN\_RESTRICT region2, int \*COIN\_RESTRICT index2) const  
  
*Updates part of 2 columns (FTRANU) real work.*
- void `updateColumnPFI` (`CoinIndexedVector` \*regionSparse) const  
  
*Updates part of column PFI (FTRAN) (after rest)*
- void `permuteBack` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*outVector) const  
  
*Permutes back at end of updateColumn.*
- void `updateColumnTransposePFI` (`CoinIndexedVector` \*region) const  
  
*Updates part of column transpose PFI (BTRAN) (before rest)*
- void `updateColumnTransposeU` (`CoinIndexedVector` \*region, int smallestIndex) const  
  
*Updates part of column transpose (BTRANU), assumes index is sorted i.e.*
- void `updateColumnTransposeUSparsish` (`CoinIndexedVector` \*region, int smallestIndex) const  
  
*Updates part of column transpose (BTRANU) when sparsish, assumes index is sorted i.e.*
- void `updateColumnTransposeUDensish` (`CoinIndexedVector` \*region, int smallestIndex) const  
  
*Updates part of column transpose (BTRANU) when densish, assumes index is sorted i.e.*
- void `updateColumnTransposeUSpase` (`CoinIndexedVector` \*region) const  
  
*Updates part of column transpose (BTRANU) when sparse, assumes index is sorted i.e.*

- void `updateColumnTransposeUByColumn` (`CoinIndexedVector` \*region, int smallestIndex) const  
*Updates part of column transpose (BTRANU) by column assumes index is sorted i.e.*
- void `updateColumnTransposeR` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANR)*
- void `updateColumnTransposeRDensish` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANR) when dense.*
- void `updateColumnTransposeRSparse` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANR) when sparse.*
- void `updateColumnTransposeL` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANL)*
- void `updateColumnTransposeLDensish` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANL) when densish by column.*
- void `updateColumnTransposeLByRow` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANL) when densish by row.*
- void `updateColumnTransposeLSparsish` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANL) when sparsish by row.*
- void `updateColumnTransposeLSparse` (`CoinIndexedVector` \*region) const  
*Updates part of column transpose (BTRANL) when sparse (by Row)*
- int `checkPivot` (double saveFromU, double oldPivot) const  
*Returns accuracy status of replaceColumn returns 0=OK, 1=Probably OK, 2=singular.*
- template<class T >  
bool **pivot** (int pivotRow, int pivotColumn, CoinBigIndex pivotRowPosition, CoinBigIndex pivotColumnPosition, CoinFactorizationDouble work[], unsigned int workArea2[], int increment2, T markRow[], int largeInteger)

### 8.20.1 Detailed Description

This deals with Factorization and Updates.

This class started with a parallel simplex code I was writing in the mid 90's. The need for parallelism led to many complications and I have simplified as much as I could to get back to this.

I was aiming at problems where I might get speed-up so I was looking at dense problems or ones with structure. This led to permuting input and output vectors and to increasing the number of rows each rank-one update. This is still in as a minor overhead.

I have also put in handling for hyper-sparsity. I have taken out all outer loop unrolling, dense matrix handling and most of the book-keeping for slacks. Also I always use FTRAN approach to updating even if factorization fairly dense. All these could improve performance.

I blame some of the coding peculiarities on the history of the code but mostly it is just because I can't do elegant code (or useful comments).

I am assuming that 32 bits is enough for number of rows or columns, but CoinBigIndex may be redefined to get 64 bits.

Definition at line 50 of file CoinFactorization.hpp.

## 8.20.2 Member Function Documentation

8.20.2.1 `int CoinFactorization::restoreFactorization ( const char * file, bool factor = false )`

Debug - restore from file - 0 if no error on file.

If factor true then factorizes as if called from ClpFactorization

8.20.2.2 `int CoinFactorization::factorize ( const CoinPackedMatrix & matrix, int rowsBasic[], int columnsBasic[], double areaFactor = 0.0 )`

When part of LP - given by basic variables.

Actually does factorization. Arrays passed in have non negative value to say basic. If status is okay, basic variables have pivot row - this is only needed If status is singular, then basic variables have pivot row and ones thrown out have -1 returns 0 -okay, -1 singular, -2 too many in basis, -99 memory

8.20.2.3 `int CoinFactorization::factorize ( int numberRows, int numberColumns, CoinBigIndex numberElements, CoinBigIndex maximumL, CoinBigIndex maximumU, const int indicesRow[], const int indicesColumn[], const double elements[], int permutation[], double areaFactor = 0.0 )`

When given as triplets.

Actually does factorization. maximumL is guessed maximum size of L part of final factorization, maximumU of U part. These are multiplied by areaFactor which can be computed by user or internally. Arrays are copied in. I could add flag to delete arrays to save a bit of memory. If status okay, permutation has pivot rows - this is only needed If status is singular, then basic variables have pivot row and ones thrown out have -1 returns 0 -okay, -1 singular, -99 memory

8.20.2.4 `int CoinFactorization::factorizePart1 ( int numberRows, int numberColumns, CoinBigIndex estimateNumberElements, int * indicesRow[], int * indicesColumn[], CoinFactorizationDouble * elements[], double areaFactor = 0.0 )`

Two part version for maximum flexibility This part creates arrays for user to fill.

estimateNumberElements is safe estimate of number returns 0 -okay, -99 memory

8.20.2.5 `int CoinFactorization::replaceColumn ( CoinIndexedVector * regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying = false, double acceptablePivot = 1.0e-8 )`

Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.

Whether to set this depends on speed considerations. You could just do this on first iteration after factorization and thereafter re-factorize partial update already in U

8.20.2.6 `int CoinFactorization::updateColumnFT ( CoinIndexedVector * regionSparse, CoinIndexedVector * regionSparse2 )`

Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.

Note - if regionSparse2 packed on input - will be packed on output

8.20.2.7 `int CoinFactorization::updateTwoColumnsFT ( CoinIndexedVector * regionSparse1, CoinIndexedVector * regionSparse2, CoinIndexedVector * regionSparse3, bool noPermuteRegion3 = false )`

Updates one column (FTRAN) from region2 Tries to do FT update number returned is negative if no room.

Also updates region3 region1 starts as zero and is zero at end

8.20.2.8 `int CoinFactorization::add ( CoinBigIndex numberElements, int indicesRow[], int indicesColumn[], double elements[] )`

Adds given elements to Basis and updates factorization, can increase size of basis.

Returns rank

8.20.2.9 `int CoinFactorization::addColumn ( CoinBigIndex numberElements, int indicesRow[], double elements[] )`

Adds one Column to basis, can increase size of basis.

Returns rank

8.20.2.10 `int CoinFactorization::addRow ( CoinBigIndex numberElements, int indicesColumn[], double elements[] )`

Adds one Row to basis, can increase size of basis.

Returns rank

8.20.2.11 `void CoinFactorization::preProcess ( int state, int possibleDuplicates = -1 )`

PreProcesses raw triplet data.

state is 0 - triplets, 1 - some counts etc , 2 - ..

8.20.2.12 `bool CoinFactorization::getColumnSpacelaterR ( int iColumn, double value, int iRow ) [protected]`

getColumnSpacelaterR.

Gets space for one extra R element in Column may have to do compression (returns true) also moves existing vector

8.20.2.13 `CoinBigIndex CoinFactorization::getColumnSpacelrate ( int iColumn, double value, int iRow )` [protected]

getColumnSpacelrate.

Gets space for one extra U element in Column may have to do compression (returns true) also moves existing vector. Returns -1 if no memory or where element was put Used by replaceRow (turns off R version)

8.20.2.14 `void CoinFactorization::updateColumnRFT ( CoinIndexedVector * region, int * indexIn )` [protected]

Updates part of column (FTRANR) with FT update.

Also stores update after L and R

8.20.2.15 `void CoinFactorization::updateColumnTransposeU ( CoinIndexedVector * region, int smallestIndex ) const` [protected]

Updates part of column transpose (BTRANU), assumes index is sorted i.e.

region is correct

8.20.2.16 `void CoinFactorization::updateColumnTransposeUSparsish ( CoinIndexedVector * region, int smallestIndex ) const` [protected]

Updates part of column transpose (BTRANU) when sparsish, assumes index is sorted i.e.

region is correct

8.20.2.17 `void CoinFactorization::updateColumnTransposeUDensish ( CoinIndexedVector * region, int smallestIndex ) const` [protected]

Updates part of column transpose (BTRANU) when densish, assumes index is sorted i.e.

region is correct

8.20.2.18 `void CoinFactorization::updateColumnTransposeUSparse ( CoinIndexedVector * region ) const` [protected]

Updates part of column transpose (BTRANU) when sparse, assumes index is sorted i.e.

region is correct

8.20.2.19 `void CoinFactorization::updateColumnTransposeUByColumn ( CoinIndexedVector * region, int smallestIndex ) const` [protected]

Updates part of column transpose (BTRANU) by column assumes index is sorted i.e.

region is correct

8.20.2.20 `int CoinFactorization::replaceColumnPFI ( CoinIndexedVector * regionSparse, int pivotRow, double alpha )`

Replaces one Column to basis for PFI returns 0=OK, 1=Probably OK, 2=singular, 3=no room.

In this case region is not empty - it is incoming variable (updated)

### 8.20.3 Member Data Documentation

8.20.3.1 `int CoinFactorization::numberTrials_` [protected]

0 - no increasing rows - no permutations, 1 - no increasing rows but permutations 2 - increasing rows

- taken out as always 2 Number of trials before rejection

Definition at line 1244 of file CoinFactorization.hpp.

8.20.3.2 `CoinBigIndex CoinFactorization::lengthU_` [protected]

Base of U is always 0.

Length of U

Definition at line 1313 of file CoinFactorization.hpp.

The documentation for this class was generated from the following file:

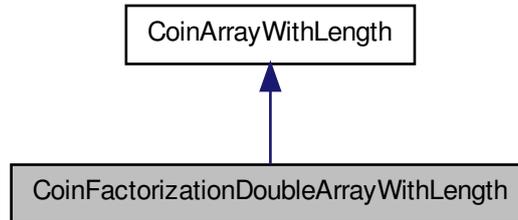
- CoinFactorization.hpp

## 8.21 CoinFactorizationDoubleArrayWithLength Class Reference

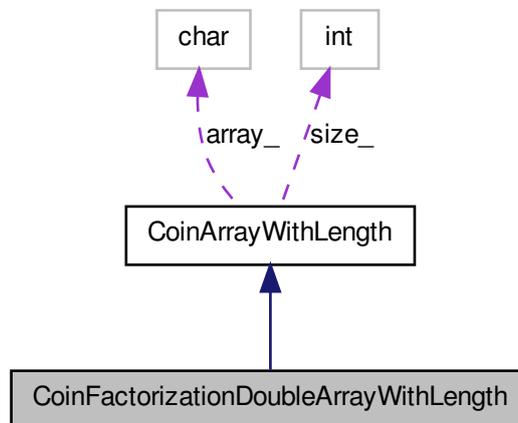
CoinFactorizationDouble \* version.

```
#include <CoinIndexedVector.hpp>
```

Inheritance diagram for CoinFactorizationDoubleArrayWithLength:



Collaboration diagram for CoinFactorizationDoubleArrayWithLength:



#### Public Member Functions

##### Get methods.

- int `getSize ()` const  
*Get the size.*
- `CoinFactorizationDouble * array ()` const  
*Get Array.*

**Set methods**

- void [setSize](#) (int value)  
*Set the size.*

**Condition methods**

- CoinFactorizationDouble \* [conditionalNew](#) (int sizeWanted)  
*Conditionally gets new array.*

**Constructors and destructors**

- [CoinFactorizationDoubleArrayWithLength](#) ()  
*Default constructor - NULL.*
- [CoinFactorizationDoubleArrayWithLength](#) (int size)  
*Alternate Constructor - length in bytes - size\_ -1.*
- [CoinFactorizationDoubleArrayWithLength](#) (int size, int mode)  
*Alternate Constructor - length in bytes mode - 0 size\_ set to size 1 size\_ set to size and zeroed.*
- [CoinFactorizationDoubleArrayWithLength](#) (const [CoinFactorizationDoubleArrayWithLength](#) &rhs)  
*Copy constructor.*
- [CoinFactorizationDoubleArrayWithLength](#) (const [CoinFactorizationDoubleArrayWithLength](#) \*rhs)  
*Copy constructor.2.*
- [CoinFactorizationDoubleArrayWithLength](#) & [operator=](#) (const [CoinFactorizationDoubleArrayWithLength](#) &rhs)  
*Assignment operator.*

**8.21.1 Detailed Description**

CoinFactorizationDouble \* version.

Definition at line 642 of file CoinIndexedVector.hpp.

**8.21.2 Constructor & Destructor Documentation****8.21.2.1 CoinFactorizationDoubleArrayWithLength::CoinFactorizationDoubleArrayWithLength ( const CoinFactorizationDoubleArrayWithLength & rhs ) [inline]**

Copy constructor.

Definition at line 684 of file CoinIndexedVector.hpp.

**8.21.3 Member Function Documentation****8.21.3.1 CoinFactorizationDoubleArrayWithLength& CoinFactorizationDoubleArrayWithLength::operator= ( const CoinFactorizationDoubleArrayWithLength & rhs ) [inline]**

Assignment operator.

Definition at line 690 of file CoinIndexedVector.hpp.

The documentation for this class was generated from the following file:

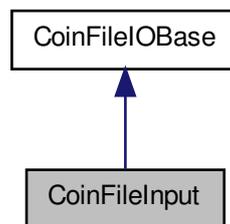
- CoinIndexedVector.hpp

## 8.22 CoinFileInput Class Reference

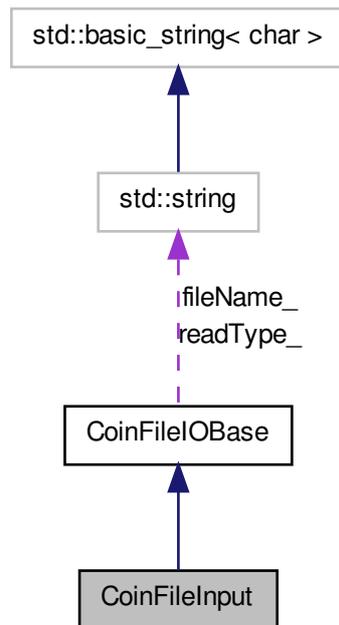
Abstract base class for file input classes.

```
#include <CoinFileIO.hpp>
```

Inheritance diagram for CoinFileInput:



Collaboration diagram for CoinFileInput:



### Public Member Functions

- `CoinFileInput` (const std::string &fileName)  
*Constructor (don't use this, use the create method instead).*
- virtual `~CoinFileInput` ()  
*Destructor.*
- virtual int `read` (void \*buffer, int size)=0  
*Read a block of data from the file, similar to fread.*
- virtual char \* `gets` (char \*buffer, int size)=0  
*Reads up to (size-1) characters and stores them into the buffer, similar to fgets.*

### Static Public Member Functions

- static bool `haveGzipSupport` ()  
*indicates whether CoinFileInput supports gzip'ed files*
- static bool `haveBzip2Support` ()

indicates whether [CoinFileInput](#) supports bzip2'ed files

- static [CoinFileInput](#) \* [create](#) (const std::string &fileName)

Factory method, that creates a [CoinFileInput](#) (more precisely a subclass of it) for the file specified.

### Related Functions

(Note that these are not member functions.)

- bool [fileAbsPath](#) (const std::string &path)  
Test if the given string looks like an absolute file path.
- bool [fileCoinReadable](#) (std::string &name, const std::string &dfmtPrefix=std::string(""))

Test if the file is readable, using likely versions of the file name, and return the name that worked.

#### 8.22.1 Detailed Description

Abstract base class for file input classes.

Definition at line 37 of file CoinFileIO.hpp.

#### 8.22.2 Constructor & Destructor Documentation

##### 8.22.2.1 CoinFileInput::CoinFileInput ( const std::string & fileName )

Constructor (don't use this, use the create method instead).

### Parameters

<i>fileName</i>	The name of the file used by this object.
-----------------	---

#### 8.22.3 Member Function Documentation

##### 8.22.3.1 static CoinFileInput\* CoinFileInput::create ( const std::string & fileName )

[static]

Factory method, that creates a [CoinFileInput](#) (more precisely a subclass of it) for the file specified.

This method reads the first few bytes of the file and determines if this is a compressed or a plain file and returns the correct subclass to handle it. If the file does not exist or uses a compression not compiled in an exception is thrown.

### Parameters

<i>fileName</i>	The file that should be read.
-----------------	-------------------------------

**8.22.3.2** `virtual int CoinFileInput::read ( void * buffer, int size )` [pure virtual]

Read a block of data from the file, similar to fread.

#### Parameters

<i>buffer</i>	Address of a buffer to store the data into.
<i>size</i>	Number of bytes to read (buffer should be large enough).

#### Returns

Number of bytes read.

**8.22.3.3** `virtual char* CoinFileInput::gets ( char * buffer, int size )` [pure virtual]

Reads up to (size-1) characters and stores them into the buffer, similar to fgets.

Reading ends, when EOF or a newline occurs or (size-1) characters have been read. The resulting string is terminated with '\0'. If reading ends due to an encountered newline, the

' is put into the buffer, before the '\0' is appended.

#### Parameters

<i>buffer</i>	The buffer to put the string into.
<i>size</i>	The size of the buffer in characters.

#### Returns

buffer on success, or 0 if no characters have been read.

### 8.22.4 Friends And Related Function Documentation

**8.22.4.1** `bool fileAbsPath ( const std::string & path )` [related]

Test if the given string looks like an absolute file path.

The criteria are:

- unix: string begins with '/'
- windows: string begins with '\ ' or with 'drv:' (drive specifier)

**8.22.4.2** `bool fileCoinReadable ( std::string & name, const std::string & dfmtPrefix = std::string("") )` [related]

Test if the file is readable, using likely versions of the file name, and return the name that worked.

The file name is constructed from *name* using the following rules:

- An absolute path is not modified.

- If the name begins with '~', an attempt is made to replace '~' with the value of the environment variable HOME.
- If a default prefix (`dfltPrefix`) is provided, it is prepended to the name.

If the constructed file name cannot be opened, and `CoinUtils` was built with support for compressed files, `fileCoinReadable` will try any standard extensions for supported compressed files.

The value returned in `name` is the file name that actually worked.

The documentation for this class was generated from the following file:

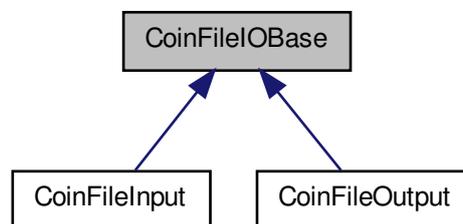
- `CoinFileIO.hpp`

### 8.23 CoinFileIOBase Class Reference

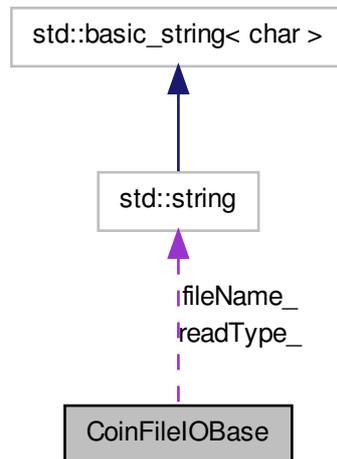
Base class for FileIO classes.

```
#include <CoinFileIO.hpp>
```

Inheritance diagram for `CoinFileIOBase`:



Collaboration diagram for CoinFileIOBase:



#### Public Member Functions

- [CoinFileIOBase](#) (const std::string &fileName)  
*Constructor.*
- [~CoinFileIOBase](#) ()  
*Destructor.*
- const char \* [getFileName](#) () const  
*Return the name of the file used by this object.*
- std::string [getReadType](#) () const  
*Return the method of reading being used.*

#### 8.23.1 Detailed Description

Base class for FileIO classes.

Definition at line 11 of file CoinFileIO.hpp.

#### 8.23.2 Constructor & Destructor Documentation

##### 8.23.2.1 CoinFileIOBase::CoinFileIOBase ( const std::string & fileName )

Constructor.

**Parameters**

<i>fileName</i> The name of the file used by this object.
---

The documentation for this class was generated from the following file:

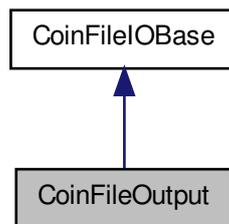
- CoinFileIO.hpp

**8.24 CoinFileOutput Class Reference**

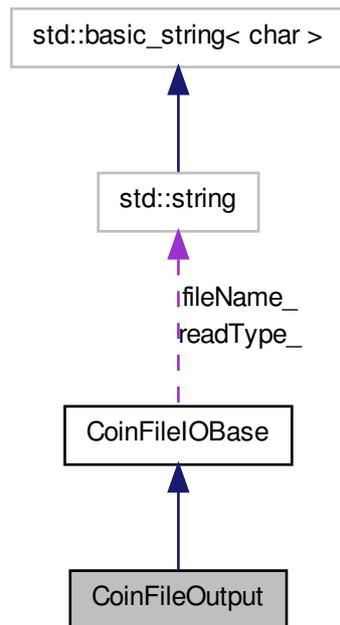
Abstract base class for file output classes.

```
#include <CoinFileIO.hpp>
```

Inheritance diagram for CoinFileOutput:



Collaboration diagram for CoinFileOutput:



### Public Types

- enum `Compression` { `COMPRESS_NONE = 0`, `COMPRESS_GZIP = 1`, `COMPRESS_BZIP2 = 2` }

*The compression method.*

### Public Member Functions

- `CoinFileOutput` (const `std::string` &fileName)  
*Constructor (don't use this, use the create method instead).*
- virtual `~CoinFileOutput` ()  
*Destructor.*
- virtual int `write` (const void \*buffer, int size)=0  
*Write a block of data to the file, similar to fwrite.*
- virtual bool `puts` (const char \*s)  
*Write a string to the file (like fputs).*

- bool [puts](#) (const std::string &s)  
*Convenience method: just a 'puts(s.c\_str())'.*

#### Static Public Member Functions

- static bool [compressionSupported](#) ([Compression](#) compression)  
*Returns whether the specified compression method is supported (i.e.*
- static [CoinFileOutput](#) \* [create](#) (const std::string &fileName, [Compression](#) compression)  
*Factory method, that creates a [CoinFileOutput](#) (more precisely a subclass of it) for the file specified.*

#### 8.24.1 Detailed Description

Abstract base class for file output classes.

Definition at line 80 of file CoinFileIO.hpp.

#### 8.24.2 Member Enumeration Documentation

##### 8.24.2.1 enum [CoinFileOutput::Compression](#)

The compression method.

#### Enumerator:

- COMPRESS\_NONE*** No compression.
- COMPRESS\_GZIP*** gzip compression.
- COMPRESS\_BZIP2*** bzip2 compression.

Definition at line 85 of file CoinFileIO.hpp.

#### 8.24.3 Constructor & Destructor Documentation

##### 8.24.3.1 [CoinFileOutput::CoinFileOutput](#) ( const std::string & *fileName* )

Constructor (don't use this, use the create method instead).

#### Parameters

<i>fileName</i>	The name of the file used by this object.
-----------------	---

#### 8.24.4 Member Function Documentation

8.24.4.1 `static bool CoinFileOutput::compressionSupported ( Compression compression )`  
`[static]`

Returns whether the specified compression method is supported (i.e. was compiled into COIN).

8.24.4.2 `static CoinFileOutput* CoinFileOutput::create ( const std::string & fileName, Compression compression )` `[static]`

Factory method, that creates a [CoinFileOutput](#) (more precisely a subclass of it) for the file specified.

If the compression method is not supported an exception is thrown (so use `compressionSupported` first, if this is a problem). The reason for not providing direct access to the subclasses (and using such a method instead) is that depending on the build configuration some of the classes are not available (or functional). This way we can handle all required `ifdefs` here instead of polluting other files.

#### Parameters

<i>fileName</i>	The file that should be read.
<i>compression</i>	Compression method used.

8.24.4.3 `virtual int CoinFileOutput::write ( const void * buffer, int size )` `[pure virtual]`

Write a block of data to the file, similar to `fwrite`.

#### Parameters

<i>buffer</i>	Address of a buffer containing the data to be written.
<i>size</i>	Number of bytes to write.

#### Returns

Number of bytes written.

8.24.4.4 `virtual bool CoinFileOutput::puts ( const char * s )` `[virtual]`

Write a string to the file (like `fputs`).

Just as with `fputs` no trailing newline is inserted! The terminating `'\0'` is not written to the file. The default implementation determines the length of the string and calls `write` on it.

#### Parameters

<i>s</i>	The zero terminated string to be written.
----------	---

#### Returns

true on success, false on error.

The documentation for this class was generated from the following file:

- CoinFileIO.hpp

## 8.25 CoinFirstAbsGreater\_2< S, T > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

### Public Member Functions

- bool `operator()` (`CoinPair`< S, T > t1, `CoinPair`< S, T > t2) const  
*Compare function.*

#### 8.25.1 Detailed Description

```
template<class S, class T>class CoinFirstAbsGreater_2< S, T >
```

Function operator.

Returns true if `abs(t1.first) > abs(t2.first)` (i.e., decreasing).

Definition at line 85 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- CoinSort.hpp

## 8.26 CoinFirstAbsGreater\_3< S, T, U > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

### Public Member Functions

- bool `operator()` (const `CoinTriple`< S, T, U > &t1, const `CoinTriple`< S, T, U > &t2) const  
*Compare function.*

#### 8.26.1 Detailed Description

```
template<class S, class T, class U>class CoinFirstAbsGreater_3< S, T, U >
```

Function operator.

Returns true if `abs(t1.first) > abs(t2.first)` (i.e., decreasing).

Definition at line 416 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

## 8.27 CoinFirstAbsLess\_2< S, T > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

### Public Member Functions

- `bool operator()` (const `CoinPair`< S, T > &t1, const `CoinPair`< S, T > &t2) const

*Compare function.*

### 8.27.1 Detailed Description

```
template<class S, class T>class CoinFirstAbsLess_2< S, T >
```

Function operator.

Returns true if `abs(t1.first) < abs(t2.first)` (i.e., increasing).

Definition at line 70 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

## 8.28 CoinFirstAbsLess\_3< S, T, U > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

### Public Member Functions

- `bool operator()` (const `CoinTriple`< S, T, U > &t1, const `CoinTriple`< S, T, U > &t2) const

*Compare function.*

### 8.28.1 Detailed Description

```
template<class S, class T, class U>class CoinFirstAbsLess_3< S, T, U >
```

Function operator.

Returns true if `abs(t1.first) < abs(t2.first)` (i.e., increasing).

Definition at line 401 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

## 8.29 CoinFirstGreater\_2< S, T > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

### Public Member Functions

- `bool operator()` (const `CoinPair< S, T >` &t1, const `CoinPair< S, T >` &t2) const

*Compare function.*

### 8.29.1 Detailed Description

```
template<class S, class T>class CoinFirstGreater_2< S, T >
```

Function operator.

Returns true if `t1.first > t2.first` (i.e, decreasing).

Definition at line 59 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

## 8.30 CoinFirstGreater\_3< S, T, U > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

### Public Member Functions

- `bool operator()` (const `CoinTriple< S, T, U >` &t1, const `CoinTriple< S, T, U >` &t2) const

*Compare function.*

#### 8.30.1 Detailed Description

```
template<class S, class T, class U>class CoinFirstGreater_3< S, T, U >
```

Function operator.

Returns true if `t1.first > t2.first` (i.e, decreasing).

Definition at line 390 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

### 8.31 CoinFirstLess\_2< S, T > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

#### Public Member Functions

- `bool operator()` (const `CoinPair< S, T >` &t1, const `CoinPair< S, T >` &t2) const

*Compare function.*

#### 8.31.1 Detailed Description

```
template<class S, class T>class CoinFirstLess_2< S, T >
```

Function operator.

Returns true if `t1.first < t2.first` (i.e., increasing).

Definition at line 48 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

### 8.32 CoinFirstLess\_3< S, T, U > Class Template Reference

Function operator.

```
#include <CoinSort.hpp>
```

### Public Member Functions

- bool `operator()` (const `CoinTriple`< S, T, U > &t1, const `CoinTriple`< S, T, U > &t2) const

*Compare function.*

#### 8.32.1 Detailed Description

```
template<class S, class T, class U>class CoinFirstLess_3< S, T, U >
```

Function operator.

Returns true if `t1.first < t2.first` (i.e., increasing).

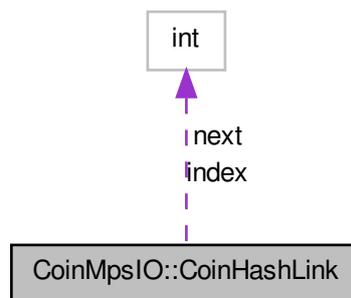
Definition at line 379 of file `CoinSort.hpp`.

The documentation for this class was generated from the following file:

- `CoinSort.hpp`

### 8.33 CoinMpsIO::CoinHashLink Struct Reference

Collaboration diagram for `CoinMpsIO::CoinHashLink`:



#### 8.33.1 Detailed Description

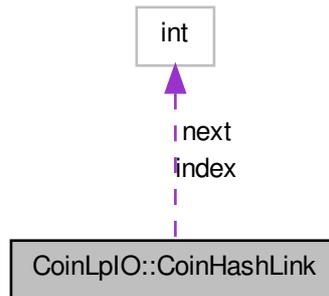
Definition at line 894 of file `CoinMpsIO.hpp`.

The documentation for this struct was generated from the following file:

- `CoinMpsIO.hpp`

### 8.34 CoinLpIO::CoinHashLink Struct Reference

Collaboration diagram for CoinLpIO::CoinHashLink:



#### 8.34.1 Detailed Description

Definition at line 572 of file CoinLpIO.hpp.

The documentation for this struct was generated from the following file:

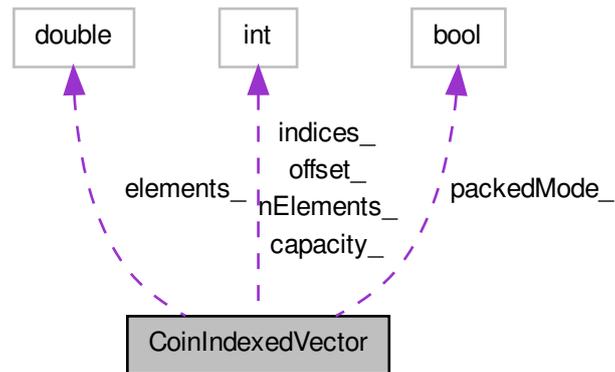
- CoinLpIO.hpp

### 8.35 CoinIndexedVector Class Reference

Indexed Vector.

```
#include <CoinIndexedVector.hpp>
```

Collaboration diagram for CoinIndexedVector:



### Public Member Functions

#### Get methods.

- int [getNumElements](#) () const  
*Get the size.*
- const int \* [getIndices](#) () const  
*Get indices of elements.*
- int \* [getIndices](#) ()  
*Get element values.*
- double \* [denseVector](#) () const  
*Get the vector as a dense vector.*
- void [setDenseVector](#) (double \*array)  
*For very temporary use when user needs to borrow a dense vector.*
- void [setIndexVector](#) (int \*array)  
*For very temporary use when user needs to borrow an index vector.*
- double & [operator\[\]](#) (int i) const  
*Access the i'th element of the full storage vector.*

#### Set methods

- void [setNumElements](#) (int value)  
*Set the size.*
- void [clear](#) ()  
*Reset the vector (as if were just created an empty vector). This leaves arrays!*
- void [empty](#) ()

- Reset the vector (as if were just created an empty vector)*

  - `CoinIndexedVector & operator=` (const `CoinIndexedVector &`)  
*Assignment operator.*
  - `CoinIndexedVector & operator=` (const `CoinPackedVectorBase &rhs`)  
*Assignment operator from a `CoinPackedVectorBase`.*
  - void `copy` (const `CoinIndexedVector &rhs`, double multiplier=1.0)  
*Copy the contents of one vector into another.*
  - void `borrowVector` (int size, int numberIndices, int \*inds, double \*elems)  
*Borrow ownership of the arguments to this vector.*
  - void `returnVector` ()  
*Return ownership of the arguments to this vector.*
  - void `setVector` (int numberIndices, const int \*inds, const double \*elems)  
*Set vector numberIndices, indices, and elements.*
  - void `setVector` (int size, int numberIndices, const int \*inds, const double \*elems)  
*Set vector size, indices, and elements.*
- void `setConstant` (int size, const int \*inds, double elems)  
*Elements set to have the same scalar value.*
- void `setFull` (int size, const double \*elems)  
*Indices are not specified and are taken to be 0,1,...,size-1.*
- void `setElement` (int index, double element)  
*Set an existing element in the indexed vector The first argument is the "index" into the elements() array.*
- void `insert` (int index, double element)  
*Insert an element into the vector.*
- void `quickInsert` (int index, double element)  
*Insert a nonzero element into the vector.*
- void `add` (int index, double element)  
*Insert or if exists add an element into the vector Any resulting zero elements will be made tiny.*
- void `quickAdd` (int index, double element)  
*Insert or if exists add an element into the vector Any resulting zero elements will be made tiny.*
- void `quickAddNonZero` (int index, double element)  
*Insert or if exists add an element into the vector Any resulting zero elements will be made tiny.*
- void `zero` (int index)  
*Makes nonzero tiny.*
- int `clean` (double tolerance)  
*set all small values to zero and return number remaining*
- int `cleanAndPack` (double tolerance)  
*Same but packs down.*
- int `cleanAndPackSafe` (double tolerance)  
*Same but packs down and is safe (i.e. if order is odd)*
- void `setPacked` ()  
*Mark as packed.*
- void `checkClear` ()  
*For debug check vector is clear i.e. no elements.*
- void `checkClean` ()

- For debug check vector is clean i.e. elements match indices.*
- int `scan` ()
  - Scan dense region and set up indices (returns number found)*
- int `scan` (int start, int end)
  - Scan dense region from start to < end and set up indices returns number found.*
- int `scan` (double tolerance)
  - Scan dense region and set up indices (returns number found).*
- int `scan` (int start, int end, double tolerance)
  - Scan dense region from start to < end and set up indices returns number found.*
- int `scanAndPack` ()
  - These are same but pack down.*
- int `scanAndPack` (int start, int end)
- int `scanAndPack` (double tolerance)
- int `scanAndPack` (int start, int end, double tolerance)
- void `createPacked` (int number, const int \*indices, const double \*elements)
  - Create packed array.*
- void `expand` ()
  - This is mainly for testing - goes from packed to indexed.*
- void `append` (const `CoinPackedVectorBase` &caboose)
  - Append a `CoinPackedVector` to the end.*
- void `append` (const `CoinIndexedVector` &caboose)
  - Append a `CoinIndexedVector` to the end.*
- void `swap` (int i, int j)
  - Swap values in positions i and j of indices and elements.*
- void `truncate` (int newSize)
  - Throw away all entries in rows >= newSize.*
- void `print` () const
  - Print out.*

#### Arithmetic operators.

- void `operator+=` (double value)
  - add value to every entry*
- void `operator-=` (double value)
  - subtract value from every entry*
- void `operator*=` (double value)
  - multiply every entry by value*
- void `operator/=` (double value)
  - divide every entry by value (\*\* 0 vanishes)*

#### Comparison operators on two indexed vectors

- bool `operator==` (const `CoinPackedVectorBase` &rhs) const
  - Equal.*
- bool `operator!=` (const `CoinPackedVectorBase` &rhs) const
  - Not equal.*
- bool `operator==` (const `CoinIndexedVector` &rhs) const
  - Equal.*
- bool `operator!=` (const `CoinIndexedVector` &rhs) const
  - Not equal.*

## Index methods

- int `getMaxIndex ()` const  
*Get value of maximum index.*
- int `getMinIndex ()` const  
*Get value of minimum index.*

## Sorting

- void `sort ()`  
*Sort the indexed storage vector (increasing indices).*
- void `sortIncrIndex ()`
- void `sortDecrIndex ()`
- void `sortIncrElement ()`
- void `sortDecrElement ()`

## Arithmetic operators on packed vectors.

**NOTE:** These methods operate on those positions where at least one of the arguments has a value listed.

At those positions the appropriate operation is executed, Otherwise the result of the operation is considered 0.

**NOTE 2:** Because these methods return an object (they can't return a reference, though they could return a pointer...) they are very inefficient...

- `CoinIndexedVector operator+ (const CoinIndexedVector &op2)`  
*Return the sum of two indexed vectors.*
- `CoinIndexedVector operator- (const CoinIndexedVector &op2)`  
*Return the difference of two indexed vectors.*
- `CoinIndexedVector operator* (const CoinIndexedVector &op2)`  
*Return the element-wise product of two indexed vectors.*
- `CoinIndexedVector operator/ (const CoinIndexedVector &op2)`  
*Return the element-wise ratio of two indexed vectors (0.0/0.0 => 0.0) (0 vanishes)*
- void `operator+= (const CoinIndexedVector &op2)`  
*The sum of two indexed vectors.*
- void `operator-= (const CoinIndexedVector &op2)`  
*The difference of two indexed vectors.*
- void `operator*= (const CoinIndexedVector &op2)`  
*The element-wise product of two indexed vectors.*
- void `operator/= (const CoinIndexedVector &op2)`  
*The element-wise ratio of two indexed vectors (0.0/0.0 => 0.0) (0 vanishes)*

## Memory usage

- void `reserve (int n)`  
*Reserve space.*
- int `capacity ()` const  
*capacity returns the size which could be accomodated without having to reallocate storage.*
- void `setPackedMode (bool yesNo)`  
*Sets packed mode.*
- bool `packedMode ()` const  
*Gets packed mode.*

**Constructors and destructors**

- [CoinIndexedVector](#) ()  
*Default constructor.*
- [CoinIndexedVector](#) (int size, const int \*inds, const double \*elems)  
*Alternate Constructors - set elements to vector of doubles.*
- [CoinIndexedVector](#) (int size, const int \*inds, double element)  
*Alternate Constructors - set elements to same scalar value.*
- [CoinIndexedVector](#) (int size, const double \*elements)  
*Alternate Constructors - construct full storage with indices 0 through size-1.*
- [CoinIndexedVector](#) (int size)  
*Alternate Constructors - just size.*
- [CoinIndexedVector](#) (const [CoinIndexedVector](#) &)  
*Copy constructor.*
- [CoinIndexedVector](#) (const [CoinIndexedVector](#) \*)  
*Copy constructor.2.*
- [CoinIndexedVector](#) (const [CoinPackedVectorBase](#) &rhs)  
*Copy constructor from a PackedVectorBase.*
- [~CoinIndexedVector](#) ()  
*Destructor.*

**Friends**

- void [CoinIndexedVectorUnitTest](#) ()  
*A function that tests the methods in the [CoinIndexedVector](#) class.*

**8.35.1 Detailed Description**

Indexed Vector.

This stores values unpacked but apart from that is a bit like [CoinPackedVector](#). It is designed to be lightweight in normal use.

It now has a "packed" mode when it is even more like [CoinPackedVector](#)

Indices array has capacity\_ extra chars which are zeroed and can be used for any purpose - but must be re-zeroed

Stores vector of indices and associated element values. Supports sorting of indices.

Does not support negative indices.

Does NOT support testing for duplicates

getElements is no longer supported

Here is a sample usage:

```
const int ne = 4;
int inx[ne] = { 1, 4, 0, 2 }
double el[ne] = { 10., 40., 1., 50. }

// Create vector and set its value1
```

```
CoinIndexedVector r(ne,inx,el);

// access as a full storage vector
assert( r[ 0]==1. );
assert( r[ 1]==10.);
assert( r[ 2]==50.);
assert( r[ 3]==0. );
assert( r[ 4]==40.);

// sort Elements in increasing order
r.sortIncrElement();

// access each index and element
assert( r.getIndices () [0]== 0 );
assert( r.getIndices () [1]== 1 );
assert( r.getIndices () [2]== 4 );
assert( r.getIndices () [3]== 2 );

// access as a full storage vector
assert( r[ 0]==1. );
assert( r[ 1]==10.);
assert( r[ 2]==50.);
assert( r[ 3]==0. );
assert( r[ 4]==40.);

// Tests for equality and equivalence
CoinIndexedVector r1;
r1=r;
assert( r==r1 );
assert( r.equivalent(r1) );
r.sortIncrElement();
assert( r!=r1 );
assert( r.equivalent(r1) );

// Add indexed vectors.
// Similarly for subtraction, multiplication,
// and division.
CoinIndexedVector add = r + r1;
assert( add[0] == 1.+ 1. );
assert( add[1] == 10.+10. );
assert( add[2] == 50.+50. );
assert( add[3] == 0.+ 0. );
assert( add[4] == 40.+40. );

assert( r.sum() == 10.+40.+1.+50. );
```

Definition at line 104 of file CoinIndexedVector.hpp.

### 8.35.2 Constructor & Destructor Documentation

#### 8.35.2.1 CoinIndexedVector::CoinIndexedVector ( int *size*, const double \* *elements* )

Alternate Constructors - construct full storage with indices 0 through size-1.

#### 8.35.2.2 CoinIndexedVector::CoinIndexedVector ( const CoinIndexedVector & )

Copy constructor.

## 8.35.2.3 CoinIndexedVector::CoinIndexedVector ( const CoinPackedVectorBase &amp; rhs )

Copy constructor *from a PackedVectorBase*.

## 8.35.3 Member Function Documentation

## 8.35.3.1 int\* CoinIndexedVector::getIndices ( ) [inline]

Get element values.

Get indices of elements

Definition at line 117 of file CoinIndexedVector.hpp.

## 8.35.3.2 double\* CoinIndexedVector::denseVector ( ) const [inline]

Get the vector as a dense vector.

This is normal storage method. The user should not not delete [] this.

Definition at line 121 of file CoinIndexedVector.hpp.

## 8.35.3.3 CoinIndexedVector&amp; CoinIndexedVector::operator= ( const CoinIndexedVector &amp; )

Assignment operator.

## 8.35.3.4 CoinIndexedVector&amp; CoinIndexedVector::operator= ( const CoinPackedVectorBase &amp; rhs )

Assignment operator from a [CoinPackedVectorBase](#).

**NOTE:** This assumes no duplicates

## 8.35.3.5 void CoinIndexedVector::copy ( const CoinIndexedVector &amp; rhs, double multiplier = 1.0 )

Copy the contents of one vector into another.

If multiplier is 1 It is the equivalent of = but if vectors are same size does not re-allocate memory just clears and copies

## 8.35.3.6 void CoinIndexedVector::borrowVector ( int size, int numberIndices, int \* inds, double \* elems )

Borrow ownership of the arguments to this vector.

Size is the length of the unpacked elements vector.

## 8.35.3.7 void CoinIndexedVector::returnVector ( )

Return ownership of the arguments to this vector.

State after is empty .

**8.35.3.8** void CoinIndexedVector::setVector ( int *numberIndices*, const int \* *inds*, const double \* *elems* )

Set vector numberIndices, indices, and elements.

NumberIndices is the length of both the indices and elements vectors. The indices and elements vectors are copied into this class instance's member data. Assumed to have no duplicates

**8.35.3.9** void CoinIndexedVector::setVector ( int *size*, int *numberIndices*, const int \* *inds*, const double \* *elems* )

Set vector size, indices, and elements.

Size is the length of the unpacked elements vector. The indices and elements vectors are copied into this class instance's member data. We do not check for duplicate indices

**8.35.3.10** void CoinIndexedVector::quickAdd ( int *index*, double *element* ) [inline]

Insert or if exists add an element into the vector Any resulting zero elements will be made tiny.

This version does no checking

Definition at line 206 of file CoinIndexedVector.hpp.

**8.35.3.11** void CoinIndexedVector::quickAddNonZero ( int *index*, double *element* ) [inline]

Insert or if exists add an element into the vector Any resulting zero elements will be made tiny.

This knows element is nonzero This version does no checking

Definition at line 225 of file CoinIndexedVector.hpp.

**8.35.3.12** void CoinIndexedVector::zero ( int *index* ) [inline]

Makes nonzero tiny.

This version does no checking

Definition at line 243 of file CoinIndexedVector.hpp.

**8.35.3.13** int CoinIndexedVector::clean ( double *tolerance* )

set all small values to zero and return number remaining

- < tolerance => 0.0

**8.35.3.14** int CoinIndexedVector::scan ( double *tolerance* )

Scan dense region and set up indices (returns number found).

Only ones >= tolerance

8.35.3.15 `int CoinIndexedVector::scan ( int start, int end, double tolerance )`

Scan dense region from start to < end and set up indices returns number found.

Only  $\geq$  tolerance

8.35.3.16 `bool CoinIndexedVector::operator==( const CoinPackedVectorBase & rhs ) const`

Equal.

Returns true if vectors have same length and corresponding element of each vector is equal.

8.35.3.17 `bool CoinIndexedVector::operator==( const CoinIndexedVector & rhs ) const`

Equal.

Returns true if vectors have same length and corresponding element of each vector is equal.

8.35.3.18 `void CoinIndexedVector::sort ( ) [inline]`

Sort the indexed storage vector (increasing indices).

Definition at line 340 of file CoinIndexedVector.hpp.

8.35.3.19 `void CoinIndexedVector::reserve ( int n )`

Reserve space.

If one knows the eventual size of the indexed vector, then it may be more efficient to reserve the space.

#### 8.35.4 Friends And Related Function Documentation

8.35.4.1 `void CoinIndexedVectorUnitTest ( ) [friend]`

A function that tests the methods in the [CoinIndexedVector](#) class.

The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging.

The documentation for this class was generated from the following file:

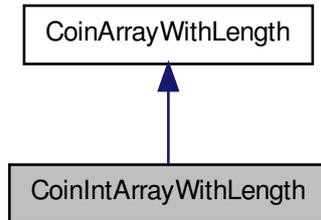
- CoinIndexedVector.hpp

## 8.36 CoinIntArrayWithLength Class Reference

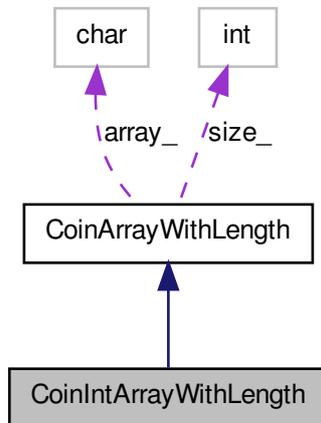
int \* version

```
#include <CoinIndexedVector.hpp>
```

Inheritance diagram for CoinIntArrayWithLength:



Collaboration diagram for CoinIntArrayWithLength:



#### Public Member Functions

##### Get methods.

- int [getSize](#) () const  
*Get the size.*
- int \* [array](#) () const  
*Get Array.*

#### Set methods

- void `setSize` (int value)  
*Set the size.*

#### Condition methods

- int \* `conditionalNew` (int sizeWanted)  
*Conditionally gets new array.*

#### Constructors and destructors

- `CoinIntArrayWithLength` ()  
*Default constructor - NULL.*
- `CoinIntArrayWithLength` (int size)  
*Alternate Constructor - length in bytes - size\_ -1.*
- `CoinIntArrayWithLength` (int size, int mode)  
*Alternate Constructor - length in bytes mode - 0 size\_ set to size 1 size\_ set to size and zeroed.*
- `CoinIntArrayWithLength` (const `CoinIntArrayWithLength` &rhs)  
*Copy constructor.*
- `CoinIntArrayWithLength` (const `CoinIntArrayWithLength` \*rhs)  
*Copy constructor.2.*
- `CoinIntArrayWithLength` & `operator=` (const `CoinIntArrayWithLength` &rhs)  
*Assignment operator.*

#### 8.36.1 Detailed Description

int \* version

Definition at line 696 of file `CoinIndexedVector.hpp`.

#### 8.36.2 Constructor & Destructor Documentation

##### 8.36.2.1 `CoinIntArrayWithLength::CoinIntArrayWithLength ( const CoinIntArrayWithLength & rhs ) [inline]`

Copy constructor.

Definition at line 738 of file `CoinIndexedVector.hpp`.

#### 8.36.3 Member Function Documentation

##### 8.36.3.1 `CoinIntArrayWithLength& CoinIntArrayWithLength::operator= ( const CoinIntArrayWithLength & rhs ) [inline]`

Assignment operator.

Definition at line 744 of file `CoinIndexedVector.hpp`.

The documentation for this class was generated from the following file:

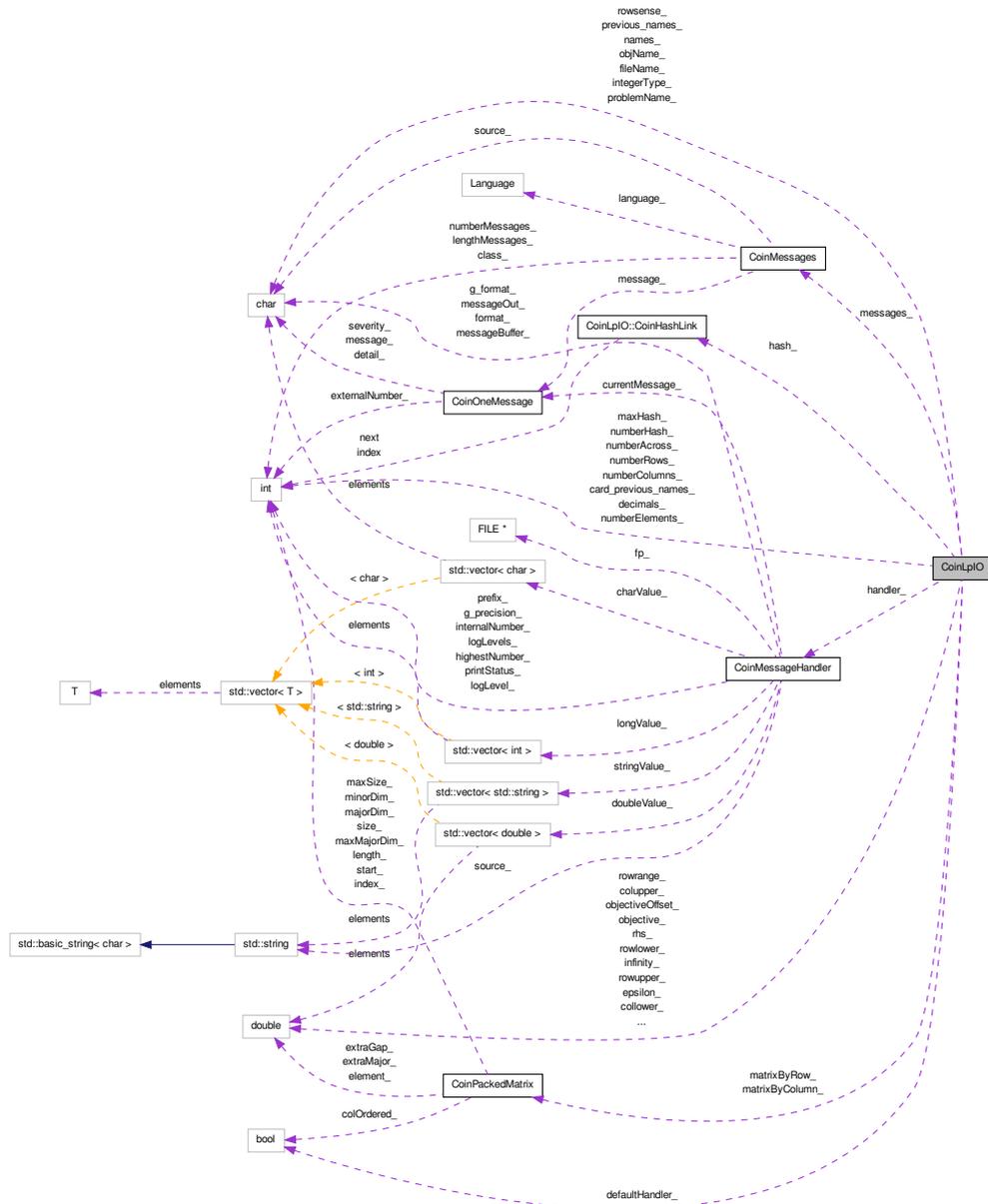
- `CoinIndexedVector.hpp`

### 8.37 CoinLpIO Class Reference

Class to read and write Lp files.

```
#include <CoinLpIO.hpp>
```

Collaboration diagram for CoinLpIO:



## Classes

- struct [CoinHashLink](#)

## Public Member Functions

- void [convertBoundToSense](#) (const double lower, const double upper, char &sense, double &right, double &range) const  
*A quick inlined function to convert from lb/ub style constraint definition to sense/rhs/range style.*

## Constructor and Destructor

- [CoinLpIO](#) ()  
*Default Constructor.*
- [~CoinLpIO](#) ()  
*Destructor.*
- void [freePreviousNames](#) (const int section)  
*Free the vector previous\_names\_[section] and set card\_previous\_names\_[section] to 0.*
- void [freeAll](#) ()  
*Free all memory (except memory related to hash tables and objName\_).*

## Queries

- const char \* [getProblemName](#) () const  
*Get the problem name.*
- void [setProblemName](#) (const char \*name)  
*Set problem name.*
- int [getNumCols](#) () const  
*Get number of columns.*
- int [getNumRows](#) () const  
*Get number of rows.*
- int [getNumElements](#) () const  
*Get number of nonzero elements.*
- const double \* [getColLower](#) () const  
*Get pointer to array[getNumCols()] of column lower bounds.*
- const double \* [getColUpper](#) () const  
*Get pointer to array[getNumCols()] of column upper bounds.*
- const double \* [getRowLower](#) () const  
*Get pointer to array[getNumRows()] of row lower bounds.*
- const double \* [getRowUpper](#) () const  
*Get pointer to array[getNumRows()] of row upper bounds.*
- const char \* [getRowSense](#) () const  
*Get pointer to array[getNumRows()] of constraint senses.*
- const double \* [getRightHandSide](#) () const  
*Get pointer to array[getNumRows()] of constraint right-hand sides.*
- const double \* [getRowRange](#) () const

- Get pointer to array[[getNumRows\(\)](#)] of row ranges.
- const double \* [getObjCoefficients](#) () const
  - Get pointer to array[[getNumCols\(\)](#)] of objective function coefficients.
- const [CoinPackedMatrix](#) \* [getMatrixByRow](#) () const
  - Get pointer to row-wise copy of the coefficient matrix.
- const [CoinPackedMatrix](#) \* [getMatrixByCol](#) () const
  - Get pointer to column-wise copy of the coefficient matrix.
- const char \* [getObjName](#) () const
  - Get objective function name.
- void [getPreviousRowNames](#) (char const \*const \*prev, int \*card\_prev) const
  - Get pointer to array[\*card\_prev] of previous row names.
- void [getPreviousColNames](#) (char const \*const \*prev, int \*card\_prev) const
  - Get pointer to array[\*card\_prev] of previous column names.
- char const \*const [getRowNames](#) () const
  - Get pointer to array[[getNumRows\(\)](#)+1] of row names, including objective function name as last entry.
- char const \*const [getColNames](#) () const
  - Get pointer to array[[getNumCols\(\)](#)] of column names.
- const char \* [rowName](#) (int index) const
  - Return the row name for the specified index.
- const char \* [columnName](#) (int index) const
  - Return the column name for the specified index.
- int [rowIndex](#) (const char \*name) const
  - Return the index for the specified row name.
- int [columnIndex](#) (const char \*name) const
  - Return the index for the specified column name.
- double [objectiveOffset](#) () const
  - Returns the (constant) objective offset.
- void [setObjectiveOffset](#) (double value)
  - Set objective offset.
- bool [isInteger](#) (int columnNumber) const
  - Return true if a column is an integer (binary or general integer) variable.
- const char \* [integerColumns](#) () const
  - Get characteristic vector of integer variables.

#### Parameters

- double [getInfinity](#) () const
  - Get infinity.
- void [setInfinity](#) (const double)
  - Set infinity.
- double [getEpsilon](#) () const
  - Get epsilon.
- void [setEpsilon](#) (const double)
  - Set epsilon.
- int [getNumberAcross](#) () const
  - Get numberAcross, the number of monomials to be printed per line.
- void [setNumberAcross](#) (const int)
  - Set numberAcross.
- int [getDecimals](#) () const
  - Get decimals, the number of digits to write after the decimal point.
- void [setDecimals](#) (const int)
  - Set decimals.

## Public methods

- void [setLpDataWithoutRowAndColNames](#) (const [CoinPackedMatrix](#) &m, const double \*collb, const double \*colub, const double \*obj\_coeff, const char \*integrality, const double \*rowlb, const double \*rowub)  
*Set the data of the object.*
- int [is\\_invalid\\_name](#) (const char \*buff, const bool ranged) const  
*Return 0 if buff is a valid name for a row, a column or objective function, return a positive number otherwise.*
- int [are\\_invalid\\_names](#) (char const \*const \*vnames, const int card\_vnames, const bool check\_ranged) const  
*Return 0 if each of the card\_vnames entries of vnames is a valid name, return a positive number otherwise.*
- void [setDefaultRowNames](#) ()  
*Set objective function name to the default "obj" and row names to the default "cons0", "cons1", ...*
- void [setDefaultColNames](#) ()  
*Set column names to the default "x0", "x1", ...*
- void [setLpDataRowAndColNames](#) (char const \*const \*const rownames, char const \*const \*const colnames)  
*Set the row and column names.*
- int [writeLp](#) (const char \*filename, const double epsilon, const int numberAcross, const int decimals, const bool useRowNames=true)  
*Write the data in Lp format in the file with name filename.*
- int [writeLp](#) (FILE \*fp, const double epsilon, const int numberAcross, const int decimals, const bool useRowNames=true)  
*Write the data in Lp format in the file pointed to by the parameter fp.*
- int [writeLp](#) (const char \*filename, const bool useRowNames=true)  
*Write the data in Lp format in the file with name filename.*
- int [writeLp](#) (FILE \*fp, const bool useRowNames=true)  
*Write the data in Lp format in the file pointed to by the parameter fp.*
- void [readLp](#) (const char \*filename, const double epsilon)  
*Read the data in Lp format from the file with name filename, using the given value for epsilon.*
- void [readLp](#) (const char \*filename)  
*Read the data in Lp format from the file with name filename.*
- void [readLp](#) (FILE \*fp, const double epsilon)  
*Read the data in Lp format from the file stream, using the given value for epsilon.*
- void [readLp](#) (FILE \*fp)  
*Read the data in Lp format from the file stream.*
- void [print](#) () const  
*Dump the data. Low level method for debugging.*

## Message handling

- void [passInMessageHandler](#) ([CoinMessageHandler](#) \*handler)  
*Pass in Message handler.*
- void [newLanguage](#) ([CoinMessages::Language](#) language)  
*Set the language for messages.*
- void [setLanguage](#) ([CoinMessages::Language](#) language)  
*Set the language for messages.*

- `CoinMessageHandler * messageHandler ()` const  
*Return the message handler.*
- `CoinMessages messages ()`  
*Return the messages.*
- `CoinMessages * messagesPointer ()`  
*Return the messages pointer.*

#### Protected Member Functions

- void `startHash` (char const \*const \*const names, const COINColumnIndex number, int section)  
*Build the hash table for the given names.*
- void `stopHash` (int section)  
*Delete hash storage.*
- COINColumnIndex `findHash` (const char \*name, int section) const  
*Return the index of the given name, return -1 if the name is not found.*
- void `insertHash` (const char \*thisName, int section)  
*Insert thisName in the hash table if not present yet; does nothing if the name is already in.*
- void `out_coeff` (FILE \*fp, double v, int print\_1) const  
*Write a coefficient.*
- int `find_obj` (FILE \*fp) const  
*Locate the objective function.*
- int `is_subject_to` (const char \*buff) const  
*Return an integer indicating if the keyword "subject to" or one of its variants has been read.*
- int `first_is_number` (const char \*buff) const  
*Return 1 if the first character of buff is a number.*
- int `is_comment` (const char \*buff) const  
*Return 1 if the first character of buff is '/' or '^'.*
- void `skip_comment` (char \*buff, FILE \*fp) const  
*Read the file fp until buff contains an end of line.*
- void `scan_next` (char \*buff, FILE \*fp) const  
*Put in buff the next string that is not part of a comment.*
- int `is_free` (const char \*buff) const  
*Return 1 if buff is the keyword "free" or one of its variants.*
- int `is_inf` (const char \*buff) const  
*Return 1 if buff is the keyword "inf" or one of its variants.*
- int `is_sense` (const char \*buff) const  
*Return an integer indicating the inequality sense read.*
- int `is_keyword` (const char \*buff) const  
*Return an integer indicating if one of the keywords "Bounds", "Integers", "Generals", "Binaries", "End", or one of their variants has been read.*
- int `read_monom_obj` (FILE \*fp, double \*coeff, char \*\*name, int \*cnt, char \*\*obj\_name)

*Read a monomial of the objective function.*

- int [read\\_monom\\_row](#) (FILE \*fp, char \*start\_str, double \*coeff, char \*\*name, int cnt\_coeff) const

*Read a monomial of a constraint.*

- void [realloc\\_coeff](#) (double \*\*coeff, char \*\*\*colNames, int \*maxcoeff) const

*Reallocate vectors related to number of coefficients.*

- void [realloc\\_row](#) (char \*\*\*rowNames, int \*\*start, double \*\*rhs, double \*\*rowlow, double \*\*rowup, int \*maxrow) const

*Reallocate vectors related to rows.*

- void [realloc\\_col](#) (double \*\*collow, double \*\*colup, char \*\*is\_int, int \*maxcol) const

*Reallocate vectors related to columns.*

- void [read\\_row](#) (FILE \*fp, char \*buff, double \*\*pcoeff, char \*\*\*pcolNames, int \*cnt\_coeff, int \*maxcoeff, double \*rhs, double \*rowlow, double \*rowup, int \*cnt\_row, double inf) const

*Read a constraint.*

- void [checkRowNames](#) ()

*Check that current objective name and all row names are distinct including row names obtained by adding "\_low" for ranged constraints.*

- void [checkColNames](#) ()

*Check that current column names are distinct.*

#### Protected Attributes

- char \* [problemName\\_](#)

*Problem name.*

- [CoinMessageHandler](#) \* [handler\\_](#)

*Message handler.*

- bool [defaultHandler\\_](#)

*Flag to say if the message handler is the default handler.*

- [CoinMessages](#) [messages\\_](#)

*Messages.*

- int [numberRows\\_](#)

*Number of rows.*

- int [numberColumns\\_](#)

*Number of columns.*

- int [numberElements\\_](#)

*Number of elements.*

- [CoinPackedMatrix](#) \* [matrixByColumn\\_](#)

*Pointer to column-wise copy of problem matrix coefficients.*

- [CoinPackedMatrix](#) \* [matrixByRow\\_](#)

*Pointer to row-wise copy of problem matrix coefficients.*

- double \* [rowlower\\_](#)

*Pointer to dense vector of row lower bounds.*

- double \* [rowupper\\_](#)  
*Pointer to dense vector of row upper bounds.*
- double \* [collower\\_](#)  
*Pointer to dense vector of column lower bounds.*
- double \* [colupper\\_](#)  
*Pointer to dense vector of column upper bounds.*
- double \* [rhs\\_](#)  
*Pointer to dense vector of row rhs.*
- double \* [rowrange\\_](#)  
*Pointer to dense vector of slack variable upper bounds for ranged constraints (undefined for non-ranged constraints)*
- char \* [rowsense\\_](#)  
*Pointer to dense vector of row senses.*
- double \* [objective\\_](#)  
*Pointer to dense vector of objective coefficients.*
- double [objectiveOffset\\_](#)  
*Constant offset for objective value.*
- char \* [integerType\\_](#)  
*Pointer to dense vector specifying if a variable is continuous (0) or integer (1).*
- char \* [fileName\\_](#)  
*Current file name.*
- double [infinity\\_](#)  
*Value to use for infinity.*
- double [epsilon\\_](#)  
*Value to use for epsilon.*
- int [numberAcross\\_](#)  
*Number of monomials printed in a row.*
- int [decimals\\_](#)  
*Number of decimals printed for coefficients.*
- char \* [objName\\_](#)  
*Objective function name.*
- char \*\* [previous\\_names\\_](#) [2]  
*Row names (including objective function name) and column names when [stopHash\(\)](#) for the corresponding section was last called or for initial names (deemed invalid) read from a file.*
- int [card\\_previous\\_names\\_](#) [2]  
*[card\\_previous\\_names\\_\[section\]](#) holds the number of entries in the vector [previous\\_names\\_\[section\]](#).*
- char \*\* [names\\_](#) [2]  
*Row names (including objective function name) and column names (linked to Hash tables).*
- int [maxHash\\_](#) [2]  
*Maximum number of entries in a hash table section.*
- int [numberHash\\_](#) [2]

*Number of entries in a hash table section.*

- [CoinHashLink](#) \* `hash_ [2]`

*Hash tables with two sections.*

### 8.37.1 Detailed Description

Class to read and write Lp files.

Lp file format:

/ this is a comment

\ this too

Min

obj:  $x_0 + x_1 + 3x_2 - 4.5x_{yr} + 1$

s.t.

cons1:  $x_0 - x_2 - 2.3x_4 \leq 4.2$  / this is another comment

c2:  $x_1 + x_2 \geq 1$

cc:  $x_1 + x_2 + x_{yr} = 2$

Bounds

$0 \leq x_1 \leq 3$

$1 \geq x_2$

$x_3 = 1$

$-2 \leq x_4 \leq \text{Inf}$

`xyr` free

Integers

`x0`

Generals

`x1` `xyr`

Binaries

`x2`

End

Notes:

- Keywords are: Min, Max, Minimize, Maximize, s.t., Subject To, Bounds, Integers, Generals, Binaries, End, Free, Inf.
- Keywords are not case sensitive and may be in plural or singular form. They should not be used as objective, row or column names.
- Bounds, Integers, Generals, Binaries sections are optional.

- Generals and Integers are synonymous.
- Bounds section (if any) must come before Integers, Generals, and Binaries sections.
- Row names must be followed by ':' without blank space. Row names are optional. If row names are present, they must be distinct (if the k-th constraint has no given name, its name is set automatically to "consk" for k=0,...). For valid row names, see the method [is\\_invalid\\_name\(\)](#).
- Column names must be followed by a blank space. They must be distinct. For valid column names, see the method [is\\_invalid\\_name\(\)](#).
- The objective function name must be followed by ':' without blank space. Objective function name is optional (if no objective function name is given, it is set to "obj" by default). For valid objective function names, see the method [is\\_invalid\\_name\(\)](#).
- Ranged constraints are written as two constraints. If a name is given for a ranged constraint, the upper bound constraint has that name and the lower bound constraint has that name with "\_low" as suffix. This should be kept in mind when assigning names to ranged constraint, as the resulting name must be distinct from all the other names and be considered valid by the method [is\\_invalid\\_name\(\)](#).
- At most one constant term may appear in the objective function; if present, it must appear last.
- Default bounds are 0 for lower bound and +infinity for upper bound.
- Free variables get default lower bound -infinity and default upper bound +infinity. Writing "x0 Free" in an LP file means "set lower bound on x0 to -infinity".
- If more than one upper (resp. lower) bound on a variable appears in the Bounds section, the last one is the one taken into account. The bounds for a binary variable are set to 0/1 only if this bound is stronger than the bound obtained from the Bounds section.
- Numbers larger than DBL\_MAX (or larger than 1e+400) in the input file might crash the code.
- A comment must start with '\#' or '/'. That symbol must either be the first character of a line or be preceded by a blank space. The comment ends at the end of the line. Comments are skipped while reading an Lp file and they may be inserted anywhere.

Definition at line 94 of file CoinLpIO.hpp.

### 8.37.2 Member Function Documentation

#### 8.37.2.1 void CoinLpIO::freePreviousNames ( const int *section* )

Free the vector `previous_names_[section]` and set `card_previous_names_[section]` to 0. `section = 0` for row names, `section = 1` for column names.

**8.37.2.2** `const char* CoinLpIO::getRowSense ( ) const`

Get pointer to array[[getNumRows\(\)](#)] of constraint senses.

- 'L':  $\leq$  constraint
- 'E': = constraint
- 'G':  $\geq$  constraint
- 'R': ranged constraint
- 'N': free constraint

**8.37.2.3** `const double* CoinLpIO::getRightHandSide ( ) const`

Get pointer to array[[getNumRows\(\)](#)] of constraint right-hand sides.

Given constraints with upper (rowupper) and/or lower (rowlower) bounds, the constraint right-hand side (rhs) is set as

- if `rowsense()[i] == 'L'` then `rhs()[i] == rowupper()[i]`
- if `rowsense()[i] == 'G'` then `rhs()[i] == rowlower()[i]`
- if `rowsense()[i] == 'R'` then `rhs()[i] == rowupper()[i]`
- if `rowsense()[i] == 'N'` then `rhs()[i] == 0.0`

**8.37.2.4** `const double* CoinLpIO::getRowRange ( ) const`

Get pointer to array[[getNumRows\(\)](#)] of row ranges.

Given constraints with upper (rowupper) and/or lower (rowlower) bounds, the constraint range (rowrange) is set as

- if `rowsense()[i] == 'R'` then `rowrange()[i] == rowupper()[i] - rowlower()[i]`
- if `rowsense()[i] != 'R'` then `rowrange()[i]` is 0.0

Put another way, only ranged constraints have a nontrivial value for rowrange.

**8.37.2.5** `void CoinLpIO::getPreviousRowNames ( char const *const * prev, int * card_prev ) const`

Get pointer to array[\*card\_prev] of previous row names.

The value of \*card\_prev might be different than [getNumRows\(\)](#)+1 if non distinct row names were present or if no previous names were saved or if the object was holding a different problem before.

**8.37.2.6** void CoinLpIO::getPreviousColNames ( char const \*const \* prev, int \* card\_prev )  
const

Get pointer to array[\*card\_prev] of previous column names.

The value of \*card\_prev might be different than [getNumCols\(\)](#) if non distinct column names were present or if no previous names were saved, or if the object was holding a different problem before.

**8.37.2.7** char const\* const CoinLpIO::getRowNames ( ) const

Get pointer to array[[getNumRows\(\)](#)+1] of row names, including objective function name as last entry.

**8.37.2.8** const char\* CoinLpIO::rowName ( int index ) const

Return the row name for the specified index.

Return the objective function name if index = [getNumRows\(\)](#). Return 0 if the index is out of range or if row names are not defined.

**8.37.2.9** const char\* CoinLpIO::columnName ( int index ) const

Return the column name for the specified index.

Return 0 if the index is out of range or if column names are not defined.

**8.37.2.10** int CoinLpIO::rowIndex ( const char \* name ) const

Return the index for the specified row name.

Return [getNumRows\(\)](#) for the objective function name. Return -1 if the name is not found.

**8.37.2.11** int CoinLpIO::columnIndex ( const char \* name ) const

Return the index for the specified column name.

Return -1 if the name is not found.

**8.37.2.12** void CoinLpIO::setInfinity ( const double )

Set infinity.

Any number larger is considered infinity. Default: DBL\_MAX

**8.37.2.13** void CoinLpIO::setEpsilon ( const double )

Set epsilon.

Default: 1e-5.

**8.37.2.14** void CoinLpIO::setNumberAcross ( const int )

Set numberAcross.

Default: 10.

**8.37.2.15** void CoinLpIO::setDecimals ( const int )

Set decimals.

Default: 5

**8.37.2.16** void CoinLpIO::setLpDataWithoutRowAndColNames ( const CoinPackedMatrix & *m*, const double \* *collb*, const double \* *colub*, const double \* *obj\_coeff*, const char \* *integrality*, const double \* *rowlb*, const double \* *rowub* )

Set the data of the object.

Set it from the coefficient matrix *m*, the lower bounds *collb*, the upper bounds *colub*, objective function *obj\_coeff*, integrality vector *integrality*, lower/upper bounds on the constraints. The sense of optimization of the objective function is assumed to be a minimization. Numbers larger than DBL\_MAX (or larger than 1e+400) might crash the code.

**8.37.2.17** int CoinLpIO::is\_invalid\_name ( const char \* *buff*, const bool *ranged* ) const

Return 0 if *buff* is a valid name for a row, a column or objective function, return a positive number otherwise.

If parameter *ranged* = true, the name is intended for a ranged constraint.

Return 1 if the name has more than 100 characters (96 characters for a ranged constraint name, as "\_low" will be added to the name).

Return 2 if the name starts with a number.

Return 3 if the name is not built with the letters a to z, A to Z, the numbers 0 to 9 or the characters " ! # \$ % & ( ) . ; ? @ \_ ' { } ~

Return 4 if the name is a keyword.

Return 5 if the name is empty or NULL.

**8.37.2.18** int CoinLpIO::are\_invalid\_names ( char const \*const \* *vnames*, const int *card\_vnames*, const bool *check\_ranged* ) const

Return 0 if each of the *card\_vnames* entries of *vnames* is a valid name, return a positive number otherwise.

The return value, if not 0, is the return value of [is\\_invalid\\_name\(\)](#) for the last invalid name in *vnames*. If *check\_ranged* = true, the names are row names and names for ranged constraints must be checked for additional restrictions since "\_low" will be added to the name if an Lp file is written. When *check\_ranged* = true, *card\_vnames* must have [getNumRows\(\)+1](#) entries, with entry *vnames*[[getNumRows\(\)](#)] being the name of the objective function. For a description of valid names and return values, see the method [is\\_invalid\\_name\(\)](#).

This method must not be called with *check\_ranged* = true before [setLpDataWithoutRowAndColNames\(\)](#) has been called, since access to the indices of all the ranged constraints is required.

### 8.37.2.19 void CoinLpIO::setDefaultRowNames ( )

Set objective function name to the default "obj" and row names to the default "cons0", "cons1", ...

### 8.37.2.20 void CoinLpIO::setLpDataRowAndColNames ( char const \*const \*const rownames, char const \*const \*const colnames )

Set the row and column names.

The array rownames must either be NULL or have exactly `getNumRows()+1` distinct entries, each of them being a valid name (see `is_invalid_name()`) and the last entry being the intended name for the objective function. If rownames is NULL, existing row names and objective function name are not changed. If rownames is deemed invalid, default row names and objective function name are used (see `setDefaultRowNames()`). The memory location of array rownames (or its entries) should not be related to the memory location of the array (or entries) obtained from `getRowNames()` or `getPreviousRowNames()`, as the call to `setLpDataRowAndColNames()` modifies the corresponding arrays. Unpredictable results are obtained if this requirement is ignored.

Similar remarks apply to the array colnames, which must either be NULL or have exactly `getNumCols()` entries.

### 8.37.2.21 int CoinLpIO::writeLp ( const char \* filename, const double epsilon, const int numberAcross, const int decimals, const bool useRowNames = true )

Write the data in Lp format in the file with name filename.

Coefficients with value less than epsilon away from an integer value are written as integers. Write at most numberAcross monomials on a line. Write non integer numbers with decimals digits after the decimal point. Write objective function name and row names if `useRowNames = true`.

Ranged constraints are written as two constraints. If row names are used, the upper bound constraint has the name of the original ranged constraint and the lower bound constraint has for name the original name with "\_low" as suffix. If doing so creates two identical row names, default row names are used (see `setDefaultRowNames()`).

### 8.37.2.22 int CoinLpIO::writeLp ( FILE \* fp, const double epsilon, const int numberAcross, const int decimals, const bool useRowNames = true )

Write the data in Lp format in the file pointed to by the parameter fp.

Coefficients with value less than epsilon away from an integer value are written as integers. Write at most numberAcross monomials on a line. Write non integer numbers with decimals digits after the decimal point. Write objective function name and row names if `useRowNames = true`.

Ranged constraints are written as two constraints. If row names are used, the upper bound constraint has the name of the original ranged constraint and the lower bound constraint has for name the original name with "\_low" as suffix. If doing so creates two identical row names, default row names are used (see `setDefaultRowNames()`).

**8.37.2.23** `int CoinLpIO::writeLp ( const char * filename, const bool useRowNames = true )`

Write the data in Lp format in the file with name filename.

Write objective function name and row names if useRowNames = true.

**8.37.2.24** `int CoinLpIO::writeLp ( FILE * fp, const bool useRowNames = true )`

Write the data in Lp format in the file pointed to by the parameter fp.

Write objective function name and row names if useRowNames = true.

**8.37.2.25** `void CoinLpIO::readLp ( const char * filename, const double epsilon )`

Read the data in Lp format from the file with name filename, using the given value for epsilon.

If the original problem is a maximization problem, the objective function is immediatly flipped to get a minimization problem.

**8.37.2.26** `void CoinLpIO::readLp ( const char * filename )`

Read the data in Lp format from the file with name filename.

If the original problem is a maximization problem, the objective function is immediatly flipped to get a minimization problem.

**8.37.2.27** `void CoinLpIO::readLp ( FILE * fp, const double epsilon )`

Read the data in Lp format from the file stream, using the given value for epsilon.

If the original problem is a maximization problem, the objective function is immediatly flipped to get a minimization problem.

**8.37.2.28** `void CoinLpIO::readLp ( FILE * fp )`

Read the data in Lp format from the file stream.

If the original problem is a maximization problem, the objective function is immediatly flipped to get a minimization problem.

**8.37.2.29** `void CoinLpIO::passInMessageHandler ( CoinMessageHandler * handler )`

Pass in Message handler.

Supply a custom message handler. It will not be destroyed when the [CoinMpsIO](#) object is destroyed.

**8.37.2.30** `void CoinLpIO::startHash ( char const *const *const names, const COINColumnIndex number, int section ) [protected]`

Build the hash table for the given names.

The parameter number is the cardinality of parameter names. Remove duplicate names.  
section = 0 for row names, section = 1 for column names.

**8.37.2.31** void CoinLpIO::stopHash ( int *section* ) [protected]

Delete hash storage.

If section = 0, it also frees objName\_. section = 0 for row names, section = 1 for column names.

**8.37.2.32** COINColumnIndex CoinLpIO::findHash ( const char \* *name*, int *section* ) const [protected]

Return the index of the given name, return -1 if the name is not found.

Return [getNumRows\(\)](#) for the objective function name. section = 0 for row names (including objective function name), section = 1 for column names.

**8.37.2.33** void CoinLpIO::insertHash ( const char \* *thisName*, int *section* ) [protected]

Insert thisName in the hash table if not present yet; does nothing if the name is already in.

section = 0 for row names, section = 1 for column names.

**8.37.2.34** void CoinLpIO::out\_coeff ( FILE \* *fp*, double *v*, int *print\_1* ) const [protected]

Write a coefficient.

print\_1 = 0 : do not print the value 1.

**8.37.2.35** int CoinLpIO::find\_obj ( FILE \* *fp* ) const [protected]

Locate the objective function.

Return 1 if found the keyword "Minimize" or one of its variants, -1 if found keyword "Maximize" or one of its variants.

**8.37.2.36** int CoinLpIO::is\_subject.to ( const char \* *buff* ) const [protected]

Return an integer indicating if the keyword "subject to" or one of its variants has been read.

Return 1 if buff is the keyword "s.t" or one of its variants. Return 2 if buff is the keyword "subject" or one of its variants. Return 0 otherwise.

**8.37.2.37** int CoinLpIO::first\_is\_number ( const char \* *buff* ) const [protected]

Return 1 if the first character of buff is a number.

Return 0 otherwise.

**8.37.2.38** int CoinLpIO::is\_comment ( const char \* *buff* ) const [protected]

Return 1 if the first character of buff is '/' or '\'.  
Return 0 otherwise.

**8.37.2.39** `int CoinLpIO::is_free ( const char * buff ) const` [protected]

Return 1 if buff is the keyword "free" or one of its variants.

Return 0 otherwise.

**8.37.2.40** `int CoinLpIO::is_inf ( const char * buff ) const` [protected]

Return 1 if buff is the keyword "inf" or one of its variants.

Return 0 otherwise.

**8.37.2.41** `int CoinLpIO::is_sense ( const char * buff ) const` [protected]

Return an integer indicating the inequality sense read.

Return 0 if buff is '<='. Return 1 if buff is '='. Return 2 if buff is '>='. Return -1 otherwise.

**8.37.2.42** `int CoinLpIO::is_keyword ( const char * buff ) const` [protected]

Return an integer indicating if one of the keywords "Bounds", "Integers", "Generals", "Binaries", "End", or one of their variants has been read.

Return 1 if buff is the keyword "Bounds" or one of its variants. Return 2 if buff is the keyword "Integers" or "Generals" or one of their variants. Return 3 if buff is the keyword "Binaries" or one of its variants. Return 4 if buff is the keyword "End" or one of its variants. Return 0 otherwise.

**8.37.2.43** `int CoinLpIO::read_monom_obj ( FILE * fp, double * coeff, char ** name, int * cnt, char ** obj_name )` [protected]

Read a monomial of the objective function.

Return 1 if "subject to" or one of its variants has been read.

**8.37.2.44** `int CoinLpIO::read_monom_row ( FILE * fp, char * start_str, double * coeff, char ** name, int cnt, int * coeff ) const` [protected]

Read a monomial of a constraint.

Return a positive number if the sense of the inequality has been read (see method [is\\_sense\(\)](#) for the return code). Return -1 otherwise.

**8.37.2.45** `void CoinLpIO::checkRowNames ( )` [protected]

Check that current objective name and all row names are distinct including row names obtained by adding "\_low" for ranged constraints.

If there is a conflict in the names, they are replaced by default row names (see [setDefaultRowNames\(\)](#)).

This method must not be called before [setLpDataWithoutRowAndColNames\(\)](#) has been called, since access to the indices of all the ranged constraints is required.

This method must not be called before [setLpDataRowAndColNames\(\)](#) has been called,

since access to all the row names is required.

#### 8.37.2.46 void CoinLpIO::checkColNames ( ) [protected]

Check that current column names are distinct.

If not, they are replaced by default column names (see [setDefaultColNames\(\)](#)).

This method must not be called before [setLpDataRowAndColNames\(\)](#) has been called, since access to all the column names is required.

### 8.37.3 Member Data Documentation

#### 8.37.3.1 bool CoinLpIO::defaultHandler\_ [protected]

Flag to say if the message handler is the default handler.

If true, the handler will be destroyed when the [CoinMpsIO](#) object is destroyed; if false, it will not be destroyed.

Definition at line 482 of file [CoinLpIO.hpp](#).

#### 8.37.3.2 char\* CoinLpIO::integerType\_ [protected]

Pointer to dense vector specifying if a variable is continuous (0) or integer (1).

Definition at line 532 of file [CoinLpIO.hpp](#).

#### 8.37.3.3 char\*\* CoinLpIO::previous\_names\_[2] [protected]

Row names (including objective function name) and column names when [stopHash\(\)](#) for the corresponding section was last called or for initial names (deemed invalid) read from a file.

section = 0 for row names, section = 1 for column names.

Definition at line 558 of file [CoinLpIO.hpp](#).

#### 8.37.3.4 int CoinLpIO::card\_previous\_names\_[2] [protected]

`card_previous_names_[section]` holds the number of entries in the vector `previous_names_[section]`.

section = 0 for row names, section = 1 for column names.

Definition at line 564 of file [CoinLpIO.hpp](#).

#### 8.37.3.5 char\*\* CoinLpIO::names\_[2] [protected]

Row names (including objective function name) and column names (linked to Hash tables).

section = 0 for row names, section = 1 for column names.

Definition at line 570 of file [CoinLpIO.hpp](#).

**8.37.3.6** `int CoinLpIO::maxHash_[2]` [protected]

Maximum number of entries in a hash table section.

section = 0 for row names, section = 1 for column names.

Definition at line 579 of file CoinLpIO.hpp.

**8.37.3.7** `int CoinLpIO::numberHash_[2]` [protected]

Number of entries in a hash table section.

section = 0 for row names, section = 1 for column names.

Definition at line 584 of file CoinLpIO.hpp.

**8.37.3.8** `CoinHashLink* CoinLpIO::hash_[2]` [mutable, protected]

Hash tables with two sections.

section = 0 for row names (including objective function name), section = 1 for column names.

Definition at line 589 of file CoinLpIO.hpp.

The documentation for this class was generated from the following file:

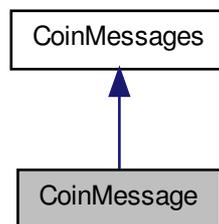
- CoinLpIO.hpp

**8.38** CoinMessage Class Reference

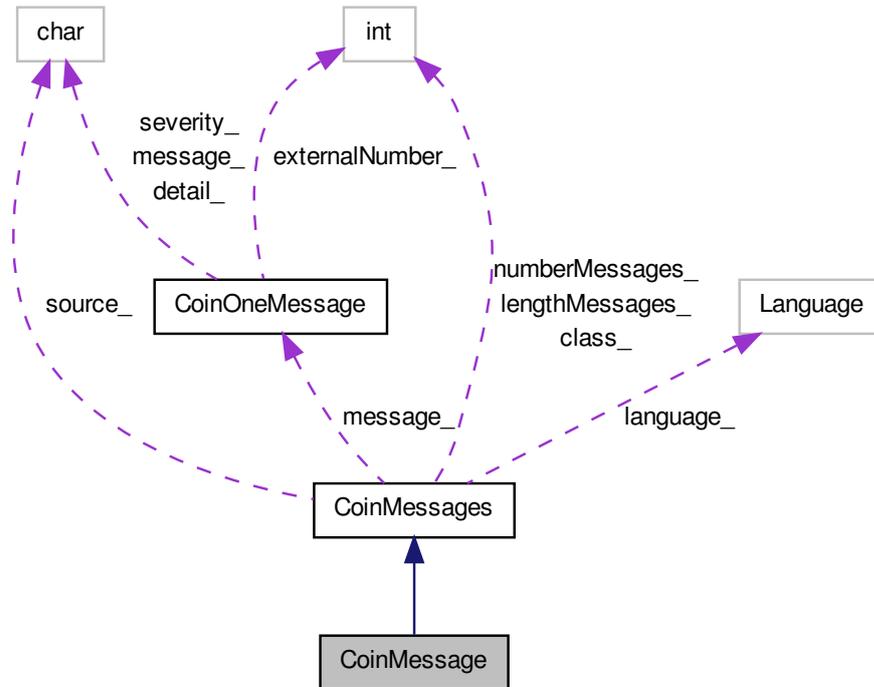
The standard set of Coin messages.

```
#include <CoinMessage.hpp>
```

Inheritance diagram for CoinMessage:



Collaboration diagram for CoinMessage:



### Public Member Functions

#### Constructors etc

- [CoinMessage](#) ([Language](#) language=us\_en)  
*Constructor.*

#### 8.38.1 Detailed Description

The standard set of Coin messages.

This class provides convenient access to the standard set of Coin messages. In a nutshell, it's a [CoinMessages](#) object with a constructor that preloads the standard Coin messages.

Definition at line 79 of file `CoinMessage.hpp`.

## 8.38.2 Constructor &amp; Destructor Documentation

8.38.2.1 CoinMessage::CoinMessage ( Language *language* = us\_en )

Constructor.

Build a [CoinMessages](#) object and load it with the standard set of Coin messages.

The documentation for this class was generated from the following file:

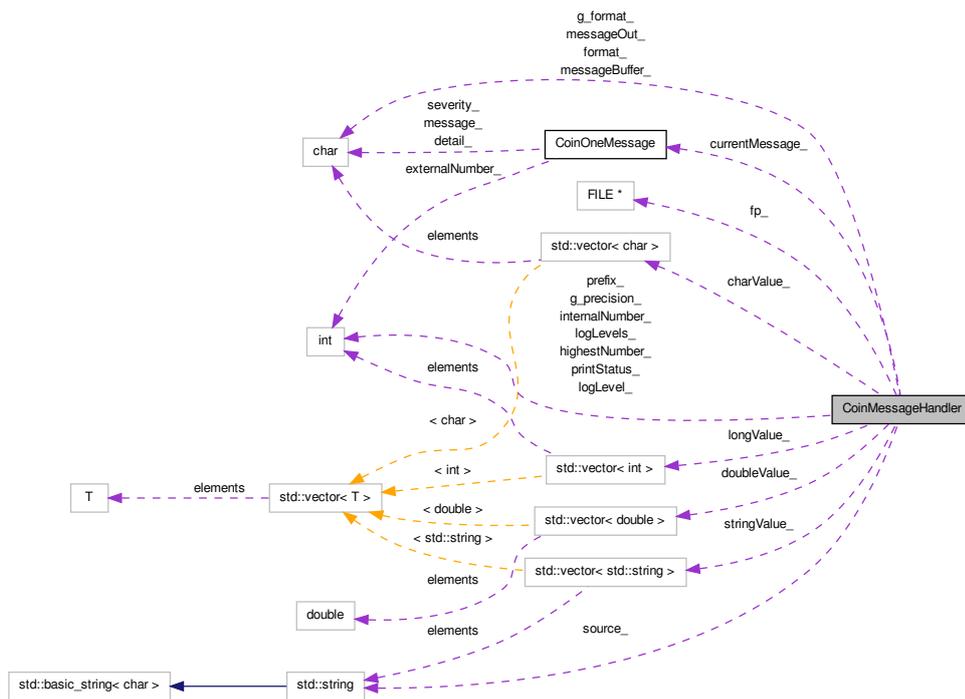
- [CoinMessage.hpp](#)

## 8.39 CoinMessageHandler Class Reference

Base class for message handling.

```
#include <CoinMessageHandler.hpp>
```

Collaboration diagram for CoinMessageHandler:



## Public Member Functions

## Virtual methods that the derived classes may provide

- virtual int `print ()`  
*Print message, return 0 normally.*
- virtual void `checkSeverity ()`  
*Check message severity - if too bad then abort.*

## Constructors etc

- `CoinMessageHandler ()`  
*Constructor.*
- `CoinMessageHandler (FILE *fp)`  
*Constructor to put to file pointer (won't be closed)*
- virtual `~CoinMessageHandler ()`  
*Destructor.*
- `CoinMessageHandler (const CoinMessageHandler &)`  
*The copy constructor.*
- `CoinMessageHandler & operator= (const CoinMessageHandler &)`  
*Assignment operator.*
- virtual `CoinMessageHandler * clone () const`  
*Clone.*

## Get and set methods

- int `detail (int messageNumber, const CoinMessages &normalMessage) const`  
*Get detail level of a message.*
- int `logLevel () const`  
*Get current log (detail) level.*
- void `setLogLevel (int value)`  
*Set current log (detail) level.*
- int `logLevel (int which) const`  
*Get alternative log level.*
- void `setLogLevel (int which, int value)`  
*Set alternative log level value.*
- void `setPrecision (unsigned int new_precision)`  
*Set the number of significant digits for printing floating point numbers.*
- int `precision ()`  
*Current number of significant digits for printing floating point numbers.*
- void `setPrefix (bool yesNo)`  
*Switch message prefix on or off.*
- bool `prefix () const`  
*Current setting for printing message prefix.*
- double `doubleValue (int position) const`  
*Values of double fields already processed.*
- int `numberDoubleFields () const`  
*Number of double fields already processed.*
- int `intValue (int position) const`  
*Values of integer fields already processed.*

- int `numberIntFields` () const  
*Number of integer fields already processed.*
- char `charValue` (int position) const  
*Values of char fields already processed.*
- int `numberCharFields` () const  
*Number of char fields already processed.*
- std::string `stringValue` (int position) const  
*Values of string fields already processed.*
- int `numberStringFields` () const  
*Number of string fields already processed.*
- `CoinOneMessage` `currentMessage` () const  
*Current message.*
- std::string `currentSource` () const  
*Source of current message.*
- const char \* `messageBuffer` () const  
*Output buffer.*
- int `highestNumber` () const  
*Highest message number (indicates any errors)*
- FILE \* `filePointer` () const  
*Get current file pointer.*
- void `setFilePointer` (FILE \*fp)  
*Set new file pointer.*

#### Actions to create a message

- `CoinMessageHandler` & `message` (int messageNumber, const `CoinMessages` &messages)  
*Start a message.*
- `CoinMessageHandler` & `message` ()  
*Start or continue a message.*
- `CoinMessageHandler` & `message` (int externalNumber, const char \*header, const char \*msg, char severity)  
*Generate a standard prefix and append msg 'as is'.*
- `CoinMessageHandler` & `operator<<` (int intValue)  
*Process an integer parameter value.*
- `CoinMessageHandler` & `operator<<` (double doublevalue)  
*Process a double parameter value.*
- `CoinMessageHandler` & `operator<<` (const std::string &stringvalue)  
*Process a STL string parameter value.*
- `CoinMessageHandler` & `operator<<` (char charvalue)  
*Process a char parameter value.*
- `CoinMessageHandler` & `operator<<` (const char \*stringvalue)  
*Process a C-style string parameter value.*
- `CoinMessageHandler` & `operator<<` (`CoinMessageMarker`)  
*Process a marker.*
- int `finish` ()  
*Finish (and print) the message.*
- `CoinMessageHandler` & `printing` (bool onOff)  
*Enable or disable printing of an optional portion of a message.*
- char \* `nextPerCent` (char \*start, const bool initial=false)  
*Internal function to locate next format code.*
- int `internalPrint` ()  
*Internal printing function.*

### Protected Attributes

#### Protected member data

- `std::vector< double > doubleValue_`  
*values in message*
- `std::vector< int > longValue_`
- `std::vector< char > charValue_`
- `std::vector< std::string > stringValue_`
- `int logLevel_`  
*Log level.*
- `int logLevels_ [COIN_NUM_LOG]`  
*Log levels.*
- `int prefix_`  
*Whether we want prefix (may get more subtle so is int)*
- `CoinOneMessage currentMessage_`  
*Current message.*
- `int internalNumber_`  
*Internal number for use with enums.*
- `char * format_`  
*Format string for message (remainder)*
- `char messageBuffer_ [COIN_MESSAGE_HANDLER_MAX_BUFFER_SIZE]`  
*Output buffer.*
- `char * messageOut_`  
*Position in output buffer.*
- `std::string source_`  
*Current source of message.*
- `int printStatus_`  
*0 - normal, 1 - put in values, move along format, no print 2 - put in values, no print 3 - skip message*
- `int highestNumber_`  
*Highest message number (indicates any errors)*
- `FILE * fp_`  
*File pointer.*
- `char g_format_ [8]`  
*Current format for floating point numbers.*
- `int g_precision_`  
*Current number of significant digits for floating point numbers.*

### Friends

- `bool CoinMessageHandlerUnitTest ()`  
*A function that tests the methods in the `CoinMessageHandler` class.*

### 8.39.1 Detailed Description

Base class for message handling.

The default behavior is described here: messages are printed, and (if the severity is sufficiently high) execution will be aborted. Inherit and redefine the methods [print](#) and [checkSeverity](#) to augment the behaviour.

Messages can be printed with or without a prefix; the prefix will consist of a source string, the external ID number, and a letter code, *e.g.*, Clp6024W. A prefix makes the messages look less nimble but is very useful for "grep" *etc.*

#### Usage

The general approach to using the COIN messaging facility is as follows:

- Define your messages. For each message, you must supply an external ID number, a log (detail) level, and a format string. Typically, you define a convenience structure for this, something that's easy to use to create an array of initialised message definitions at compile time.
- Create a [CoinMessages](#) object, sized to accommodate the number of messages you've defined. (Incremental growth will happen if necessary as messages are loaded, but it's inefficient.)
- Load the messages into the [CoinMessages](#) object. Typically this entails creating a [CoinOneMessage](#) object for each message and passing it as a parameter to [CoinMessages::addMessage\(\)](#). You specify the message's internal ID as the other parameter to [addMessage](#).
- Create and use a [CoinMessageHandler](#) object to print messages.

See, for example, [CoinMessage.hpp](#) and [CoinMessage.cpp](#) for an example of the first three steps. 'Format codes' below has a simple example of printing a message.

#### External ID numbers and severity

[CoinMessageHandler](#) assumes the following relationship between the external ID number of a message and the severity of the message:

- <3000 are informational ('I')
- <6000 warnings ('W')
- <9000 non-fatal errors ('E')
- >=9000 aborts the program (after printing the message) ('S')

#### Format codes

[CoinMessageHandler](#) can print integers (normal, long, and long long), doubles, characters, and strings. See the descriptions of the various << operators.

When processing a standard message with a format string, the formatting codes specified in the format string will be passed to the `sprintf` function, along with the argument. When generating a message with no format string, each `<<` operator uses a simple format code appropriate for its argument. Consult the documentation for the standard `printf` facility for further information on format codes.

The special format code `'%?'` provides a hook to enable or disable printing. For each `'%?'` code, there must be a corresponding call to `printing(bool)`. This provides a way to define optional parts in messages, delineated by the code `'%?'` in the format string. Printing can be suppressed for these optional parts, but any operands must still be supplied. For example, given the message string

```
"A message with%? an optional integer %d and%? a double %g."
```

installed in `CoinMessages` `exampleMsgs` with index 5, and `CoinMessageHandler` `hdl`, the code

```
hdl.message(5,exampleMsgs) ;
hdl.printing(true) << 42 ;
hdl.printing(true) << 53.5 << CoinMessageEol ;
```

will print

```
A message with an optional integer 42 and a double 53.5.
```

while

```
hdl.message(5,exampleMsgs) ;
hdl.printing(false) << 42 ;
hdl.printing(true) << 53.5 << CoinMessageEol ;
```

will print

```
A message with a double 53.5.
```

For additional examples of usage, see `CoinMessageHandlerUnitTest` in `CoinMessageHandlerTest.cpp`.

Definition at line 313 of file `CoinMessageHandler.hpp`.

### 8.39.2 Member Function Documentation

#### 8.39.2.1 `CoinMessageHandler& CoinMessageHandler::operator= ( const CoinMessageHandler & )`

Assignment operator.

#### 8.39.2.2 `int CoinMessageHandler::logLevel ( ) const [inline]`

Get current log (detail) level.

Definition at line 353 of file `CoinMessageHandler.hpp`.

**8.39.2.3 void CoinMessageHandler::setLogLevel ( int *value* )**

Set current log (detail) level.

If the log level is equal or greater than the detail level of a message, the message will be printed. A rough convention for the amount of output expected is

- 0 - none
- 1 - minimal
- 2 - normal low
- 3 - normal high
- 4 - verbose

Please assign log levels to messages accordingly. Log levels of 8 and above (8,16,32, etc.) are intended for selective debugging. The logical AND of the log level specified in the message and the current log level is used to determine if the message is printed. (In other words, you're using individual bits to determine which messages are printed.)

**8.39.2.4 int CoinMessageHandler::logLevel ( int *which* ) const [inline]**

Get alternative log level.

Definition at line 374 of file CoinMessageHandler.hpp.

**8.39.2.5 void CoinMessageHandler::setLogLevel ( int *which*, int *value* )**

Set alternative log level value.

Can be used to store alternative log level information within the handler.

**8.39.2.6 double CoinMessageHandler::doubleValue ( int *position* ) const [inline]**

Values of double fields already processed.

As the parameter for a double field is processed, the value is saved and can be retrieved using this function.

Definition at line 396 of file CoinMessageHandler.hpp.

**8.39.2.7 int CoinMessageHandler::numberDoubleFields ( ) const [inline]**

Number of double fields already processed.

Incremented each time a field of type double is processed.

Definition at line 402 of file CoinMessageHandler.hpp.

**8.39.2.8 int CoinMessageHandler::intValue ( int *position* ) const [inline]**

Values of integer fields already processed.

As the parameter for a integer field is processed, the value is saved and can be retrieved using this function.

Definition at line 409 of file CoinMessageHandler.hpp.

**8.39.2.9** `int CoinMessageHandler::numberIntFields ( ) const [inline]`

Number of integer fields already processed.

Incremented each time a field of type integer is processed.

Definition at line 415 of file CoinMessageHandler.hpp.

**8.39.2.10** `char CoinMessageHandler::charValue ( int position ) const [inline]`

Values of char fields already processed.

As the parameter for a char field is processed, the value is saved and can be retrieved using this function.

Definition at line 422 of file CoinMessageHandler.hpp.

**8.39.2.11** `int CoinMessageHandler::numberCharFields ( ) const [inline]`

Number of char fields already processed.

Incremented each time a field of type char is processed.

Definition at line 428 of file CoinMessageHandler.hpp.

**8.39.2.12** `std::string CoinMessageHandler::stringValue ( int position ) const [inline]`

Values of string fields already processed.

As the parameter for a string field is processed, the value is saved and can be retrieved using this function.

Definition at line 435 of file CoinMessageHandler.hpp.

**8.39.2.13** `int CoinMessageHandler::numberStringFields ( ) const [inline]`

Number of string fields already processed.

Incremented each time a field of type string is processed.

Definition at line 441 of file CoinMessageHandler.hpp.

**8.39.2.14** `CoinMessageHandler& CoinMessageHandler::message ( int messageNumber,  
const CoinMessages & messages )`

Start a message.

Look up the specified message. A prefix will be generated if enabled. The message will be printed if the current log level is equal or greater than the log level of the message.

**8.39.2.15** `CoinMessageHandler& CoinMessageHandler::message ( )`

Start or continue a message.

Does nothing except return a reference to the handler. This can be used with any of the << operators. One use is to start a message which will be constructed entirely from scratch. Another use is continuation of a message after code that interrupts the usual sequence of << operators.

**8.39.2.16 CoinMessageHandler& CoinMessageHandler::message ( int *externalNumber*,  
const char \* *header*, const char \* *msg*, char *severity* )**

Generate a standard prefix and append `msg` 'as is'.

Intended as a transition mechanism. The standard prefix is generated (if enabled), and `msg` is appended. Only the [operator<<\(CoinMessageMarker\)](#) operator can be used with a message started with this call.

**8.39.2.17 CoinMessageHandler& CoinMessageHandler::operator<< ( int *intvalue* )**

Process an integer parameter value.

The default format code is 'd'.

**8.39.2.18 CoinMessageHandler& CoinMessageHandler::operator<< ( double *doublevalue*  
)**

Process a double parameter value.

The default format code is 'd'.

**8.39.2.19 CoinMessageHandler& CoinMessageHandler::operator<< ( const std::string &  
*stringvalue* )**

Process a STL string parameter value.

The default format code is 'g'.

**8.39.2.20 CoinMessageHandler& CoinMessageHandler::operator<< ( char *charvalue* )**

Process a char parameter value.

The default format code is 's'.

**8.39.2.21 CoinMessageHandler& CoinMessageHandler::operator<< ( const char \*  
*stringvalue* )**

Process a C-style string parameter value.

The default format code is 'c'.

**8.39.2.22 CoinMessageHandler& CoinMessageHandler::operator<< ( CoinMessageMarker  
)**

Process a marker.

The default format code is 's'.

**8.39.2.23** `int CoinMessageHandler::finish ( )`

Finish (and print) the message.

Equivalent to using the `CoinMessageEol` marker.

**8.39.2.24** `CoinMessageHandler& CoinMessageHandler::printing ( bool onOff )`

Enable or disable printing of an optional portion of a message.

Optional portions of a message are delimited by “%?” markers, and printing processes one %? marker. If `onOff` is true, the subsequent portion of the message (to the next %? marker or the end of the format string) will be printed. If `onOff` is false, printing is suppressed. Parameters must still be supplied, whether printing is suppressed or not. See the class documentation for an example.

**8.39.2.25** `char* CoinMessageHandler::nextPerCent ( char * start, const bool initial = false )`

Internal function to locate next format code.

Intended for internal use. Side effects modify the format string.

**8.39.2.26** `int CoinMessageHandler::internalPrint ( )`

Internal printing function.

Makes it easier to split up print into clean, print and check severity

**8.39.3 Friends And Related Function Documentation****8.39.3.1** `bool CoinMessageHandlerUnitTest ( ) [friend]`

A function that tests the methods in the `CoinMessageHandler` class.

The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging.

The documentation for this class was generated from the following file:

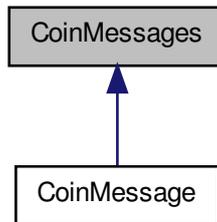
- [CoinMessageHandler.hpp](#)

**8.40 CoinMessages Class Reference**

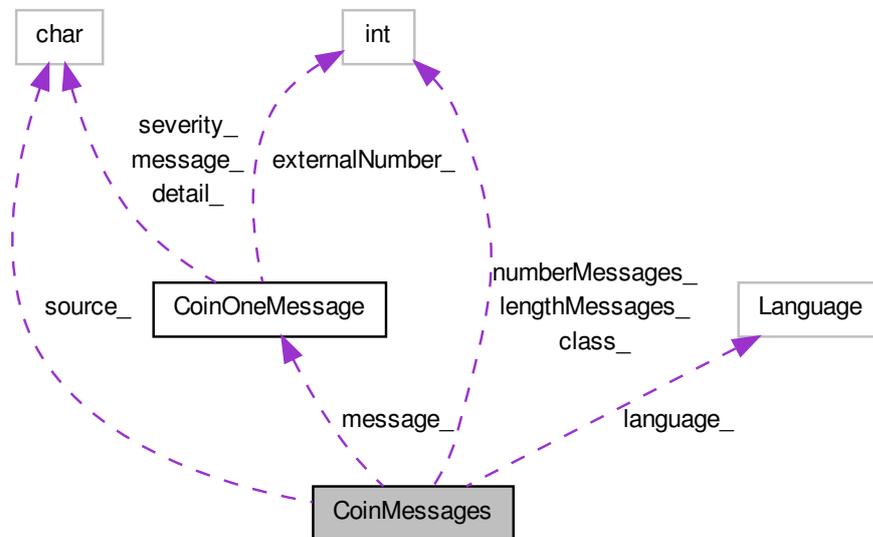
Class to hold and manipulate an array of massaged messages.

```
#include <CoinMessageHandler.hpp>
```

Inheritance diagram for CoinMessages:



Collaboration diagram for CoinMessages:



#### Public Types

- enum [Language](#)  
*Supported languages.*

## Public Member Functions

### Constructors etc

- [CoinMessages](#) (int numberMessages=0)  
*Constructor with number of messages.*
- [~CoinMessages](#) ()  
*Destructor.*
- [CoinMessages](#) (const [CoinMessages](#) &)  
*The copy constructor.*
- [CoinMessages](#) & [operator=](#) (const [CoinMessages](#) &)  
*assignment operator.*

### Useful stuff

- void [addMessage](#) (int messageNumber, const [CoinOneMessage](#) &message)  
  
*Installs a new message in the specified index position.*
- void [replaceMessage](#) (int messageNumber, const char \*message)  
*Replaces the text of the specified message.*
- [Language](#) [language](#) () const  
*Language.*
- void [setLanguage](#) ([Language](#) newlanguage)  
*Set language.*
- void [setDetailMessage](#) (int newLevel, int messageNumber)  
*Change detail level for one message.*
- void [setDetailMessages](#) (int newLevel, int numberMessages, int \*messageNumbers)  
  
*Change detail level for several messages.*
- void [setDetailMessages](#) (int newLevel, int low, int high)  
*Change detail level for all messages with low <= ID number < high.*
- int [getClass](#) () const  
*Returns class.*
- void [toCompact](#) ()  
*Moves to compact format.*
- void [fromCompact](#) ()  
*Moves from compact format.*

## Public Attributes

### member data

- int [numberMessages\\_](#)  
*Number of messages.*
- [Language](#) [language\\_](#)  
*Language.*
- char [source\\_](#) [5]  
*Source (null-terminated string, maximum 4 characters).*
- int [class\\_](#)

- Class - see later on before [CoinMessageHandler](#).*
- int [lengthMessages\\_](#)  
*Length of fake [CoinOneMessage](#) array.*
  - [CoinOneMessage](#) \*\* [message\\_](#)  
*Messages.*

#### 8.40.1 Detailed Description

Class to hold and manipulate an array of massaged messages.

Note that the message index used to reference a message in the array of messages is completely distinct from the external ID number stored with the message.

Definition at line 124 of file [CoinMessageHandler.hpp](#).

#### 8.40.2 Member Enumeration Documentation

##### 8.40.2.1 enum [CoinMessages::Language](#)

Supported languages.

These are the languages that are supported. At present only `us_en` is serious and the rest are for testing.

Definition at line 132 of file [CoinMessageHandler.hpp](#).

#### 8.40.3 Constructor & Destructor Documentation

##### 8.40.3.1 [CoinMessages::CoinMessages](#) ( int *numberMessages* = 0 )

Constructor with number of messages.

#### 8.40.4 Member Function Documentation

##### 8.40.4.1 [CoinMessages&](#) [CoinMessages::operator=](#) ( const [CoinMessages](#) & )

assignment operator.

##### 8.40.4.2 void [CoinMessages::addMessage](#) ( int *messageNumber*, const [CoinOneMessage](#) & *message* )

Installs a new message in the specified index position.

Any existing message is replaced, and a copy of the specified message is installed.

##### 8.40.4.3 void [CoinMessages::replaceMessage](#) ( int *messageNumber*, const char \* *message* )

Replaces the text of the specified message.

Any existing text is deleted and the specified text is copied into the specified message.

#### 8.40.4.4 Language CoinMessages::language ( ) const [inline]

Language.

Need to think about iso codes

Definition at line 165 of file CoinMessageHandler.hpp.

#### 8.40.4.5 void CoinMessages::setDetailMessages ( int *newLevel*, int *numberMessages*, int \* *messageNumbers* )

Change detail level for several messages.

messageNumbers is expected to contain the indices of the messages to be changed. If numberMessages >= 10000 or messageNumbers is NULL, the detail level is changed on all messages.

#### 8.40.5 Member Data Documentation

##### 8.40.5.1 int CoinMessages::lengthMessages\_

Length of fake [CoinOneMessage](#) array.

First you get numberMessages\_ pointers which point to stuff

Definition at line 206 of file CoinMessageHandler.hpp.

The documentation for this class was generated from the following file:

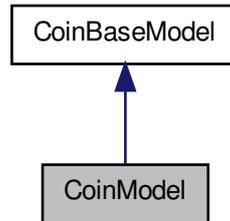
- [CoinMessageHandler.hpp](#)

## 8.41 CoinModel Class Reference

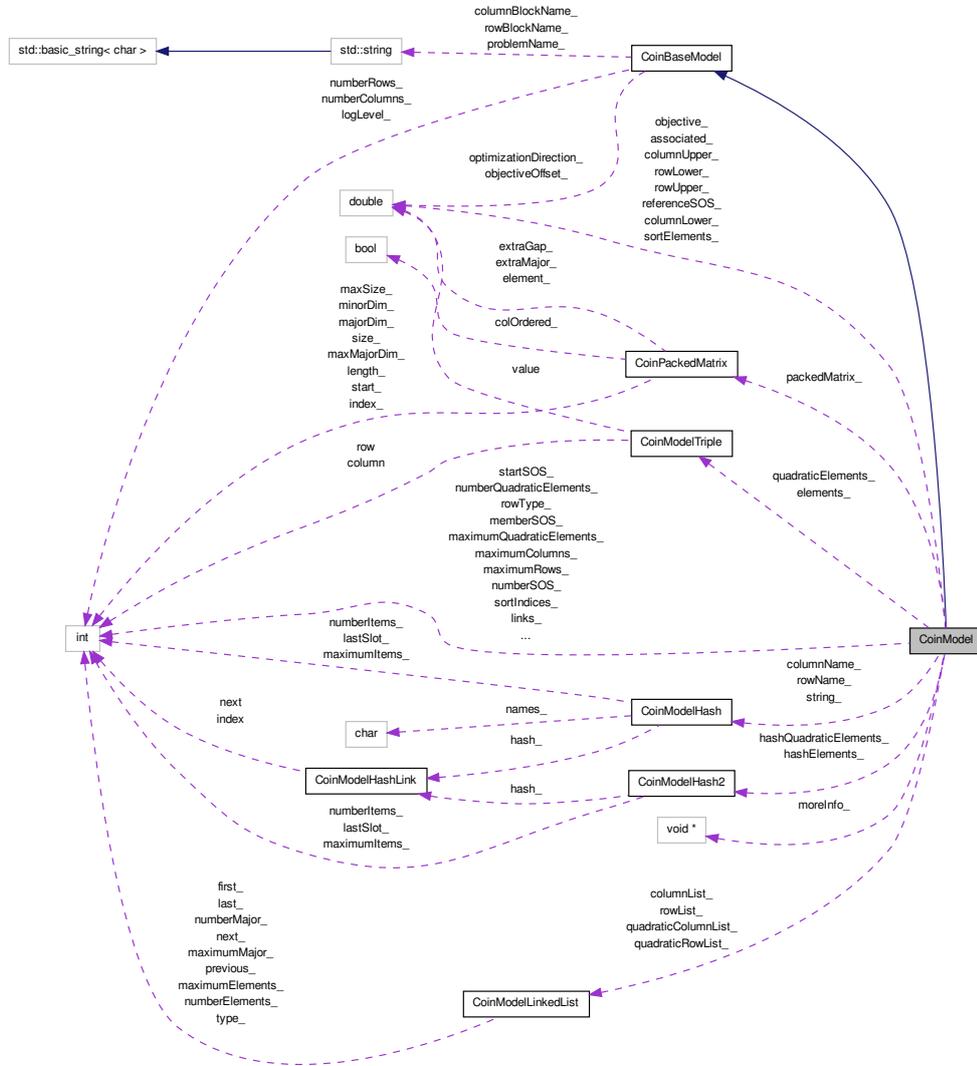
This is a simple minded model which is stored in a format which makes it easier to construct and modify but not efficient for algorithms.

```
#include <CoinModel.hpp>
```

Inheritance diagram for CoinModel:



Collaboration diagram for CoinModel:



Public Member Functions

- `int computeAssociated (double *associated)`  
*Fills in all associated - returning number of errors.*
- `CoinPackedMatrix * quadraticRow (int rowNumber, double *linear, int &numberBad) const`  
*Gets correct form for a quadratic row - user to delete If row is not quadratic then returns which other variables are involved with tiny (1.0e-100) elements and count of total number of variables which could not be put in quadratic form.*

- void [replaceQuadraticRow](#) (int rowNumber, const double \*linear, const [CoinPackedMatrix](#) \*quadraticPart)
 

*Replaces a quadratic row.*
- [CoinModel](#) \* [reorder](#) (const char \*mark) const
 

*If possible return a model where if all variables marked nonzero are fixed the problem will be linear.*
- int [expandKnapsack](#) (int knapsackRow, int &numberOutput, double \*buildObj, [CoinBigIndex](#) \*buildStart, int \*buildRow, double \*buildElement, int reConstruct=-1) const
 

*Expands out all possible combinations for a knapsack If buildObj NULL then just computes space needed - returns number elements On entry numberOutput is maximum allowed, on exit it is number needed or.*
- void [setCutMarker](#) (int size, const int \*marker)
 

*Sets cut marker array.*
- void [setPriorities](#) (int size, const int \*priorities)
 

*Sets priority array.*
- const int \* [priorities](#) () const
 

*priorities (given for all columns (-1 if not integer))*
- void [setOriginalIndices](#) (const int \*row, const int \*column)
 

*For decomposition set original row and column indices.*

#### Useful methods for building model

- void [addRow](#) (int numberInRow, const int \*columns, const double \*elements, double rowLower=-COIN\_DBL\_MAX, double rowUpper=COIN\_DBL\_MAX, const char \*name=NULL)
 

*add a row - numberInRow may be zero*
- void [addColumn](#) (int numberInColumn, const int \*rows, const double \*elements, double columnLower=0.0, double columnUpper=COIN\_DBL\_MAX, double objectiveValue=0.0, const char \*name=NULL, bool isInteger=false)
 

*add a column - numberInColumn may be zero \*/*
- void [addCol](#) (int numberInColumn, const int \*rows, const double \*elements, double columnLower=0.0, double columnUpper=COIN\_DBL\_MAX, double objectiveValue=0.0, const char \*name=NULL, bool isInteger=false)
 

*add a column - numberInColumn may be zero \*/*
- void [operator\(\)](#) (int i, int j, double value)
 

*Sets value for row i and column j.*
- void [setElement](#) (int i, int j, double value)
 

*Sets value for row i and column j.*
- int [getRow](#) (int whichRow, int \*column, double \*element)
 

*Gets sorted row - user must provide enough space (easiest is allocate number of columns).*
- int [getColumn](#) (int whichColumn, int \*column, double \*element)
 

*Gets sorted column - user must provide enough space (easiest is allocate number of rows).*
- void [setQuadraticElement](#) (int i, int j, double value)
 

*Sets quadratic value for column i and j.*

- void [operator\(\)](#) (int i, int j, const char \*value)  
*Sets value for row i and column j as string.*
- void [setElement](#) (int i, int j, const char \*value)  
*Sets value for row i and column j as string.*
- int [associateElement](#) (const char \*stringValue, double value)  
*Associates a string with a value. Returns string id (or -1 if does not exist)*
- void [setRowLower](#) (int whichRow, double rowLower)  
*Sets rowLower (if row does not exist then all rows up to this are defined with default values and no elements)*
- void [setRowUpper](#) (int whichRow, double rowUpper)  
*Sets rowUpper (if row does not exist then all rows up to this are defined with default values and no elements)*
- void [setRowBounds](#) (int whichRow, double rowLower, double rowUpper)  
*Sets rowLower and rowUpper (if row does not exist then all rows up to this are defined with default values and no elements)*
- void [setRowName](#) (int whichRow, const char \*rowName)  
*Sets name (if row does not exist then all rows up to this are defined with default values and no elements)*
- void [setColumnLower](#) (int whichColumn, double columnLower)  
*Sets columnLower (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnUpper](#) (int whichColumn, double columnUpper)  
*Sets columnUpper (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnBounds](#) (int whichColumn, double columnLower, double columnUpper)  
*Sets columnLower and columnUpper (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnObjective](#) (int whichColumn, double columnObjective)  
*Sets columnObjective (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnName](#) (int whichColumn, const char \*columnName)  
*Sets name (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnsInteger](#) (int whichColumn, bool columnsInteger)  
*Sets integer state (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setObjective](#) (int whichColumn, double columnObjective)  
*Sets columnObjective (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setIsInteger](#) (int whichColumn, bool columnsInteger)  
*Sets integer state (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setInteger](#) (int whichColumn)  
*Sets integer (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setContinuous](#) (int whichColumn)  
*Sets continuous (if column does not exist then all columns up to this are defined with default values and no elements)*

- void [setColLower](#) (int whichColumn, double columnLower)  
*Sets columnLower (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColUpper](#) (int whichColumn, double columnUpper)  
*Sets columnUpper (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColBounds](#) (int whichColumn, double columnLower, double columnUpper)  
*Sets columnLower and columnUpper (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColObjective](#) (int whichColumn, double columnObjective)  
*Sets columnObjective (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColName](#) (int whichColumn, const char \*columnName)  
*Sets name (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColsInteger](#) (int whichColumn, bool columnsInteger)  
*Sets integer (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setRowLower](#) (int whichRow, const char \*rowLower)  
*Sets rowLower (if row does not exist then all rows up to this are defined with default values and no elements)*
- void [setRowUpper](#) (int whichRow, const char \*rowUpper)  
*Sets rowUpper (if row does not exist then all rows up to this are defined with default values and no elements)*
- void [setColumnLower](#) (int whichColumn, const char \*columnLower)  
*Sets columnLower (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnUpper](#) (int whichColumn, const char \*columnUpper)  
*Sets columnUpper (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnObjective](#) (int whichColumn, const char \*columnObjective)  
*Sets columnObjective (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setColumnsInteger](#) (int whichColumn, const char \*columnsInteger)  
*Sets integer (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setObjective](#) (int whichColumn, const char \*columnObjective)  
*Sets columnObjective (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [setIsInteger](#) (int whichColumn, const char \*columnsInteger)  
*Sets integer (if column does not exist then all columns up to this are defined with default values and no elements)*
- void [deleteRow](#) (int whichRow)  
*Deletes all entries in row and bounds.*
- void [deleteColumn](#) (int whichColumn)  
*Deletes all entries in column and bounds and objective.*
- void [deleteCol](#) (int whichColumn)  
*Deletes all entries in column and bounds.*

- int `deleteElement` (int row, int column)  
*Takes element out of matrix - returning position (<0 if not there);.*
- void `deleteThisElement` (int row, int column, int position)  
*Takes element out of matrix when position known.*
- int `packRows` ()  
*Packs down all rows i.e.*
- int `packColumns` ()  
*Packs down all columns i.e.*
- int `packCols` ()  
*Packs down all columns i.e.*
- int `pack` ()  
*Packs down all rows and columns.*
- void `setObjective` (int numberColumns, const double \*objective)  
*Sets columnObjective array.*
- void `setColumnLower` (int numberColumns, const double \*columnLower)  
*Sets columnLower array.*
- void `setColLower` (int numberColumns, const double \*columnLower)  
*Sets columnLower array.*
- void `setColumnUpper` (int numberColumns, const double \*columnUpper)  
*Sets columnUpper array.*
- void `setColUpper` (int numberColumns, const double \*columnUpper)  
*Sets columnUpper array.*
- void `setRowLower` (int numberRows, const double \*rowLower)  
*Sets rowLower array.*
- void `setRowUpper` (int numberRows, const double \*rowUpper)  
*Sets rowUpper array.*
- int `writeMps` (const char \*filename, int compression=0, int formatType=0, int numberAcross=2, bool keepStrings=false)  
*Write the problem in MPS format to a file with the given filename.*
- int `differentModel` (CoinModel &other, bool ignoreNames)  
*Check two models against each other.*

#### For structured models

- void `passInMatrix` (const CoinPackedMatrix &matrix)  
*Pass in CoinPackedMatrix (and switch off element updates)*
- int `convertMatrix` ()  
*Convert elements to CoinPackedMatrix (and switch off element updates).*
- const CoinPackedMatrix \* `packedMatrix` () const  
*Return a pointer to CoinPackedMatrix (or NULL)*
- const int \* `originalRows` () const  
*Return pointers to original rows (for decomposition)*
- const int \* `originalColumns` () const  
*Return pointers to original columns (for decomposition)*

## For getting information

- CoinBigIndex [numberElements](#) () const  
*Return number of elements.*
- const [CoinModelTriple](#) \* [elements](#) () const  
*Return elements as triples.*
- double [operator\(\)](#) (int i, int j) const  
*Returns value for row i and column j.*
- double [getElement](#) (int i, int j) const  
*Returns value for row i and column j.*
- double [operator\(\)](#) (const char \*rowName, const char \*columnName) const  
*Returns value for row rowName and column columnName.*
- double [getElement](#) (const char \*rowName, const char \*columnName) const  
*Returns value for row rowName and column columnName.*
- double [getQuadraticElement](#) (int i, int j) const  
*Returns quadratic value for columns i and j.*
- const char \* [getElementAsString](#) (int i, int j) const  
*Returns value for row i and column j as string.*
- double \* [pointer](#) (int i, int j) const  
*Returns pointer to element for row i column j.*
- int [position](#) (int i, int j) const  
*Returns position in elements for row i column j.*
- [CoinModelLink](#) [firstInRow](#) (int whichRow) const  
*Returns first element in given row - index is -1 if none.*
- [CoinModelLink](#) [lastInRow](#) (int whichRow) const  
*Returns last element in given row - index is -1 if none.*
- [CoinModelLink](#) [firstInColumn](#) (int whichColumn) const  
*Returns first element in given column - index is -1 if none.*
- [CoinModelLink](#) [lastInColumn](#) (int whichColumn) const  
*Returns last element in given column - index is -1 if none.*
- [CoinModelLink](#) [next](#) ([CoinModelLink](#) &current) const  
*Returns next element in current row or column - index is -1 if none.*
- [CoinModelLink](#) [previous](#) ([CoinModelLink](#) &current) const  
*Returns previous element in current row or column - index is -1 if none.*
- [CoinModelLink](#) [firstInQuadraticColumn](#) (int whichColumn) const  
*Returns first element in given quadratic column - index is -1 if none.*
- [CoinModelLink](#) [lastInQuadraticColumn](#) (int whichColumn) const  
*Returns last element in given quadratic column - index is -1 if none.*
- double [getRowLower](#) (int whichRow) const  
*Gets rowLower (if row does not exist then -COIN\_DBL\_MAX)*
- double [getRowUpper](#) (int whichRow) const  
*Gets rowUpper (if row does not exist then +COIN\_DBL\_MAX)*
- const char \* [getRowName](#) (int whichRow) const  
*Gets name (if row does not exist then NULL)*
- double **rowLower** (int whichRow) const
- double [rowUpper](#) (int whichRow) const  
*Gets rowUpper (if row does not exist then COIN\_DBL\_MAX)*
- const char \* [rowName](#) (int whichRow) const  
*Gets name (if row does not exist then NULL)*

- double [getColumnLower](#) (int whichColumn) const  
*Gets columnLower (if column does not exist then 0.0)*
- double [getColumnUpper](#) (int whichColumn) const  
*Gets columnUpper (if column does not exist then COIN\_DBL\_MAX)*
- double [getColumnObjective](#) (int whichColumn) const  
*Gets columnObjective (if column does not exist then 0.0)*
- const char \* [getColumnName](#) (int whichColumn) const  
*Gets name (if column does not exist then NULL)*
- bool [getColumnIsInteger](#) (int whichColumn) const  
*Gets if integer (if column does not exist then false)*
- double [columnLower](#) (int whichColumn) const  
*Gets columnLower (if column does not exist then 0.0)*
- double [columnUpper](#) (int whichColumn) const  
*Gets columnUpper (if column does not exist then COIN\_DBL\_MAX)*
- double [columnObjective](#) (int whichColumn) const  
*Gets columnObjective (if column does not exist then 0.0)*
- double [objective](#) (int whichColumn) const  
*Gets columnObjective (if column does not exist then 0.0)*
- const char \* [columnName](#) (int whichColumn) const  
*Gets name (if column does not exist then NULL)*
- bool [columnIsInteger](#) (int whichColumn) const  
*Gets if integer (if column does not exist then false)*
- bool [isInteger](#) (int whichColumn) const  
*Gets if integer (if column does not exist then false)*
- double [getColLower](#) (int whichColumn) const  
*Gets columnLower (if column does not exist then 0.0)*
- double [getColUpper](#) (int whichColumn) const  
*Gets columnUpper (if column does not exist then COIN\_DBL\_MAX)*
- double [getColObjective](#) (int whichColumn) const  
*Gets columnObjective (if column does not exist then 0.0)*
- const char \* [getColName](#) (int whichColumn) const  
*Gets name (if column does not exist then NULL)*
- bool [getCollsInteger](#) (int whichColumn) const  
*Gets if integer (if column does not exist then false)*
- const char \* [getRowLowerAsString](#) (int whichRow) const  
*Gets rowLower (if row does not exist then -COIN\_DBL\_MAX)*
- const char \* [getRowUpperAsString](#) (int whichRow) const  
*Gets rowUpper (if row does not exist then +COIN\_DBL\_MAX)*
- const char \* [rowLowerAsString](#) (int whichRow) const
- const char \* [rowUpperAsString](#) (int whichRow) const  
*Gets rowUpper (if row does not exist then COIN\_DBL\_MAX)*
- const char \* [getColumnLowerAsString](#) (int whichColumn) const  
*Gets columnLower (if column does not exist then 0.0)*
- const char \* [getColumnUpperAsString](#) (int whichColumn) const  
*Gets columnUpper (if column does not exist then COIN\_DBL\_MAX)*
- const char \* [getColumnObjectiveAsString](#) (int whichColumn) const  
*Gets columnObjective (if column does not exist then 0.0)*

- const char \* [getColumnIsIntegerAsString](#) (int whichColumn) const  
*Gets if integer (if column does not exist then false)*
- const char \* [columnLowerAsString](#) (int whichColumn) const  
*Gets columnLower (if column does not exist then 0.0)*
- const char \* [columnUpperAsString](#) (int whichColumn) const  
*Gets columnUpper (if column does not exist then COIN\_DBL\_MAX)*
- const char \* [columnObjectiveAsString](#) (int whichColumn) const  
*Gets columnObjective (if column does not exist then 0.0)*
- const char \* [objectiveAsString](#) (int whichColumn) const  
*Gets columnObjective (if column does not exist then 0.0)*
- const char \* [columnIsIntegerAsString](#) (int whichColumn) const  
*Gets if integer (if column does not exist then false)*
- const char \* [isIntegerAsString](#) (int whichColumn) const  
*Gets if integer (if column does not exist then false)*
- int [row](#) (const char \*rowName) const  
*Row index from row name (-1 if no names or no match)*
- int [column](#) (const char \*columnName) const  
*Column index from column name (-1 if no names or no match)*
- int [type](#) () const  
*Returns type.*
- double [unsetValue](#) () const  
*returns unset value*
- int [createPackedMatrix](#) ([CoinPackedMatrix](#) &matrix, const double \*associated)  
  
*Creates a packed matrix - return number of errors.*
- int [countPlusMinusOne](#) (CoinBigIndex \*startPositive, CoinBigIndex \*startNegative, const double \*associated)  
*Fills in startPositive and startNegative with counts for +-1 matrix.*
- void [createPlusMinusOne](#) (CoinBigIndex \*startPositive, CoinBigIndex \*startNegative, int \*indices, const double \*associated)  
*Creates +-1 matrix given startPositive and startNegative counts for +-1 matrix.*
- int [createArrays](#) (double \*&rowLower, double \*&rowUpper, double \*&columnLower, double \*&columnUpper, double \*&objective, int \*&integerType, double \*&associated)  
  
*Creates copies of various arrays - return number of errors.*
- bool [stringsExist](#) () const  
*Says if strings exist.*
- const [CoinModelHash](#) \* [stringArray](#) () const  
*Return string array.*
- double \* [associatedArray](#) () const  
*Returns associated array.*
- double \* [rowLowerArray](#) () const  
*Return rowLower array.*
- double \* [rowUpperArray](#) () const  
*Return rowUpper array.*
- double \* [columnLowerArray](#) () const  
*Return columnLower array.*

- double \* [columnUpperArray](#) () const  
*Return columnUpper array.*
- double \* [objectiveArray](#) () const  
*Return objective array.*
- int \* [integerTypeArray](#) () const  
*Return integerType array.*
- const [CoinModelHash](#) \* [rowNames](#) () const  
*Return row names array.*
- const [CoinModelHash](#) \* [columnNames](#) () const  
*Return column names array.*
- const int \* [cutMarker](#) () const  
*Returns array of 0 or nonzero if can be a cut (or returns NULL)*
- double [optimizationDirection](#) () const  
*Direction of optimization (1 - minimize, -1 - maximize, 0 - ignore.*
- void [setOptimizationDirection](#) (double value)  
*Set direction of optimization (1 - minimize, -1 - maximize, 0 - ignore.*
- void \* [moreInfo](#) () const  
*Return pointer to more information.*
- void [setMoreInfo](#) (void \*info)  
*Set pointer to more information.*
- int [whatsSet](#) () const  
*Returns which parts of model are set 1 - matrix 2 - rhs 4 - row names 8 - column bounds and/or objective 16 - column names 32 - integer types.*

for block models - matrix will be [CoinPackedMatrix](#)

- void [loadBlock](#) (const [CoinPackedMatrix](#) &matrix, const double \*collb, const double \*colub, const double \*obj, const double \*rowlb, const double \*rowub)  
*Load in a problem by copying the arguments.*
- void [loadBlock](#) (const [CoinPackedMatrix](#) &matrix, const double \*collb, const double \*colub, const double \*obj, const char \*rowSen, const double \*rowrhs, const double \*rowrng)  
*Load in a problem by copying the arguments.*
- void [loadBlock](#) (const int numcols, const int numRows, const [CoinBigIndex](#) \*start, const int \*index, const double \*value, const double \*collb, const double \*colub, const double \*obj, const double \*rowlb, const double \*rowub)  
*Load in a problem by copying the arguments.*
- void [loadBlock](#) (const int numcols, const int numRows, const [CoinBigIndex](#) \*start, const int \*index, const double \*value, const double \*collb, const double \*colub, const double \*obj, const char \*rowSen, const double \*rowrhs, const double \*rowrng)  
*Load in a problem by copying the arguments.*

Constructors, destructor

- [CoinModel](#) ()  
*Default constructor.*
- [CoinModel](#) (const char \*fileName, int allowStrings=0)  
*Read a problem in MPS or GAMS format from the given filename.*

- [CoinModel](#) (int nonLinear, const char \*fileName, const void \*info)  
*Read a problem from AMPL nl file NOTE - as I can't work out configure etc the source code is in Cbc\_ampl.cpp!*
- [CoinModel](#) (int numberOfRows, int numberColumns, const [CoinPackedMatrix](#) \*matrix, const double \*rowLower, const double \*rowUpper, const double \*columnLower, const double \*columnUpper, const double \*objective)  
*From arrays.*
- virtual [CoinBaseModel](#) \* [clone](#) () const  
*Clone.*
- virtual [~CoinModel](#) ()  
*Destructor.*

**Copy method**

- [CoinModel](#) (const [CoinModel](#) &)  
*The copy constructor.*
- [CoinModel](#) & [operator=](#) (const [CoinModel](#) &)  
=

**For debug**

- void [validateLinks](#) () const  
*Checks that links are consistent.*

**8.41.1 Detailed Description**

This is a simple minded model which is stored in a format which makes it easier to construct and modify but not efficient for algorithms.

It has to be passed across to ClpModel or OsiSolverInterface by addRows, addCol(umn)s or loadProblem.

It may have up to four parts - 1) A matrix of doubles (or strings - see note A) 2) Column information including integer information and names 3) Row information including names 4) Quadratic objective (not implemented - but see A)

This class is meant to make it more efficient to build a model. It is at its most efficient when all additions are done as addRow or as addCol but not mixed. If only 1 and 2 exist then solver.addColumns may be used to pass to solver, if only 1 and 3 exist then solver.addRows may be used. Otherwise solver.loadProblem must be used.

If addRows and addColumns are mixed or if individual elements are set then the speed will drop to some extent and more memory will be used.

It is also possible to iterate over existing elements and to access columns and rows by name. Again each of these use memory and cpu time. However memory is unlikely to be critical as most algorithms will use much more.

Notes: A) Although this could be used to pass nonlinear information around the only use at present is to have named values e.g. value1 which can then be set to a value after model is created. I have no idea whether that could be useful but I thought it might be fun. Quadratic terms are allowed in strings! A solver could try and use this if so - the convention is that 0.5\* quadratic is stored

B) This class could be useful for modeling.

Definition at line 152 of file CoinModel.hpp.

#### 8.41.2 Constructor & Destructor Documentation

##### 8.41.2.1 CoinModel::CoinModel ( )

Default constructor.

##### 8.41.2.2 CoinModel::CoinModel ( const CoinModel & )

The copy constructor.

#### 8.41.3 Member Function Documentation

##### 8.41.3.1 int CoinModel::getRow ( int *whichRow*, int \* *column*, double \* *element* )

Gets sorted row - user must provide enough space (easiest is allocate number of columns).

If column or element NULL then just returns number Returns number of elements

##### 8.41.3.2 int CoinModel::getColumn ( int *whichColumn*, int \* *column*, double \* *element* )

Gets sorted column - user must provide enough space (easiest is allocate number of rows).

If row or element NULL then just returns number Returns number of elements

##### 8.41.3.3 void CoinModel::deleteRow ( int *whichRow* )

Deletes all entries in row and bounds.

Will be ignored by writeMps etc and will be packed down if asked for.

##### 8.41.3.4 void CoinModel::deleteColumn ( int *whichColumn* )

Deletes all entries in column and bounds and objective.

Will be ignored by writeMps etc and will be packed down if asked for.

##### 8.41.3.5 void CoinModel::deleteCol ( int *whichColumn* ) [inline]

Deletes all entries in column and bounds.

If last column the number of columns will be decremented and true returned.

Definition at line 333 of file CoinModel.hpp.

##### 8.41.3.6 int CoinModel::packRows ( )

Packs down all rows i.e.

removes empty rows permanently. Empty rows have no elements and feasible bounds. returns number of rows deleted.

#### 8.41.3.7 int CoinModel::packColumns ( )

Packs down all columns i.e.

removes empty columns permanently. Empty columns have no elements and no objective. returns number of columns deleted.

#### 8.41.3.8 int CoinModel::packCols ( ) [inline]

Packs down all columns i.e.

removes empty columns permanently. Empty columns have no elements and no objective. returns number of columns deleted.

Definition at line 347 of file CoinModel.hpp.

#### 8.41.3.9 int CoinModel::pack ( )

Packs down all rows and columns.

i.e. removes empty rows and columns permanently. Empty rows have no elements and feasible bounds. Empty columns have no elements and no objective. returns number of rows+columns deleted.

#### 8.41.3.10 int CoinModel::writeMps ( const char \* filename, int compression = 0, int formatType = 0, int numberAcross = 2, bool keepStrings = false )

Write the problem in MPS format to a file with the given filename.

#### Parameters

<i>compression</i>	can be set to three values to indicate what kind of file should be written <ul style="list-style-type: none"> <li>• 0: plain text (default)</li> <li>• 1: gzip compressed (.gz is appended to <i>filename</i>)</li> <li>• 2: bzip2 compressed (.bz2 is appended to <i>filename</i>) (TODO)</li> </ul> <p>If the library was not compiled with the requested compression then <code>writeMps</code> falls back to writing a plain text file.</p>
<i>formatType</i>	specifies the precision to used for values in the MPS file <ul style="list-style-type: none"> <li>• 0: normal precision (default)</li> <li>• 1: extra accuracy</li> <li>• 2: IEEE hex</li> </ul>
<i>numberAcross</i>	specifies whether 1 or 2 (default) values should be specified on every data line in the MPS file.

not const as may change model e.g. fill in default bounds

8.41.3.11 `int CoinModel::differentModel ( CoinModel & other, bool ignoreNames )`

Check two models against each other.

Return nonzero if different. Ignore names if that set. May modify both models by cleaning up

8.41.3.12 `int CoinModel::convertMatrix ( )`

Convert elements to [CoinPackedMatrix](#) (and switch off element updates).

Returns number of errors

8.41.3.13 `const char* CoinModel::getElementAsString ( int i, int j ) const`

Returns value for row i and column j as string.

Returns NULL if does not exist. Returns "Numeric" if not a string

8.41.3.14 `double* CoinModel::pointer ( int i, int j ) const`

Returns pointer to element for row i column j.

Only valid until next modification. NULL if element does not exist

8.41.3.15 `int CoinModel::position ( int i, int j ) const`

Returns position in elements for row i column j.

Only valid until next modification. -1 if element does not exist

8.41.3.16 `CoinModelLink CoinModel::firstInRow ( int whichRow ) const`

Returns first element in given row - index is -1 if none.

Index is given by `.index` and value by `.value`

8.41.3.17 `CoinModelLink CoinModel::lastInRow ( int whichRow ) const`

Returns last element in given row - index is -1 if none.

Index is given by `.index` and value by `.value`

8.41.3.18 `CoinModelLink CoinModel::firstInColumn ( int whichColumn ) const`

Returns first element in given column - index is -1 if none.

Index is given by `.index` and value by `.value`

8.41.3.19 `CoinModelLink CoinModel::lastInColumn ( int whichColumn ) const`

Returns last element in given column - index is -1 if none.

Index is given by `.index` and value by `.value`

**8.41.3.20 CoinModelLink CoinModel::next ( CoinModelLink & *current* ) const**

Returns next element in current row or column - index is -1 if none.

Index is given by `.index` and value by `.value`. User could also tell because `input.next` would be NULL

**8.41.3.21 CoinModelLink CoinModel::previous ( CoinModelLink & *current* ) const**

Returns previous element in current row or column - index is -1 if none.

Index is given by `.index` and value by `.value`. User could also tell because `input.previous` would be NULL May not be correct if matrix updated.

**8.41.3.22 CoinModelLink CoinModel::firstInQuadraticColumn ( int *whichColumn* ) const**

Returns first element in given quadratic column - index is -1 if none.

Index is given by `.index` and value by `.value` May not be correct if matrix updated.

**8.41.3.23 CoinModelLink CoinModel::lastInQuadraticColumn ( int *whichColumn* ) const**

Returns last element in given quadratic column - index is -1 if none.

Index is given by `.index` and value by `.value`

**8.41.3.24 int CoinModel::countPlusMinusOne ( CoinBigIndex \* *startPositive*, CoinBigIndex \* *startNegative*, const double \* *associated* )**

Fills in `startPositive` and `startNegative` with counts for +-1 matrix.

If not +-1 then `startPositive[0]==-1` otherwise counts and `startPositive[numberColumns]==size`

- return number of errors

**8.41.3.25 void CoinModel::loadBlock ( const CoinPackedMatrix & *matrix*, const double \* *collb*, const double \* *colub*, const double \* *obj*, const double \* *rowlb*, const double \* *rowub* )**

Load in a problem by copying the arguments.

The constraints on the rows are given by lower and upper bounds.

If a pointer is 0 then the following values are the default:

- `colub`: all columns have upper bound infinity
- `collb`: all columns have lower bound 0
- `rowub`: all rows have upper bound infinity
- `rowlb`: all rows have lower bound -infinity
- `obj`: all variables have 0 objective coefficient

Note that the default values for `rowub` and `rowlb` produce the constraint  $-inf \leq ax \leq inf$ . This is probably not what you want.

**8.41.3.26** `void CoinModel::loadBlock ( const CoinPackedMatrix & matrix, const double * collb, const double * colub, const double * obj, const char * rowsen, const double * rowrhs, const double * rowrng )`

Load in a problem by copying the arguments.

The constraints on the rows are given by `sense/rhs/range` triplets.

If a pointer is 0 then the following values are the default:

- `colub`: all columns have upper bound infinity
- `collb`: all columns have lower bound 0
- `obj`: all variables have 0 objective coefficient
- `rowsen`: all rows are  $\geq$
- `rowrhs`: all right hand sides are 0
- `rowrng`: 0 for the ranged rows

Note that the default values for `rowsen`, `rowrhs`, and `rowrng` produce the constraint  $ax \geq 0$ .

**8.41.3.27** `void CoinModel::loadBlock ( const int numcols, const int numrows, const CoinBigIndex * start, const int * index, const double * value, const double * collb, const double * colub, const double * obj, const double * rowlb, const double * rowub )`

Load in a problem by copying the arguments.

The constraint matrix is specified with standard column-major column starts / row indices / coefficients vectors. The constraints on the rows are given by lower and upper bounds.

The matrix vectors must be gap-free. Note that `start` must have `numcols+1` entries so that the length of the last column can be calculated as `start[numcols]-start[numcols-1]`.

See the previous `loadBlock` method using `rowlb` and `rowub` for default argument values.

**8.41.3.28** `void CoinModel::loadBlock ( const int numcols, const int numrows, const CoinBigIndex * start, const int * index, const double * value, const double * collb, const double * colub, const double * obj, const char * rowsen, const double * rowrhs, const double * rowrng )`

Load in a problem by copying the arguments.

The constraint matrix is specified with standard column-major column starts / row indices / coefficients vectors. The constraints on the rows are given by `sense/rhs/range` triplets.

The matrix vectors must be gap-free. Note that `start` must have `numcols+1` entries so that the length of the last column can be calculated as `start[numcols]-start[numcols-1]`.

See the previous `loadBlock` method using `sense/rhs/range` for default argument values.

#### 8.41.3.29 CoinModel\* CoinModel::reorder ( const char \* mark ) const

If possible return a model where if all variables marked nonzero are fixed the problem will be linear.

At present may only work if quadratic. Returns NULL if not possible

#### 8.41.3.30 int CoinModel::expandKnapsack ( int knapsackRow, int & numberOutput, double \* buildObj, CoinBigIndex \* buildStart, int \* buildRow, double \* buildElement, int reConstruct = -1 ) const

Expands out all possible combinations for a knapsack If `buildObj` NULL then just computes space needed - returns number elements On entry `numberOutput` is maximum allowed, on exit it is number needed or.

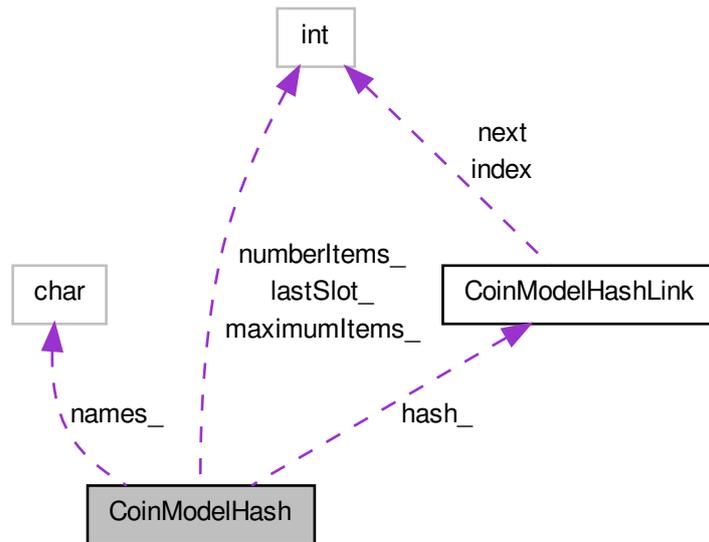
-1 (as will be number elements) if maximum exceeded. `numberOutput` will have at least space to return values which reconstruct input. Rows returned will be original rows but no entries will be returned for any rows all of whose entries are in knapsack. So up to user to allow for this. If `reConstruct`  $\geq 0$  then returns number of entries which make up item "reConstruct" in expanded knapsack. Values in `buildRow` and `buildElement`;

The documentation for this class was generated from the following file:

- CoinModel.hpp

## 8.42 CoinModelHash Class Reference

Collaboration diagram for CoinModelHash:



## Public Member Functions

## Constructors, destructor

- [CoinModelHash](#) ()  
*Default constructor.*
- [~CoinModelHash](#) ()  
*Destructor.*

## Copy method

- [CoinModelHash](#) (const [CoinModelHash](#) &)  
*The copy constructor.*
- [CoinModelHash](#) & `operator=` (const [CoinModelHash](#) &)  
=

## sizing (just increases)

- void [resize](#) (int maxItems, bool forceReHash=false)  
*Resize hash (also re-hashes)*

- int `numberItems` () const  
*Number of items i.e. rows if just row names.*
- void `setNumberItems` (int number)  
*Set number of items.*
- int `maximumItems` () const  
*Maximum number of items.*
- const char \*const `names` () const  
*Names.*

#### hashing

- int `hash` (const char \*name) const  
*Returns index or -1.*
- void `addHash` (int index, const char \*name)  
*Adds to hash.*
- void `deleteHash` (int index)  
*Deletes from hash.*
- const char \* `name` (int which) const  
*Returns name at position (or NULL)*
- char \* `getName` (int which) const  
*Returns non const name at position (or NULL)*
- void `setName` (int which, char \*name)  
*Sets name at position (does not create)*
- void `validateHash` () const  
*Validates.*

#### 8.42.1 Detailed Description

Definition at line 180 of file `CoinModelUseful.hpp`.

#### 8.42.2 Constructor & Destructor Documentation

##### 8.42.2.1 `CoinModelHash::CoinModelHash ( )`

Default constructor.

##### 8.42.2.2 `CoinModelHash::CoinModelHash ( const CoinModelHash & )`

The copy constructor.

The documentation for this class was generated from the following file:

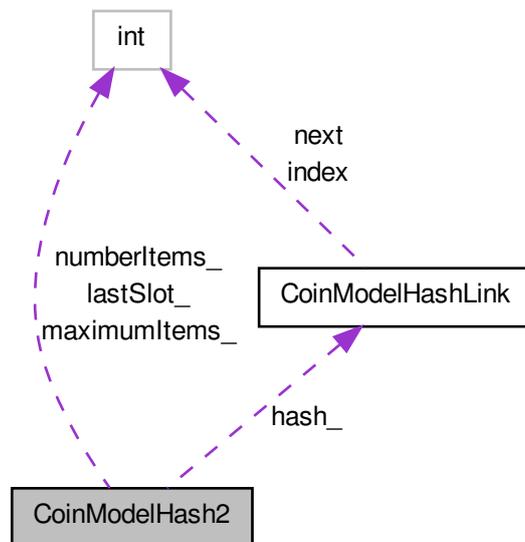
- `CoinModelUseful.hpp`

## 8.43 CoinModelHash2 Class Reference

For int,int hashing.

```
#include <CoinModelUseful.hpp>
```

Collaboration diagram for CoinModelHash2:



## Public Member Functions

## Constructors, destructor

- [CoinModelHash2 \(\)](#)  
*Default constructor.*
- [~CoinModelHash2 \(\)](#)  
*Destructor.*

## Copy method

- [CoinModelHash2 \(const CoinModelHash2 &\)](#)  
*The copy constructor.*
- [CoinModelHash2 & operator= \(const CoinModelHash2 &\)](#)  
=

**sizing (just increases)**

- void [resize](#) (int maxItems, const [CoinModelTriple](#) \*triples, bool forceReHash=false)

*Resize hash (also re-hashes)*

- int [numberItems](#) () const

*Number of items.*

- void [setNumberItems](#) (int number)

*Set number of items.*

- int [maximumItems](#) () const

*Maximum number of items.*

**hashing**

- int [hash](#) (int row, int column, const [CoinModelTriple](#) \*triples) const

*Returns index or -1.*

- void [addHash](#) (int index, int row, int column, const [CoinModelTriple](#) \*triples)

*Adds to hash.*

- void [deleteHash](#) (int index, int row, int column)

*Deletes from hash.*

**8.43.1 Detailed Description**

For int,int hashing.

Definition at line 253 of file CoinModelUseful.hpp.

**8.43.2 Constructor & Destructor Documentation****8.43.2.1 CoinModelHash2::CoinModelHash2 ( )**

Default constructor.

**8.43.2.2 CoinModelHash2::CoinModelHash2 ( const CoinModelHash2 & )**

The copy constructor.

The documentation for this class was generated from the following file:

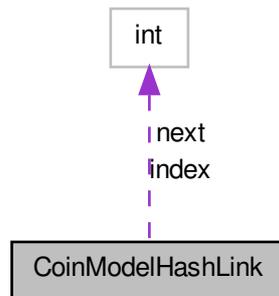
- CoinModelUseful.hpp

**8.44 CoinModelHashLink Struct Reference**

for names and hashing

```
#include <CoinModelUseful.hpp>
```

Collaboration diagram for CoinModelHashLink:



#### 8.44.1 Detailed Description

for names and hashing

Definition at line 128 of file `CoinModelUseful.hpp`.

The documentation for this struct was generated from the following file:

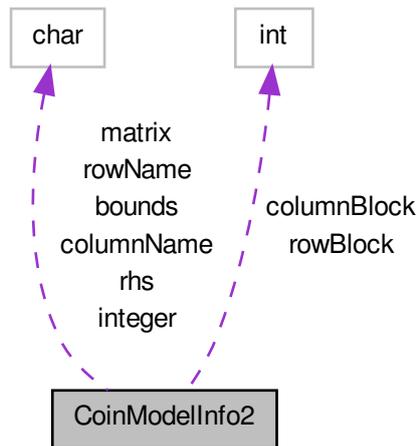
- `CoinModelUseful.hpp`

## 8.45 CoinModelInfo2 Struct Reference

This is a model which is made up of `Coin(Structured)Model` blocks.

```
#include <CoinStructuredModel.hpp>
```

Collaboration diagram for CoinModelInfo2:



#### 8.45.1 Detailed Description

This is a model which is made up of Coin(Structured)Model blocks.

Definition at line 15 of file CoinStructuredModel.hpp.

The documentation for this struct was generated from the following file:

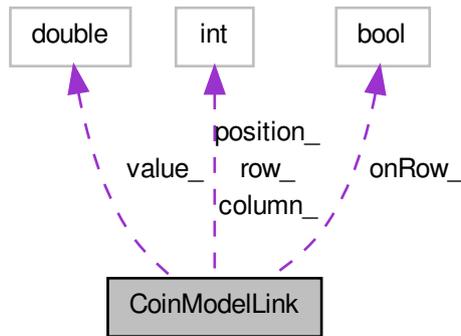
- CoinStructuredModel.hpp

#### 8.46 CoinModelLink Class Reference

This is for various structures/classes needed by [CoinModel](#).

```
#include <CoinModelUseful.hpp>
```

Collaboration diagram for CoinModelLink:



#### Public Member Functions

##### Constructors, destructor

- [CoinModelLink](#) ()  
*Default constructor.*
- [~CoinModelLink](#) ()  
*Destructor.*

##### Copy method

- [CoinModelLink](#) (const [CoinModelLink](#) &)  
*The copy constructor.*
- [CoinModelLink](#) & [operator=](#) (const [CoinModelLink](#) &)  
=

##### Sets and gets method

- int [row](#) () const  
*Get row.*
- int [column](#) () const  
*Get column.*
- double [value](#) () const  
*Get value.*
- double [element](#) () const  
*Get value.*
- int [position](#) () const  
*Get position.*

- bool [onRow](#) () const  
*Get onRow.*
- void [setRow](#) (int row)  
*Set row.*
- void [setColumn](#) (int column)  
*Set column.*
- void [setValue](#) (double value)  
*Set value.*
- void [setElement](#) (double value)  
*Set value.*
- void [setPosition](#) (int position)  
*Set position.*
- void [setOnRow](#) (bool onRow)  
*Set onRow.*

#### 8.46.1 Detailed Description

This is for various structures/classes needed by [CoinModel](#).

[CoinModelLink](#) [CoinModelLinkedList](#) [CoinModelHash](#) for going through row or column

Definition at line 30 of file [CoinModelUseful.hpp](#).

#### 8.46.2 Constructor & Destructor Documentation

##### 8.46.2.1 [CoinModelLink::CoinModelLink](#) ( )

Default constructor.

##### 8.46.2.2 [CoinModelLink::CoinModelLink](#) ( const [CoinModelLink](#) & )

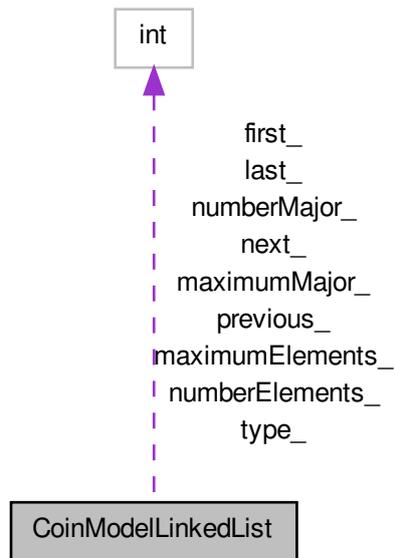
The copy constructor.

The documentation for this class was generated from the following file:

- [CoinModelUseful.hpp](#)

## 8.47 CoinModelLinkedList Class Reference

Collaboration diagram for CoinModelLinkedList:



## Public Member Functions

## Constructors, destructor

- [CoinModelLinkedList \(\)](#)  
*Default constructor.*
- [~CoinModelLinkedList \(\)](#)  
*Destructor.*

## Copy method

- [CoinModelLinkedList \(const CoinModelLinkedList &\)](#)  
*The copy constructor.*
- [CoinModelLinkedList & operator= \(const CoinModelLinkedList &\)](#)  
=

## sizing (just increases)

- void [resize](#) (int maxMajor, int maxElements)

- Resize list - for row list maxMajor is maximum rows.*
- void **create** (int maxMajor, int maxElements, int numberMajor, int numberMinor, int type, int numberElements, const **CoinModelTriple** \*triples)
  - Create list - for row list maxMajor is maximum rows.*
- int **numberMajor** () const
  - Number of major items i.e. rows if just row links.*
- int **maximumMajor** () const
  - Maximum number of major items i.e. rows if just row links.*
- int **numberElements** () const
  - Number of elements.*
- int **maximumElements** () const
  - Maximum number of elements.*
- int **firstFree** () const
  - First on free chain.*
- int **lastFree** () const
  - Last on free chain.*
- int **first** (int which) const
  - First on chain.*
- int **last** (int which) const
  - Last on chain.*
- const int \* **next** () const
  - Next array.*
- const int \* **previous** () const
  - Previous array.*

#### does work

- int **addEasy** (int majorIndex, int numberOfElements, const int \*indices, const double \*elements, **CoinModelTriple** \*triples, **CoinModelHash2** &hash)
  - Adds to list - easy case i.e.*
- void **addHard** (int minorIndex, int numberOfElements, const int \*indices, const double \*elements, **CoinModelTriple** \*triples, **CoinModelHash2** &hash)
  - Adds to list - hard case i.e.*
- void **addHard** (int first, const **CoinModelTriple** \*triples, int firstFree, int lastFree, const int \*nextOther)
  - Adds to list - hard case i.e.*
- void **deleteSame** (int which, **CoinModelTriple** \*triples, **CoinModelHash2** &hash, bool zapTriples)
  - Deletes from list - same case i.e.*
- void **updateDeleted** (int which, **CoinModelTriple** \*triples, **CoinModelLinkedList** &otherList)
  - Deletes from list - other case i.e.*
- void **deleteRowOne** (int position, **CoinModelTriple** \*triples, **CoinModelHash2** &hash)
  - Deletes one element from Row list.*
- void **updateDeletedOne** (int position, const **CoinModelTriple** \*triples)
  - Update column list for one element when one element deleted from row copy.*
- void **fill** (int first, int last)
  - Fills first,last with -1.*
- void **synchronize** (**CoinModelLinkedList** &other)
  - Puts in free list from other list.*
- void **validateLinks** (const **CoinModelTriple** \*triples) const
  - Checks that links are consistent.*

## 8.47.1 Detailed Description

Definition at line 312 of file CoinModelUseful.hpp.

## 8.47.2 Constructor &amp; Destructor Documentation

## 8.47.2.1 CoinModelLinkedList::CoinModelLinkedList ( )

Default constructor.

## 8.47.2.2 CoinModelLinkedList::CoinModelLinkedList ( const CoinModelLinkedList &amp; )

The copy constructor.

## 8.47.3 Member Function Documentation

8.47.3.1 void CoinModelLinkedList::create ( int *maxMajor*, int *maxElements*, int *numberMajor*, int *numberMinor*, int *type*, int *numberElements*, const CoinModelTriple \* *triples* )

Create list - for row list maxMajor is maximum rows.

type 0 row list, 1 column list

8.47.3.2 int CoinModelLinkedList::addEasy ( int *majorIndex*, int *numberOfElements*, const int \* *indices*, const double \* *elements*, CoinModelTriple \* *triples*, CoinModelHash2 & *hash* )

Adds to list - easy case i.e.

add row to row list Returns where chain starts

8.47.3.3 void CoinModelLinkedList::addHard ( int *minorIndex*, int *numberOfElements*, const int \* *indices*, const double \* *elements*, CoinModelTriple \* *triples*, CoinModelHash2 & *hash* )

Adds to list - hard case i.e.

add row to column list

8.47.3.4 void CoinModelLinkedList::addHard ( int *first*, const CoinModelTriple \* *triples*, int *firstFree*, int *lastFree*, const int \* *nextOther* )

Adds to list - hard case i.e.

add row to column list This is when elements have been added to other copy

8.47.3.5 void CoinModelLinkedList::deleteSame ( int *which*, CoinModelTriple \* *triples*, CoinModelHash2 & *hash*, bool *zapTriples* )

Deletes from list - same case i.e.

delete row from row list

8.47.3.6 void CoinModelLinkedList::updateDeleted ( int *which*, CoinModelTriple \* *triples*, CoinModelLinkedList & *otherList* )

Deletes from list - other case i.e.

delete row from column list This is when elements have been deleted from other copy

The documentation for this class was generated from the following file:

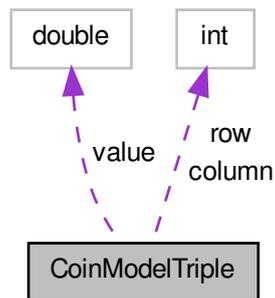
- CoinModelUseful.hpp

## 8.48 CoinModelTriple Struct Reference

for linked lists

```
#include <CoinModelUseful.hpp>
```

Collaboration diagram for CoinModelTriple:



### 8.48.1 Detailed Description

for linked lists

Definition at line 107 of file CoinModelUseful.hpp.

The documentation for this struct was generated from the following file:

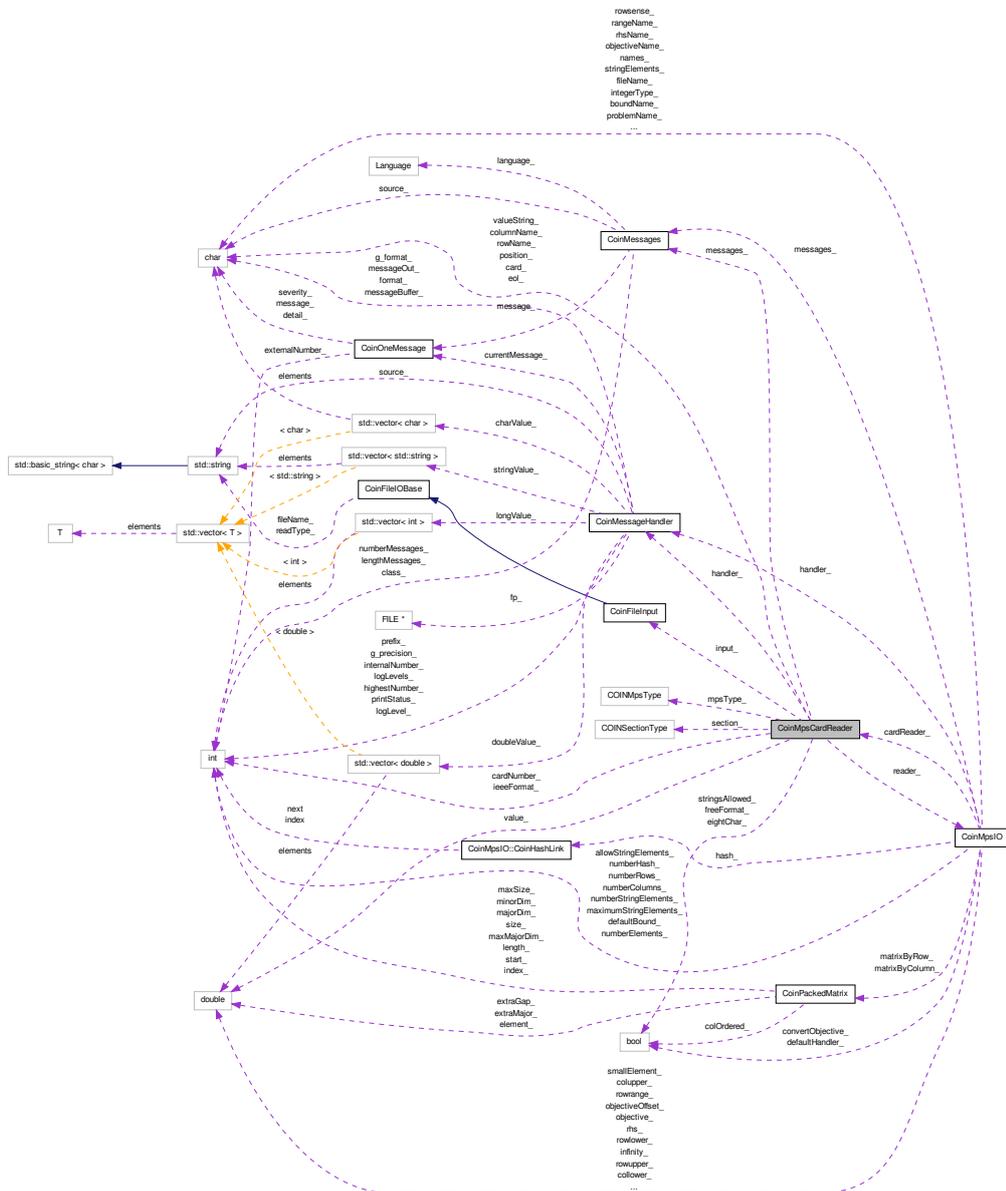
- CoinModelUseful.hpp

## 8.49 CoinMpsCardReader Class Reference

Very simple code for reading MPS data.

```
#include <CoinMpsIO.hpp>
```

Collaboration diagram for CoinMpsCardReader:



Public Member Functions

### Constructor and destructor

- `CoinMpsCardReader (CoinFileInput *input, CoinMpsIO *reader)`  
*Constructor expects file to be open This one takes gzFile if fp null.*
- `~CoinMpsCardReader ()`  
*Destructor.*

### card stuff

- `COINSectionType readToNextSection ()`  
*Read to next section.*
- `COINSectionType nextField ()`  
*Gets next field and returns section type e.g. COIN\_COLUMN\_SECTION.*
- `int nextGmsField (int expectedType)`  
*Gets next field for .gms file and returns type.*
- `COINSectionType whichSection () const`  
*Returns current section type.*
- `void setWhichSection (COINSectionType section)`  
*Sets current section type.*
- `bool freeFormat () const`  
*Sees if free format.*
- `void setFreeFormat (bool yesNo)`  
*Sets whether free format. Mainly for blank RHS etc.*
- `COINMpsType mpsType () const`  
*Only for first field on card otherwise BLANK\_COLUMN e.g.*
- `int cleanCard ()`  
*Reads and cleans card - taking out trailing blanks - return 1 if EOF.*
- `const char * rowName () const`  
*Returns row name of current field.*
- `const char * columnName () const`  
*Returns column name of current field.*
- `double value () const`  
*Returns value in current field.*
- `const char * valueString () const`  
*Returns value as string in current field.*
- `const char * card () const`  
*Whole card (for printing)*
- `char * mutableCard ()`  
*Whole card - so we look at it (not const so nextBlankOr will work for gms reader)*
- `void setPosition (char *position)`  
*set position (again so gms reader will work)*
- `char * getPosition () const`  
*get position (again so gms reader will work)*
- `CoinBigIndex cardNumber () const`  
*Returns card number.*
- `CoinFileInput * fileInput () const`  
*Returns file input.*
- `void setStringsAllowed ()`  
*Sets whether strings allowed.*

## Protected Attributes

## data

- double [value\\_](#)  
*Current value.*
- char [card\\_](#) [MAX\_CARD\_LENGTH]  
*Current card image.*
- char \* [position\\_](#)  
*Current position within card image.*
- char \* [eol\\_](#)  
*End of card.*
- COINMpsType [mpsType\\_](#)  
*Current COINMpsType.*
- char [rowName\\_](#) [COIN\_MAX\_FIELD\_LENGTH]  
*Current row name.*
- char [columnName\\_](#) [COIN\_MAX\_FIELD\_LENGTH]  
*Current column name.*
- [CoinFileInput](#) \* [input\\_](#)  
*File input.*
- COINSectionType [section\\_](#)  
*Which section we think we are in.*
- CoinBigIndex [cardNumber\\_](#)  
*Card number.*
- bool [freeFormat\\_](#)  
*Whether free format. Just for blank RHS etc.*
- int [ieeeFormat\\_](#)  
*Whether IEEE - 0 no, 1 INTEL, 2 not INTEL.*
- bool [eightChar\\_](#)  
*If all names <= 8 characters then allow embedded blanks.*
- [CoinMpsIO](#) \* [reader\\_](#)  
*MpsIO.*
- [CoinMessageHandler](#) \* [handler\\_](#)  
*Message handler.*
- [CoinMessages](#) [messages\\_](#)  
*Messages.*
- char [valueString\\_](#) [COIN\_MAX\_FIELD\_LENGTH]  
*Current element as characters (only if strings allowed)*
- bool [stringsAllowed\\_](#)  
*Whether strings allowed.*

## methods

- double [osi\\_strtod](#) (char \*ptr, char \*\*output, int type)  
*type - 0 normal, 1 INTEL IEEE, 2 other IEEE*
- double [osi\\_strtod](#) (char \*ptr, char \*\*output)  
*For strings.*
- static void [strcpyAndCompress](#) (char \*to, const char \*from)  
*remove blanks*
- static char \* [nextBlankOr](#) (char \*image)

### 8.49.1 Detailed Description

Very simple code for reading MPS data.

Definition at line 58 of file CoinMpsIO.hpp.

### 8.49.2 Member Function Documentation

#### 8.49.2.1 int CoinMpsCardReader::nextGmsField ( int *expectedType* )

Gets next field for .gms file and returns type.

-1 - EOF 0 - what we expected (and processed so pointer moves past) 1 - not what we expected leading blanks always ignored input types 0 - anything - stops on non blank card 1 - name (in columnname) 2 - value 3 - value name pair 4 - equation type 5 - ;

#### 8.49.2.2 COINMpsType CoinMpsCardReader::mpsType ( ) const [inline]

Only for first field on card otherwise BLANK\_COLUMN e.g.

COIN\_E\_ROW

Definition at line 109 of file CoinMpsIO.hpp.

The documentation for this class was generated from the following file:

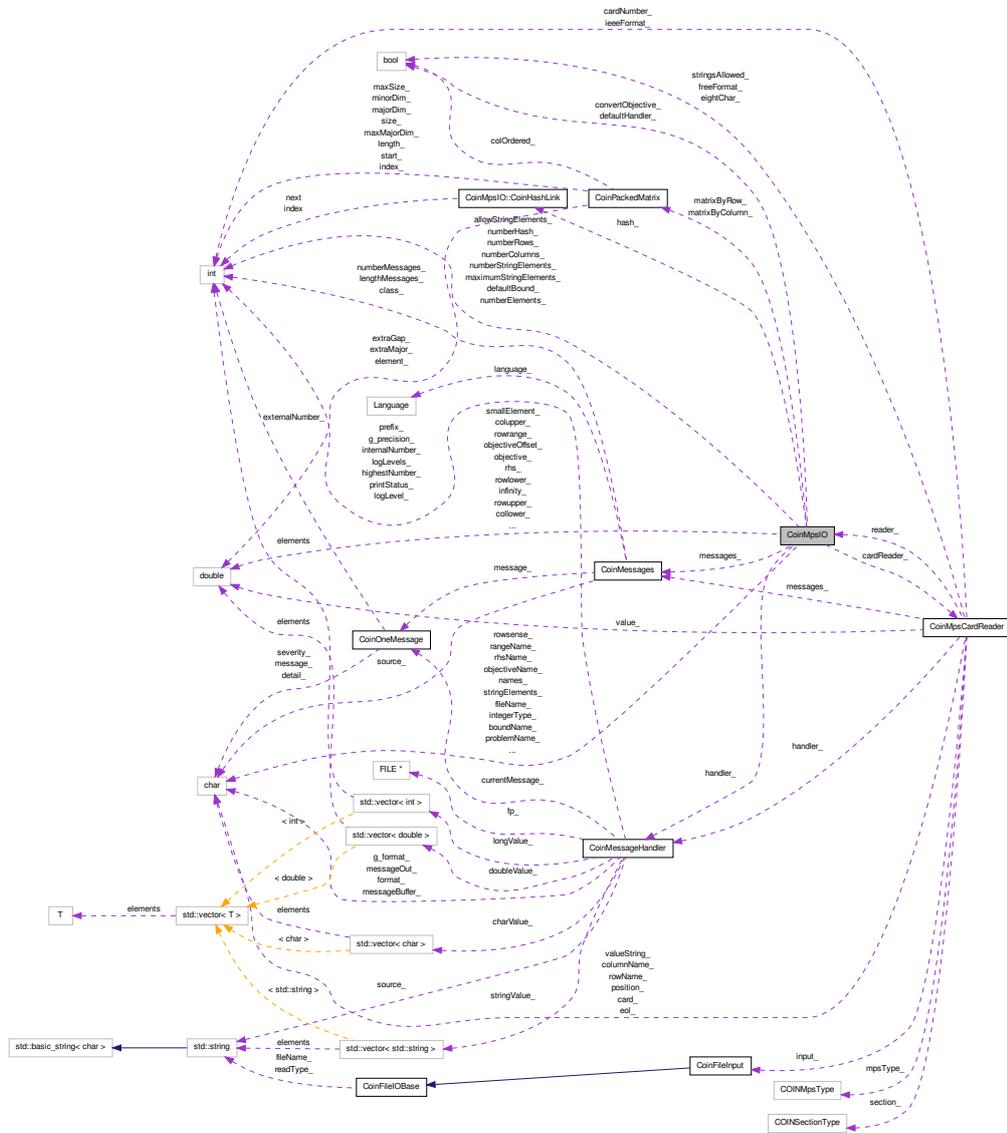
- CoinMpsIO.hpp

## 8.50 CoinMpsIO Class Reference

MPS IO Interface.

```
#include <CoinMpsIO.hpp>
```

Collaboration diagram for CoinMpsIO:



Classes

- struct [CoinHashLink](#)

Public Member Functions

### Methods to retrieve problem information

These methods return information about the problem held by the [CoinMpsIO](#) object. Querying an object that has no data associated with it result in zeros for the number of rows and columns, and NULL pointers from the methods that return vectors. Const pointers returned from any data-query method are always valid

- int [getNumCols](#) () const  
*Get number of columns.*
- int [getNumRows](#) () const  
*Get number of rows.*
- int [getNumElements](#) () const  
*Get number of nonzero elements.*
- const double \* [getColLower](#) () const  
*Get pointer to array[getNumCols()] of column lower bounds.*
- const double \* [getColUpper](#) () const  
*Get pointer to array[getNumCols()] of column upper bounds.*
- const char \* [getRowSense](#) () const  
*Get pointer to array[getNumRows()] of constraint senses.*
- const double \* [getRightHandSide](#) () const  
*Get pointer to array[getNumRows()] of constraint right-hand sides.*
- const double \* [getRowRange](#) () const  
*Get pointer to array[getNumRows()] of row ranges.*
- const double \* [getRowLower](#) () const  
*Get pointer to array[getNumRows()] of row lower bounds.*
- const double \* [getRowUpper](#) () const  
*Get pointer to array[getNumRows()] of row upper bounds.*
- const double \* [getObjCoefficients](#) () const  
*Get pointer to array[getNumCols()] of objective function coefficients.*
- const [CoinPackedMatrix](#) \* [getMatrixByRow](#) () const  
*Get pointer to row-wise copy of the coefficient matrix.*
- const [CoinPackedMatrix](#) \* [getMatrixByCol](#) () const  
*Get pointer to column-wise copy of the coefficient matrix.*
- bool [isContinuous](#) (int colNumber) const  
*Return true if column is a continuous variable.*
- bool [isInteger](#) (int columnNumber) const  
*Return true if a column is an integer variable.*
- const char \* [integerColumns](#) () const  
*Returns array[getNumCols()] specifying if a variable is integer.*
- const char \* [rowName](#) (int index) const  
*Returns the row name for the specified index.*
- const char \* [columnName](#) (int index) const  
*Returns the column name for the specified index.*
- int [rowIndex](#) (const char \*name) const  
*Returns the index for the specified row name.*
- int [columnIndex](#) (const char \*name) const  
*Returns the index for the specified column name.*
- double [objectiveOffset](#) () const

- Returns the (constant) objective offset.*

  - void `setObjectiveOffset` (double value)
    - Set objective offset.*
  - const char \* `getProblemName` () const
    - Return the problem name.*
  - const char \* `getObjectiveName` () const
    - Return the objective name.*
  - const char \* `getRhsName` () const
    - Return the RHS vector name.*
  - const char \* `getRangeName` () const
    - Return the range vector name.*
  - const char \* `getBoundName` () const
    - Return the bound vector name.*
  - int `numberStringElements` () const
    - Number of string elements.*
  - const char \* `stringElement` (int i) const
    - String element.*

#### Methods to set problem information

*Methods to load a problem into the `CoinMpsIO` object.*

- void `setMpsData` (const `CoinPackedMatrix` &m, const double infinity, const double \*collb, const double \*colub, const double \*obj, const char \*integrality, const double \*rowlb, const double \*rowub, char const \*const \*const colnames, char const \*const \*const rownames)
  - Set the problem data.*
- void `setMpsData` (const `CoinPackedMatrix` &m, const double infinity, const double \*collb, const double \*colub, const double \*obj, const char \*integrality, const double \*rowlb, const double \*rowub, const std::vector< std::string > &colnames, const std::vector< std::string > &rownames)
- void `setMpsData` (const `CoinPackedMatrix` &m, const double infinity, const double \*collb, const double \*colub, const double \*obj, const char \*integrality, const char \*rowlen, const double \*rowrhs, const double \*rowrng, char const \*const \*const colnames, char const \*const \*const rownames)
- void `setMpsData` (const `CoinPackedMatrix` &m, const double infinity, const double \*collb, const double \*colub, const double \*obj, const char \*integrality, const char \*rowlen, const double \*rowrhs, const double \*rowrng, const std::vector< std::string > &colnames, const std::vector< std::string > &rownames)
- void `copyInIntegerInformation` (const char \*integerInformation)
  - Pass in an array[`getNumCols()`] specifying if a variable is integer.*
- void `setProblemName` (const char \*name)
  - Set problem name.*
- void `setObjectiveName` (const char \*name)
  - Set objective name.*

## Parameter set/get methods

Methods to set and retrieve MPS IO parameters.

- void [setInfinity](#) (double value)  
*Set infinity.*
- double [getInfinity](#) () const  
*Get infinity.*
- void [setDefaultBound](#) (int value)  
*Set default upper bound for integer variables.*
- int [getDefaultBound](#) () const  
*Get default upper bound for integer variables.*
- int [allowStringElements](#) () const  
*Whether to allow string elements.*
- void [setAllowStringElements](#) (int yesNo)  
*Whether to allow string elements (0 no, 1 yes, 2 yes and try flip)*
- double [getSmallElementValue](#) () const  
*Small element value - elements less than this set to zero on input default is 1.0e-14.*
- void [setSmallElementValue](#) (double value)

## Methods for problem input and output

Methods to read and write MPS format problem files.

The read and write methods return the number of errors that occurred during the IO operation, or -1 if no file is opened.

**Note**

If the [CoinMpsIO](#) class was compiled with support for libz then [readMps](#) will automatically try to append .gz to the file name and open it as a compressed file if the specified file name cannot be opened. (Automatic append of the .bz2 suffix when libbz is used is on the TODO list.)

- void [setFileName](#) (const char \*name)  
*Set the current file name for the [CoinMpsIO](#) object.*
- const char \* [getFileName](#) () const  
*Get the current file name for the [CoinMpsIO](#) object.*
- int [readMps](#) (const char \*filename, const char \*extension="mps")  
*Read a problem in MPS format from the given filename.*
- int [readMps](#) (const char \*filename, const char \*extension, int &numberSets, [CoinSet](#) \*\*&sets)  
*Read a problem in MPS format from the given filename.*
- int [readMps](#) ()  
*Read a problem in MPS format from a previously opened file.*
- int [readMps](#) (int &numberSets, [CoinSet](#) \*\*&sets)  
*and*
- int [readBasis](#) (const char \*filename, const char \*extension, double \*solution, unsigned char \*rowStatus, unsigned char \*columnStatus, const std::vector< std::string > &colnames, int numberColumns, const std::vector< std::string > &rownames, int numberOfRows)

- Read a basis in MPS format from the given filename.*

  - int [readGms](#) (const char \*filename, const char \*extension="gms", bool convertObjective=false)
- Read a problem in GAMS format from the given filename.*

  - int [readGms](#) (const char \*filename, const char \*extension, int &numberSets, [CoinSet](#) \*\*&sets)
- Read a problem in GAMS format from the given filename.*

  - int [readGms](#) (int &numberSets, [CoinSet](#) \*\*&sets)
- Read a problem in GAMS format from a previously opened file.*

  - int [readGMPL](#) (const char \*modelName, const char \*dataName=NULL, bool keepNames=false)
- Read a problem in GMPL (subset of AMPL) format from the given filenames.*

  - int [writeMps](#) (const char \*filename, int compression=0, int formatType=0, int numberAcross=2, [CoinPackedMatrix](#) \*quadratic=NULL, int numberSOS=0, const [CoinSet](#) \*setInfo=NULL) const
- Write the problem in MPS format to a file with the given filename.*

  - const [CoinMpsCardReader](#) \* [reader](#) () const
- Return card reader object so can see what last card was e.g. QUADOBJ.*

  - int [readQuadraticMps](#) (const char \*filename, int \*&columnStart, int \*&column, double \*&elements, int checkSymmetry)
- Read in a quadratic objective from the given filename.*

  - int [readConicMps](#) (const char \*filename, int \*&columnStart, int \*&column, int &numberCones)
- Read in a list of cones from the given filename.*

  - void [setConvertObjective](#) (bool trueFalse)
- Set whether to move objective from matrix.*

  - int [copyStringElements](#) (const [CoinModel](#) \*model)
- copies in strings from a [CoinModel](#) - returns number*

#### Constructors and destructors

- [CoinMpsIO](#) ()  
*Default Constructor.*
- [CoinMpsIO](#) (const [CoinMpsIO](#) &)  
*Copy constructor.*
- [CoinMpsIO](#) & [operator=](#) (const [CoinMpsIO](#) &rhs)  
*Assignment operator.*
- [~CoinMpsIO](#) ()  
*Destructor.*

#### Message handling

- void [passInMessageHandler](#) ([CoinMessageHandler](#) \*handler)  
*Pass in Message handler.*
- void [newLanguage](#) ([CoinMessages::Language](#) language)  
*Set the language for messages.*
- void [setLanguage](#) ([CoinMessages::Language](#) language)  
*Set the language for messages.*
- [CoinMessageHandler](#) \* [messageHandler](#) () const  
*Return the message handler.*
- [CoinMessages](#) [messages](#) ()  
*Return the messages.*
- [CoinMessages](#) \* [messagesPointer](#) ()  
*Return the messages pointer.*

### Methods to release storage

These methods allow the client to reduce the storage used by the [CoinMpsIO](#) object by selectively releasing unneeded problem information.

- void [releaseRedundantInformation](#) ()  
*Release all information which can be re-calculated.*
- void [releaseRowInformation](#) ()  
*Release all row information (lower, upper)*
- void [releaseColumnInformation](#) ()  
*Release all column information (lower, upper, objective)*
- void [releaseIntegerInformation](#) ()  
*Release integer information.*
- void [releaseRowNames](#) ()  
*Release row names.*
- void [releaseColumnNames](#) ()  
*Release column names.*
- void [releaseMatrixInformation](#) ()  
*Release matrix information.*

### Protected Member Functions

#### Miscellaneous helper functions

- void [setMpsDataWithoutRowAndColNames](#) (const [CoinPackedMatrix](#) &m, const double infinity, const double \*collb, const double \*colub, const double \*obj, const char \*integrality, const double \*rowlb, const double \*rowub)  
*Utility method used several times to implement public methods.*
- void [setMpsDataColAndRowNames](#) (const std::vector< std::string > &colnames, const std::vector< std::string > &rownames)
- void [setMpsDataColAndRowNames](#) (char const \*const \*const colnames, char const \*const \*const rownames)
- void [gutsOfDestructor](#) ()  
*Does the heavy lifting for destruct and assignment.*
- void [gutsOfCopy](#) (const [CoinMpsIO](#) &)  
*Does the heavy lifting for copy and assignment.*
- void [freeAll](#) ()  
*Clears problem data from the [CoinMpsIO](#) object.*
- void [convertBoundToSense](#) (const double lower, const double upper, char &sense, double &right, double &range) const  
*A quick inlined function to convert from lb/ub style constraint definition to sense/rhs/range style.*
- void [convertSenseToBound](#) (const char sense, const double right, const double range, double &lower, double &upper) const  
*A quick inlined function to convert from sense/rhs/range style constraint definition to lb/ub style.*
- int [dealWithFileName](#) (const char \*filename, const char \*extension, [CoinFileInput](#) \*&input)  
*Deal with a filename.*

- void [addString](#) (int iRow, int iColumn, const char \*value)  
*Add string to list iRow==numberRows is objective, nr+1 is lo, nr+2 is up iColumn==nc is rhs (can't cope with ranges at present)*
- void [decodeString](#) (int iString, int &iRow, int &iColumn, const char \*&value) const  
*Decode string.*

#### Hash table methods

- void [startHash](#) (char \*\*names, const int number, int section)  
*Creates hash list for names (section = 0 for rows, 1 columns)*
- void [startHash](#) (int section) const  
*This one does it when names are already in.*
- void [stopHash](#) (int section)  
*Deletes hash storage.*
- int [findHash](#) (const char \*name, int section) const  
*Finds match using hash, -1 not found.*

#### Protected Attributes

##### Cached problem information

- char \* [problemName\\_](#)  
*Problem name.*
- char \* [objectiveName\\_](#)  
*Objective row name.*
- char \* [rhsName\\_](#)  
*Right-hand side vector name.*
- char \* [rangeName\\_](#)  
*Range vector name.*
- char \* [boundName\\_](#)  
*Bounds vector name.*
- int [numberRows\\_](#)  
*Number of rows.*
- int [numberColumns\\_](#)  
*Number of columns.*
- CoinBigIndex [numberElements\\_](#)  
*Number of coefficients.*
- char \* [rowsense\\_](#)  
*Pointer to dense vector of row sense indicators.*
- double \* [rhs\\_](#)  
*Pointer to dense vector of row right-hand side values.*
- double \* [rowrange\\_](#)  
*Pointer to dense vector of slack variable upper bounds for range constraints (undefined for non-range rows)*
- [CoinPackedMatrix](#) \* [matrixByRow\\_](#)  
*Pointer to row-wise copy of problem matrix coefficients.*
- [CoinPackedMatrix](#) \* [matrixByColumn\\_](#)

- Pointer to column-wise copy of problem matrix coefficients.*
- double \* [rowlower\\_](#)
  - Pointer to dense vector of row lower bounds.*
- double \* [rowupper\\_](#)
  - Pointer to dense vector of row upper bounds.*
- double \* [collower\\_](#)
  - Pointer to dense vector of column lower bounds.*
- double \* [colupper\\_](#)
  - Pointer to dense vector of column upper bounds.*
- double \* [objective\\_](#)
  - Pointer to dense vector of objective coefficients.*
- double [objectiveOffset\\_](#)
  - Constant offset for objective value (i.e., RHS value for OBJ row)*
- char \* [integerType\\_](#)
  - Pointer to dense vector specifying if a variable is continuous (0) or integer (1).*
- char \*\* [names\\_](#) [2]
  - Row and column names Linked to hash table sections (0 - row names, 1 column names)*

#### Hash tables

- char \* [fileName\\_](#)
  - Current file name.*
- int [numberHash\\_](#) [2]
  - Number of entries in a hash table section.*
- [CoinHashLink](#) \* [hash\\_](#) [2]
  - Hash tables (two sections, 0 - row names, 1 - column names)*

#### CoinMpsIO object parameters

- int [defaultBound\\_](#)
  - Upper bound when no bounds for integers.*
- double [infinity\\_](#)
  - Value to use for infinity.*
- double [smallElement\\_](#)
  - Small element value.*
- [CoinMessageHandler](#) \* [handler\\_](#)
  - Message handler.*
- bool [defaultHandler\\_](#)
  - Flag to say if the message handler is the default handler.*
- [CoinMessages](#) [messages\\_](#)
  - Messages.*
- [CoinMpsCardReader](#) \* [cardReader\\_](#)
  - Card reader.*
- bool [convertObjective\\_](#)
  - If .gms file should it be massaged to move objective.*
- int [allowStringElements\\_](#)
  - Whether to allow string elements.*
- int [maximumStringElements\\_](#)
  - Maximum number of string elements.*
- int [numberStringElements\\_](#)
  - Number of string elements.*
- char \*\* [stringElements\\_](#)
  - String elements.*

### Friends

- void [CoinMpsIOUnitTest](#) (const std::string &mpsDir)  
*A function that tests the methods in the [CoinMpsIO](#) class.*

### 8.50.1 Detailed Description

MPS IO Interface.

This class can be used to read in mps files without a solver. After reading the file, the [CoinMpsIO](#) object contains all relevant data, which may be more than a particular [OsiSolverInterface](#) allows for. Items may be deleted to allow for flexibility of data storage.

The implementation makes the [CoinMpsIO](#) object look very like a dummy solver, as the same conventions are used.

Definition at line 328 of file [CoinMpsIO.hpp](#).

### 8.50.2 Member Function Documentation

#### 8.50.2.1 const char\* CoinMpsIO::getRowSense ( ) const

Get pointer to array[[getNumRows\(\)](#)] of constraint senses.

- 'L': <= constraint
- 'E': = constraint
- 'G': >= constraint
- 'R': ranged constraint
- 'N': free constraint

#### 8.50.2.2 const double\* CoinMpsIO::getRightHandSide ( ) const

Get pointer to array[[getNumRows\(\)](#)] of constraint right-hand sides.

Given constraints with upper (rowupper) and/or lower (rowlower) bounds, the constraint right-hand side (rhs) is set as

- if [rowsense\(\)\[i\]](#) == 'L' then [rhs\(\)\[i\]](#) == [rowupper\(\)\[i\]](#)
- if [rowsense\(\)\[i\]](#) == 'G' then [rhs\(\)\[i\]](#) == [rowlower\(\)\[i\]](#)
- if [rowsense\(\)\[i\]](#) == 'R' then [rhs\(\)\[i\]](#) == [rowupper\(\)\[i\]](#)
- if [rowsense\(\)\[i\]](#) == 'N' then [rhs\(\)\[i\]](#) == 0.0

**8.50.2.3** `const double* CoinMpsIO::getRowRange ( ) const`

Get pointer to array[[getNumRows\(\)](#)] of row ranges.

Given constraints with upper (rowupper) and/or lower (rowlower) bounds, the constraint range (rowrange) is set as

- if `rowsense()[i] == 'R'` then `rowrange()[i] == rowupper()[i] - rowlower()[i]`
- if `rowsense()[i] != 'R'` then `rowrange()[i]` is 0.0

Put another way, only range constraints have a nontrivial value for rowrange.

**8.50.2.4** `bool CoinMpsIO::isInteger ( int columnNumber ) const`

Return true if a column is an integer variable.

Note: This function returns true if the the column is a binary or general integer variable.

**8.50.2.5** `const char* CoinMpsIO::integerColumns ( ) const`

Returns array[[getNumCols\(\)](#)] specifying if a variable is integer.

At present, simply coded as zero (continuous) and non-zero (integer) May be extended at a later date.

**8.50.2.6** `const char* CoinMpsIO::rowName ( int index ) const`

Returns the row name for the specified index.

Returns 0 if the index is out of range.

**8.50.2.7** `const char* CoinMpsIO::columnName ( int index ) const`

Returns the column name for the specified index.

Returns 0 if the index is out of range.

**8.50.2.8** `int CoinMpsIO::rowIndex ( const char * name ) const`

Returns the index for the specified row name.

Returns -1 if the name is not found. Returns `numberRows` for the objective row and `> numberRows` for dropped free rows.

**8.50.2.9** `int CoinMpsIO::columnIndex ( const char * name ) const`

Returns the index for the specified column name.

Returns -1 if the name is not found.

**8.50.2.10** `double CoinMpsIO::objectiveOffset ( ) const`

Returns the (constant) objective offset.

This is the RHS entry for the objective row

8.50.2.11 void CoinMpsIO::copyIntegerInformation ( const char \* *integerInformation* )

Pass in an array[getNumCols()] specifying if a variable is integer.

At present, simply coded as zero (continuous) and non-zero (integer) May be extended at a later date.

8.50.2.12 int CoinMpsIO::readMps ( const char \* *filename*, const char \* *extension* = "mps" )

Read a problem in MPS format from the given filename.

Use "stdin" or "-" to read from stdin.

8.50.2.13 int CoinMpsIO::readMps ( const char \* *filename*, const char \* *extension*, int & *numberSets*, CoinSet \*\*& *sets* )

Read a problem in MPS format from the given filename.

Use "stdin" or "-" to read from stdin. But do sets as well

8.50.2.14 int CoinMpsIO::readMps ( )

Read a problem in MPS format from a previously opened file.

More precisely, read a problem using a [CoinMpsCardReader](#) object already associated with this [CoinMpsIO](#) object.

8.50.2.15 int CoinMpsIO::readBasis ( const char \* *filename*, const char \* *extension*, double \* *solution*, unsigned char \* *rowStatus*, unsigned char \* *columnStatus*, const std::vector< std::string > & *colnames*, int *numberColumns*, const std::vector< std::string > & *rownames*, int *numberRows* )

Read a basis in MPS format from the given filename.

If VALUES on NAME card and solution not NULL fills in solution status values as for [CoinWarmStartBasis](#) (but one per char) -1 file error, 0 normal, 1 has solution values

Use "stdin" or "-" to read from stdin.

If sizes of names incorrect - read without names

8.50.2.16 int CoinMpsIO::readGms ( const char \* *filename*, const char \* *extension* = "gms", bool *convertObjective* = false )

Read a problem in GAMS format from the given filename.

Use "stdin" or "-" to read from stdin. if convertObjective then messages objective column

8.50.2.17 int CoinMpsIO::readGms ( const char \* *filename*, const char \* *extension*, int & *numberSets*, CoinSet \*\*& *sets* )

Read a problem in GAMS format from the given filename.

Use "stdin" or "-" to read from stdin. But do sets as well

8.50.2.18 `int CoinMpsIO::readGms ( int & numberSets, CoinSet **& sets )`

Read a problem in GAMS format from a previously opened file.

More precisely, read a problem using a [CoinMpsCardReader](#) object already associated with this [CoinMpsIO](#) object. and

8.50.2.19 `int CoinMpsIO::writeMps ( const char * filename, int compression = 0, int formatType = 0, int numberAcross = 2, CoinPackedMatrix * quadratic = NULL, int numberSOS = 0, const CoinSet * setInfo = NULL ) const`

Write the problem in MPS format to a file with the given filename.

#### Parameters

<i>compression</i>	can be set to three values to indicate what kind of file should be written <ul style="list-style-type: none"> <li>• 0: plain text (default)</li> <li>• 1: gzip compressed (.gz is appended to <i>filename</i>)</li> <li>• 2: bzip2 compressed (.bz2 is appended to <i>filename</i>) (TODO)</li> </ul> <p>If the library was not compiled with the requested compression then <code>writeMps</code> falls back to writing a plain text file.</p>
<i>formatType</i>	specifies the precision to used for values in the MPS file <ul style="list-style-type: none"> <li>• 0: normal precision (default)</li> <li>• 1: extra accuracy</li> <li>• 2: IEEE hex</li> </ul>
<i>number-Across</i>	specifies whether 1 or 2 (default) values should be specified on every data line in the MPS file.
<i>quadratic</i>	specifies quadratic objective to be output

8.50.2.20 `int CoinMpsIO::readQuadraticMps ( const char * filename, int *& columnStart, int *& column, double *& elements, int checkSymmetry )`

Read in a quadratic objective from the given filename.

If *filename* is NULL (or the same as the currently open file) then reading continues from the current file. If not, the file is closed and the specified file is opened.

Code should be added to general MPS reader to read this if QSECTION Data is assumed to be Q and objective is  $c + 1/2 \sum xT Q x$  No assumption is made for symmetry, positive definite, etc. No check is made for duplicates or non-triangular if `checkSymmetry==0`. If 1 checks lower triangular (so off diagonal should be  $2*Q$ ) if 2 makes lower triangular and assumes full Q (but adds off diagonals)

Arrays should be deleted by `delete []`

Returns number of errors:

- -1: bad file
- -2: no Quadratic section
- -3: an empty section

- +n: then matching errors etc (symmetry forced)
- -4: no matching errors but fails triangular test (triangularity forced)

columnStart is numberColumns+1 long, others numberNonZeros

**8.50.2.21** `int CoinMpsIO::readConicMps ( const char * filename, int *& columnStart, int *& column, int & numberCones )`

Read in a list of cones from the given filename.

If filename is NULL (or the same as the currently open file) then reading continues from the current file. If not, the file is closed and the specified file is opened.

Code should be added to general MPS reader to read this if CSECTION No checking is done that in unique cone

Arrays should be deleted by delete []

Returns number of errors, -1 bad file, -2 no conic section, -3 empty section

columnStart is numberCones+1 long, other number of columns in matrix

**8.50.2.22** `void CoinMpsIO::passinMessageHandler ( CoinMessageHandler * handler )`

Pass in Message handler.

Supply a custom message handler. It will not be destroyed when the [CoinMpsIO](#) object is destroyed.

**8.50.2.23** `void CoinMpsIO::releaseRedundantInformation ( )`

Release all information which can be re-calculated.

E.g., row sense, copies of rows, hash tables for names.

**8.50.2.24** `int CoinMpsIO::dealWithFileName ( const char * filename, const char * extension, CoinFileInput *& input ) [protected]`

Deal with a filename.

As the name says. Returns +1 if the file name is new, 0 if it's the same as before (i.e., matches fileName\_), and -1 if there's an error and the file can't be opened. Handles automatic append of .gz suffix when compiled with libz.

### 8.50.3 Friends And Related Function Documentation

**8.50.3.1** `void CoinMpsIOUnitTest ( const std::string & mpsDir ) [friend]`

A function that tests the methods in the [CoinMpsIO](#) class.

The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging. Also, if this method is compiled with optimization, the compilation takes 10-15 minutes and the machine

pages (has 256M core memory!)

#### 8.50.4 Member Data Documentation

##### 8.50.4.1 `bool CoinMpsIO::defaultHandler_` [protected]

Flag to say if the message handler is the default handler.

If true, the handler will be destroyed when the `CoinMpsIO` object is destroyed; if false, it will not be destroyed.

Definition at line 1012 of file `CoinMpsIO.hpp`.

The documentation for this class was generated from the following file:

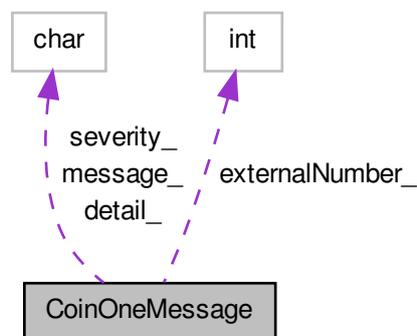
- `CoinMpsIO.hpp`

## 8.51 CoinOneMessage Class Reference

Class for one massaged message.

```
#include <CoinMessageHandler.hpp>
```

Collaboration diagram for `CoinOneMessage`:



### Public Member Functions

#### Constructors etc

- `CoinOneMessage ()`  
*Default constructor.*

- [CoinOneMessage](#) (int externalNumber, char detail, const char \*message)  
*Normal constructor.*
- [~CoinOneMessage](#) ()  
*Destructor.*
- [CoinOneMessage](#) (const [CoinOneMessage](#) &)  
*The copy constructor.*
- [CoinOneMessage](#) & [operator=](#) (const [CoinOneMessage](#) &)  
*assignment operator.*

#### Useful stuff

- void [replaceMessage](#) (const char \*message)  
*Replace message text (e.g., text in a different language)*

#### Get and set methods

- int [externalNumber](#) () const  
*Get message ID number.*
- void [setExternalNumber](#) (int number)  
*Set message ID number.*
- char [severity](#) () const  
*Severity.*
- void [setDetail](#) (int level)  
*Set detail level.*
- int [detail](#) () const  
*Get detail level.*
- char \* [message](#) () const  
*Return the message text.*

#### Public Attributes

##### member data

- int [externalNumber\\_](#)  
*number to print out (also determines severity)*
- char [detail\\_](#)  
*Will only print if detail matches.*
- char [severity\\_](#)  
*Severity.*
- char [message\\_](#) [400]  
*Messages (in correct language) (not all 400 may exist)*

#### 8.51.1 Detailed Description

Class for one massaged message.

A message consists of a text string with formatting codes ([message\\_](#)), an integer identifier ([externalNumber\\_](#)) which also determines the severity level ([severity\\_](#)) of the message, and a detail (logging) level ([detail\\_](#)).

[CoinOneMessage](#) is just a container to hold this information. The interpretation is set by [CoinMessageHandler](#), which see.

Definition at line 54 of file [CoinMessageHandler.hpp](#).

### 8.51.2 Constructor & Destructor Documentation

#### 8.51.2.1 CoinOneMessage::CoinOneMessage ( )

Default constructor.

### 8.51.3 Member Function Documentation

#### 8.51.3.1 CoinOneMessage& CoinOneMessage::operator= ( const CoinOneMessage & )

assignment operator.

#### 8.51.3.2 void CoinOneMessage::setExternalNumber ( int *number* ) [inline]

Set message ID number.

In the default [CoinMessageHandler](#), this number is printed in the message prefix and is used to determine the message severity level.

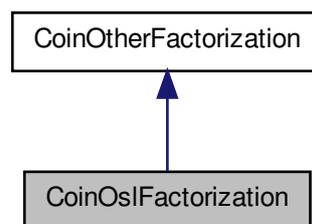
Definition at line 88 of file `CoinMessageHandler.hpp`.

The documentation for this class was generated from the following file:

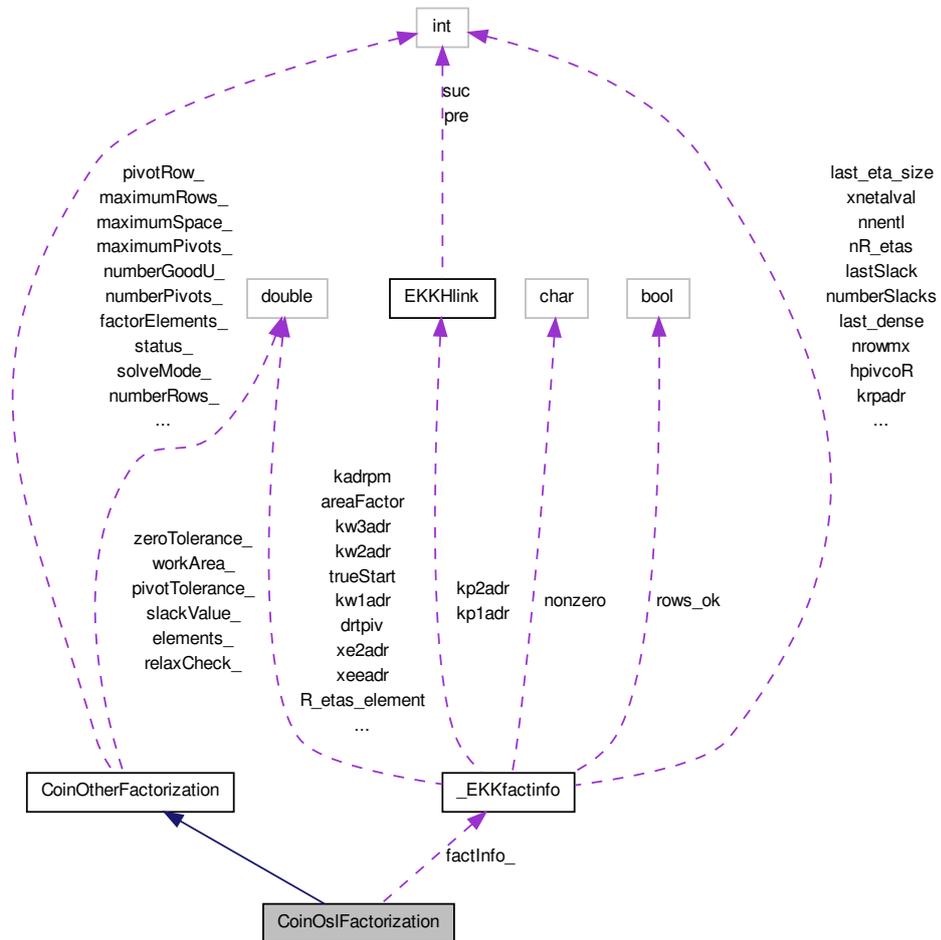
- [CoinMessageHandler.hpp](#)

## 8.52 CoinOslFactorization Class Reference

Inheritance diagram for CoinOslFactorization:



Collaboration diagram for CoinOslFactorization:



### Public Member Functions

- void [gutsOfDestructor](#) (bool clearFact=true)  
*The real work of desstructor.*
- void [gutsOfInitialize](#) (bool zapFact=true)  
*The real work of constructor.*
- void [gutsOfCopy](#) (const [CoinOslFactorization](#) &other)  
*The real work of copy.*

**Constructors and destructor and copy**

- [CoinOslFactorization](#) ()  
*Default constructor.*
- [CoinOslFactorization](#) (const [CoinOslFactorization](#) &other)  
*Copy constructor.*
- virtual [~CoinOslFactorization](#) ()  
*Destructor.*
- [CoinOslFactorization](#) & [operator=](#) (const [CoinOslFactorization](#) &other)  
*= copy*
- virtual [CoinOtherFactorization](#) \* [clone](#) () const  
*Clone.*

**Do factorization - public**

- virtual void [getAreas](#) (int numberOfRows, int numberColumns, CoinBigIndex maximumL, CoinBigIndex maximumU)  
*Gets space for a factorization.*
- virtual void [preProcess](#) ()  
*PreProcesses column ordered copy of basis.*
- virtual int [factor](#) ()  
*Does most of factorization returning status 0 - OK.*
- virtual void [postProcess](#) (const int \*sequence, int \*pivotVariable)  
*Does post processing on valid factorization - putting variables on correct rows.*
- virtual void [makeNonSingular](#) (int \*sequence, int numberColumns)  
*Makes a non-singular basis by replacing variables.*
- int [factorize](#) (const [CoinPackedMatrix](#) &matrix, int rowIsBasic[], int columnIsBasic[], double areaFactor=0.0)  
*When part of LP - given by basic variables.*

**general stuff such as number of elements**

- virtual int [numberElements](#) () const  
*Total number of elements in factorization.*
- virtual [CoinFactorizationDouble](#) \* [elements](#) () const  
*Returns array to put basis elements in.*
- virtual int \* [pivotRow](#) () const  
*Returns pivot row.*
- virtual [CoinFactorizationDouble](#) \* [workArea](#) () const  
*Returns work area.*
- virtual int \* [intWorkArea](#) () const  
*Returns int work area.*
- virtual int \* [numberInRow](#) () const  
*Number of entries in each row.*
- virtual int \* [numberInColumn](#) () const  
*Number of entries in each column.*
- virtual [CoinBigIndex](#) \* [starts](#) () const  
*Returns array to put basis starts in.*
- virtual int \* [permuteBack](#) () const

- Returns permute back.*

  - virtual bool [wantsTableauColumn](#) () const
 

*Returns true if wants tableauColumn in replaceColumn.*
  - virtual void [setUsefullInformation](#) (const int \*info, int whereFrom)
 

*Useful information for factorization 0 - iteration number whereFrom is 0 for factorize and 1 for replaceColumn.*
  - virtual void [maximumPivots](#) (int value)
 

*Set maximum pivots.*
  - double [maximumCoefficient](#) () const
 

*Returns maximum absolute value in factorization.*
  - double [conditionNumber](#) () const
 

*Condition number - product of pivots after factorization.*
  - virtual void [clearArrays](#) ()
 

*Get rid of all memory.*

#### rank one updates which do exist

- virtual int [replaceColumn](#) (CoinIndexedVector \*regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying=false, double acceptablePivot=1.0e-8)
 

*Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.*

#### various uses of factorization (return code number elements)

*which user may want to know about*

- virtual int [updateColumnFT](#) (CoinIndexedVector \*regionSparse, CoinIndexedVector \*regionSparse2, bool noPermute=false)
 

*Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.*
- virtual int [updateColumn](#) (CoinIndexedVector \*regionSparse, CoinIndexedVector \*regionSparse2, bool noPermute=false) const
 

*This version has same effect as above with FTUpdate==false so number returned is always >=0.*
- virtual int [updateTwoColumnsFT](#) (CoinIndexedVector \*regionSparse1, CoinIndexedVector \*regionSparse2, CoinIndexedVector \*regionSparse3, bool noPermute=false)
 

*does FTRAN on two columns*
- virtual int [updateColumnTranspose](#) (CoinIndexedVector \*regionSparse, CoinIndexedVector \*regionSparse2) const
 

*Updates one column (BTRAN) from regionSparse2 regionSparse starts as zero and is zero at end Note - if regionSparse2 packed on input - will be packed on output.*

#### various uses of factorization

*\*\*\* Below this user may not want to know about*

*which user may not want to know about (left over from my LP code)*

- virtual int \* [indices](#) () const  
*Get rid of all memory.*
- virtual int \* [permute](#) () const  
*Returns permute in.*

#### Protected Member Functions

- int [checkPivot](#) (double saveFromU, double oldPivot) const  
*Returns accuracy status of replaceColumn returns 0=OK, 1=Probably OK, 2=singular.*

#### Protected Attributes

data

- [EKKfactinfo factInfo\\_](#)  
*Osl factorization data.*

#### 8.52.1 Detailed Description

Definition at line 106 of file CoinOslFactorization.hpp.

#### 8.52.2 Member Function Documentation

##### 8.52.2.1 virtual int CoinOslFactorization::factor ( ) [virtual]

Does most of factorization returning status 0 - OK.

-99 - needs more memory -1 - singular - use numberGoodColumns and redo

Implements [CoinOtherFactorization](#).

##### 8.52.2.2 int CoinOslFactorization::factorize ( const CoinPackedMatrix & matrix, int rowsBasic[], int columnsBasic[], double areaFactor = 0.0 )

When part of LP - given by basic variables.

Actually does factorization. Arrays passed in have non negative value to say basic. If status is okay, basic variables have pivot row - this is only needed If status is singular, then basic variables have pivot row and ones thrown out have -1 returns 0 -okay, -1 singular, -2 too many in basis, -99 memory

##### 8.52.2.3 virtual int CoinOslFactorization::replaceColumn ( CoinIndexedVector \* regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying = false, double acceptablePivot = 1.0e-8 ) [virtual]

Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.

Whether to set this depends on speed considerations. You could just do this on first iteration after factorization and thereafter re-factorize partial update already in U

Implements [CoinOtherFactorization](#).

```
8.52.2.4 virtual int CoinOslFactorization::updateColumnFT ( CoinIndexedVector *
    regionSparse, CoinIndexedVector * regionSparse2, bool noPermute = false )
    [virtual]
```

Updates one column (FTRAN) from regionSparse2. Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.

Note - if regionSparse2 packed on input - will be packed on output

Implements [CoinOtherFactorization](#).

```
8.52.2.5 virtual int* CoinOslFactorization::indices ( ) const [virtual]
```

Get rid of all memory.

Returns array to put basis indices in

Implements [CoinOtherFactorization](#).

The documentation for this class was generated from the following file:

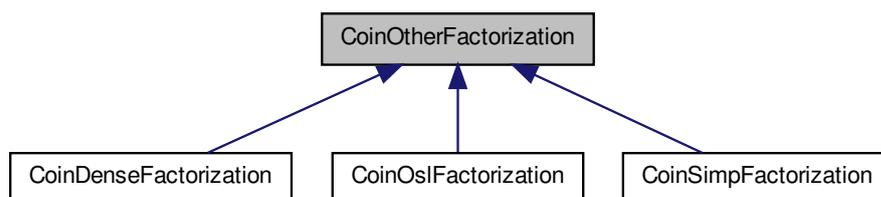
- CoinOslFactorization.hpp

### 8.53 CoinOtherFactorization Class Reference

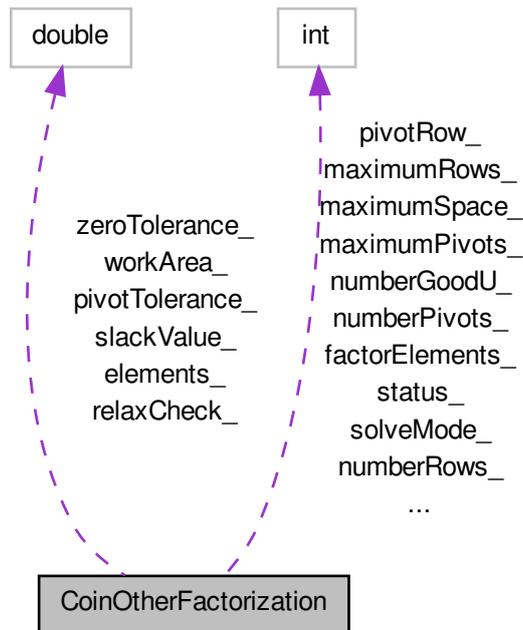
Abstract base class which also has some scalars so can be used from Dense or Simp.

```
#include <CoinDenseFactorization.hpp>
```

Inheritance diagram for CoinOtherFactorization:



Collaboration diagram for CoinOtherFactorization:



### Public Member Functions

#### Constructors and destructor and copy

- [CoinOtherFactorization](#) ()  
*Default constructor.*
- [CoinOtherFactorization](#) (const [CoinOtherFactorization](#) &other)  
*Copy constructor.*
- virtual [~CoinOtherFactorization](#) ()  
*Destructor.*
- [CoinOtherFactorization](#) & [operator=](#) (const [CoinOtherFactorization](#) &other)  
*= copy*
- virtual [CoinOtherFactorization](#) \* [clone](#) () const =0  
*Clone.*

#### general stuff such as status

- int [status](#) () const

- Returns status.*
- void [setStatus](#) (int value)
- Sets status.*
- int [pivots](#) () const
- Returns number of pivots since factorization.*
- void [setPivots](#) (int value)
- Sets number of pivots since factorization.*
- void [setNumberRows](#) (int value)
- Set number of Rows after factorization.*
- int [numberRows](#) () const
- Number of Rows after factorization.*
- int [numberColumns](#) () const
- Total number of columns in factorization.*
- int [numberGoodColumns](#) () const
- Number of good columns in factorization.*
- void [relaxAccuracyCheck](#) (double value)
- Allows change of pivot accuracy check 1.0 == none > 1.0 relaxed.*
- double [getAccuracyCheck](#) () const
- int [maximumPivots](#) () const
- Maximum number of pivots between factorizations.*
- virtual void [maximumPivots](#) (int value)
- Set maximum pivots.*
- double [pivotTolerance](#) () const
- Pivot tolerance.*
- void [pivotTolerance](#) (double value)
- double [zeroTolerance](#) () const
- Zero tolerance.*
- void [zeroTolerance](#) (double value)
- double [slackValue](#) () const
- Whether slack value is +1 or -1.*
- void [slackValue](#) (double value)
- virtual CoinFactorizationDouble \* [elements](#) () const
- Returns array to put basis elements in.*
- virtual int \* [pivotRow](#) () const
- Returns pivot row.*
- virtual CoinFactorizationDouble \* [workArea](#) () const
- Returns work area.*
- virtual int \* [intWorkArea](#) () const
- Returns int work area.*
- virtual int \* [numberInRow](#) () const
- Number of entries in each row.*
- virtual int \* [numberInColumn](#) () const
- Number of entries in each column.*
- virtual CoinBigIndex \* [starts](#) () const
- Returns array to put basis starts in.*
- virtual int \* [permuteBack](#) () const
- Returns permute back.*
- int [solveMode](#) () const

- *Get solve mode e.g.*
- void [setSolveMode](#) (int value)
- *Set solve mode e.g.*
- virtual bool [wantsTableauColumn](#) () const
- *Returns true if wants tableauColumn in replaceColumn.*
- virtual void [setUsefullInformation](#) (const int \*info, int whereFrom)
- *Useful information for factorization 0 - iteration number whereFrom is 0 for factorize and 1 for replaceColumn.*
- virtual void [clearArrays](#) ()
- *Get rid of all memory.*

#### virtual general stuff such as permutation

- virtual int \* [indices](#) () const =0
- *Returns array to put basis indices in.*
- virtual int \* [permute](#) () const =0
- *Returns permute in.*
- virtual int [numberElements](#) () const =0
- *Total number of elements in factorization.*

#### Do factorization - public

- virtual void [getAreas](#) (int numberOfRows, int numberColumns, CoinBigIndex maximumL, CoinBigIndex maximumU)=0
- *Gets space for a factorization.*
- virtual void [preProcess](#) ()=0
- *PreProcesses column ordered copy of basis.*
- virtual int [factor](#) ()=0
- *Does most of factorization returning status 0 - OK.*
- virtual void [postProcess](#) (const int \*sequence, int \*pivotVariable)=0
- *Does post processing on valid factorization - putting variables on correct rows.*
- virtual void [makeNonSingular](#) (int \*sequence, int numberColumns)=0
- *Makes a non-singular basis by replacing variables.*

#### rank one updates which do exist

- virtual int [replaceColumn](#) (CoinIndexedVector \*regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying=false, double acceptablePivot=1.0e-8)=0
- *Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.*

#### various uses of factorization (return code number elements)

*which user may want to know about*

- virtual int [updateColumnFT](#) (CoinIndexedVector \*regionSparse, CoinIndexedVector \*regionSparse2, bool noPermute=false)=0

Updates one column (FTRAN) from regionSparse2. Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.

- virtual int [updateColumn](#) (CoinIndexedVector \*regionSparse, CoinIndexedVector \*regionSparse2, bool noPermute=false) const =0

This version has same effect as above with FTUpdate==false so number returned is always >=0.

- virtual int [updateTwoColumnsFT](#) (CoinIndexedVector \*regionSparse1, CoinIndexedVector \*regionSparse2, CoinIndexedVector \*regionSparse3, bool noPermute=false)=0

does FTRAN on two columns

- virtual int [updateColumnTranspose](#) (CoinIndexedVector \*regionSparse, CoinIndexedVector \*regionSparse2) const =0

Updates one column (BTRAN) from regionSparse2 regionSparse starts as zero and is zero at end Note - if regionSparse2 packed on input - will be packed on output.

#### Protected Attributes

##### data

- double [pivotTolerance\\_](#)  
Pivot tolerance.
- double [zeroTolerance\\_](#)  
Zero tolerance.
- double [slackValue\\_](#)  
Whether slack value is +1 or -1.
- double [relaxCheck\\_](#)  
Relax check on accuracy in replaceColumn.
- CoinBigIndex [factorElements\\_](#)  
Number of elements after factorization.
- int [numberRows\\_](#)  
Number of Rows in factorization.
- int [numberColumns\\_](#)  
Number of Columns in factorization.
- int [numberGoodU\\_](#)  
Number factorized in U (not row singletons)
- int [maximumPivots\\_](#)  
Maximum number of pivots before factorization.
- int [numberPivots\\_](#)  
Number pivots since last factorization.
- int [status\\_](#)  
Status of factorization.
- int [maximumRows\\_](#)  
Maximum rows ever (i.e. use to copy arrays etc)
- CoinBigIndex [maximumSpace\\_](#)  
Maximum length of iterating area.
- int \* [pivotRow\\_](#)  
Pivot row.

- CoinFactorizationDouble \* [elements\\_](#)  
*Elements of factorization and updates length is  $\max R * \max R + \max \text{Space}$  will always be long enough so can have  $nR * nR$  ints in  $\max \text{Space}$ .*
- CoinFactorizationDouble \* [workArea\\_](#)  
*Work area of numberRows\_.*
- int [solveMode\\_](#)  
*Solve mode e.g.*

### 8.53.1 Detailed Description

Abstract base class which also has some scalars so can be used from Dense or Simp.  
Definition at line 24 of file CoinDenseFactorization.hpp.

### 8.53.2 Member Function Documentation

#### 8.53.2.1 int CoinOtherFactorization::solveMode ( ) const [inline]

Get solve mode e.g.

0 C++ code, 1 Lapack, 2 choose If 4 set then values pass if 8 set then has iterated

Definition at line 124 of file CoinDenseFactorization.hpp.

#### 8.53.2.2 void CoinOtherFactorization::setSolveMode ( int value ) [inline]

Set solve mode e.g.

0 C++ code, 1 Lapack, 2 choose If 4 set then values pass if 8 set then has iterated

Definition at line 130 of file CoinDenseFactorization.hpp.

#### 8.53.2.3 virtual int CoinOtherFactorization::factor ( ) [pure virtual]

Does most of factorization returning status 0 - OK.

-99 - needs more memory -1 - singular - use numberGoodColumns and redo

Implemented in [CoinDenseFactorization](#), [CoinOslFactorization](#), and [CoinSimpFactorization](#).

#### 8.53.2.4 virtual int CoinOtherFactorization::replaceColumn ( CoinIndexedVector \* regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying = false, double acceptablePivot = 1.0e-8 ) [pure virtual]

Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.

Whether to set this depends on speed considerations. You could just do this on first iteration after factorization and thereafter re-factorize partial update already in U

Implemented in [CoinDenseFactorization](#), [CoinOslFactorization](#), and [CoinSimpFactorization](#).

```
8.53.2.5 virtual int CoinOtherFactorization::updateColumnFT ( CoinIndexedVector *  
    regionSparse, CoinIndexedVector * regionSparse2, bool noPermute = false )  
    [pure virtual]
```

Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.

Note - if regionSparse2 packed on input - will be packed on output

Implemented in [CoinDenseFactorization](#), [CoinOslFactorization](#), and [CoinSimpFactorization](#).

### 8.53.3 Member Data Documentation

```
8.53.3.1 int CoinOtherFactorization::solveMode_ [protected]
```

Solve mode e.g.

0 C++ code, 1 Lapack, 2 choose If 4 set then values pass if 8 set then has iterated

Definition at line 270 of file CoinDenseFactorization.hpp.

The documentation for this class was generated from the following file:

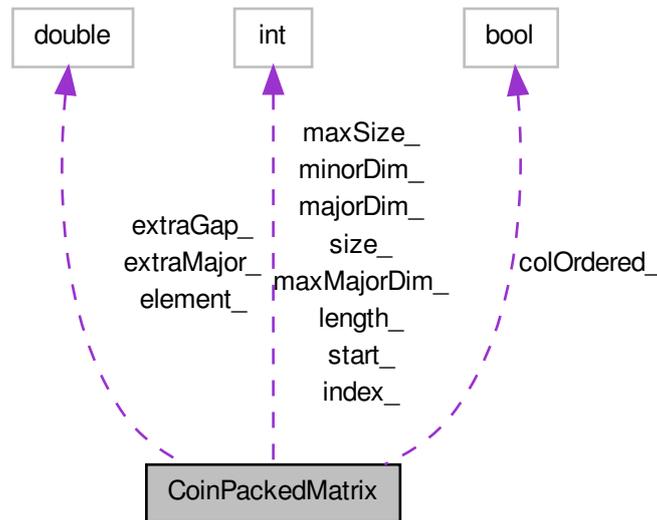
- CoinDenseFactorization.hpp

## 8.54 CoinPackedMatrix Class Reference

Sparse Matrix Base Class.

```
#include <CoinPackedMatrix.hpp>
```

Collaboration diagram for CoinPackedMatrix:



## Public Member Functions

### Query members

- double [getExtraGap](#) () const  
*Return the current setting of the extra gap.*
- double [getExtraMajor](#) () const  
*Return the current setting of the extra major.*
- void [reserve](#) (const int newMaxMajorDim, const CoinBigIndex newMaxSize, bool create=false)  
*Reserve sufficient space for appending major-ordered vectors.*
- void [clear](#) ()  
*Clear the data, but do not free any arrays.*
- bool [isColOrdered](#) () const  
*Whether the packed matrix is column major ordered or not.*
- bool [hasGaps](#) () const  
*Whether the packed matrix has gaps or not.*
- CoinBigIndex [getNumElements](#) () const  
*Number of entries in the packed matrix.*
- int [getNumCols](#) () const  
*Number of columns.*
- int [getNumRows](#) () const

- Number of rows.*

  - const double \* [getElements](#) () const  
*A vector containing the elements in the packed matrix.*
  - const int \* [getIndices](#) () const  
*A vector containing the minor indices of the elements in the packed matrix.*
  - int [getSizeVectorStarts](#) () const  
*The size of the `vectorStarts` array.*
  - int [getSizeVectorLengths](#) () const  
*The size of the `vectorLengths` array.*
  - const CoinBigIndex \* [getVectorStarts](#) () const  
*The positions where the major-dimension vectors start in elements and indices.*
  - const int \* [getVectorLengths](#) () const  
*The lengths of the major-dimension vectors.*
  - CoinBigIndex [getVectorFirst](#) (const int i) const  
*The position of the first element in the *i*'th major-dimension vector.*
  - CoinBigIndex [getVectorLast](#) (const int i) const  
*The position of the last element (well, one entry past the last) in the *i*'th major-dimension vector.*
  - int [getVectorSize](#) (const int i) const  
*The length of *i*'th vector.*
  - const [CoinShallowPackedVector](#) [getVector](#) (int i) const  
*Return the *i*'th vector in matrix.*
  - int \* [getMajorIndices](#) () const  
*Returns an array containing major indices.*

#### Modifying members

- void [setDimensions](#) (int numRows, int numcols)  
*Set the dimensions of the matrix.*
- void [setExtraGap](#) (const double newGap)  
*Set the extra gap to be allocated to the specified value.*
- void [setExtraMajor](#) (const double newMajor)  
*Set the extra major to be allocated to the specified value.*
- void [appendCol](#) (const [CoinPackedVectorBase](#) &vec)  
*Append a column to the end of the matrix.*
- void [appendCol](#) (const int vecsize, const int \*vecind, const double \*vecelem)  
*Append a column to the end of the matrix.*
- void [appendCols](#) (const int numcols, const [CoinPackedVectorBase](#) \*const \*cols)  
  
*Append a set of columns to the end of the matrix.*
- int [appendCols](#) (const int numcols, const CoinBigIndex \*columnStarts, const int \*row, const double \*element, int numberOfRows=-1)  
*Append a set of columns to the end of the matrix.*
- void [appendRow](#) (const [CoinPackedVectorBase](#) &vec)  
*Append a row to the end of the matrix.*
- void [appendRow](#) (const int vecsize, const int \*vecind, const double \*vecelem)  
  
*Append a row to the end of the matrix.*
- void [appendRows](#) (const int numRows, const [CoinPackedVectorBase](#) \*const \*rows)

- Append a set of rows to the end of the matrix.*

  - int [appendRows](#) (const int numRows, const CoinBigIndex \*rowStarts, const int \*column, const double \*element, int numberColumns=-1)

*Append a set of rows to the end of the matrix.*
- void [rightAppendPackedMatrix](#) (const [CoinPackedMatrix](#) &matrix)

*Append the argument to the "right" of the current matrix.*
- void [bottomAppendPackedMatrix](#) (const [CoinPackedMatrix](#) &matrix)

*Append the argument to the "bottom" of the current matrix.*
- void [deleteCols](#) (const int numDel, const int \*indDel)

*Delete the columns whose indices are listed in indDel.*
- void [deleteRows](#) (const int numDel, const int \*indDel)

*Delete the rows whose indices are listed in indDel.*
- void [replaceVector](#) (const int index, const int numReplace, const double \*newElements)

*Replace the elements of a vector.*
- void [modifyCoefficient](#) (int row, int column, double newElement, bool keepZero=false)

*Modify one element of packed matrix.*
- double [getCoefficient](#) (int row, int column) const

*Return one element of packed matrix.*
- int [compress](#) (double threshold)

*Eliminate all elements in matrix whose absolute value is less than threshold.*
- int [eliminateDuplicates](#) (double threshold)

*Eliminate all duplicate AND small elements in matrix The column starts are not affected.*
- void [orderMatrix](#) ()

*Sort all columns so indices are increasing in each column.*
- int [cleanMatrix](#) (double threshold=1.0e-20)

*Really clean up matrix.*

#### Methods that reorganize the whole matrix

- void [removeGaps](#) (double removeValue=-1.0)

*Remove the gaps from the matrix if there were any Can also remove small elements fabs() <= removeValue.*
- void [submatrixOf](#) (const [CoinPackedMatrix](#) &matrix, const int numMajor, const int \*indMajor)

*Extract a submatrix from matrix.*
- void [submatrixOfWithDuplicates](#) (const [CoinPackedMatrix](#) &matrix, const int numMajor, const int \*indMajor)

*Extract a submatrix from matrix.*
- void [copyOf](#) (const [CoinPackedMatrix](#) &rhs)

*Copy method.*
- void [copyOf](#) (const bool colordered, const int minor, const int major, const CoinBigIndex numels, const double \*elem, const int \*ind, const CoinBigIndex \*start, const int \*len, const double extraMajor=0.0, const double extraGap=0.0)

*Copy the arguments to the matrix.*
- void [copyReuseArrays](#) (const [CoinPackedMatrix](#) &rhs)

*Copy method.*

- void [reverseOrderedCopyOf](#) (const [CoinPackedMatrix](#) &rhs)  
*Make a reverse-ordered copy.*
- void [assignMatrix](#) (const bool colordered, const int minor, const int major, const [CoinBigIndex](#) numels, double \*&elem, int \*&ind, [CoinBigIndex](#) \*&start, int \*&len, const int maxmajor=-1, const [CoinBigIndex](#) maxsize=-1)  
*Assign the arguments to the matrix.*
- [CoinPackedMatrix](#) & [operator=](#) (const [CoinPackedMatrix](#) &rhs)  
*Assignment operator.*
- void [reverseOrdering](#) ()  
*Reverse the ordering of the packed matrix.*
- void [transpose](#) ()  
*Transpose the matrix.*
- void [swap](#) ([CoinPackedMatrix](#) &matrix)  
*Swap the content of two packed matrices.*

#### Matrix times vector methods

- void [times](#) (const double \*x, double \*y) const  
*Return  $A * x$  in  $y$ .*
- void [times](#) (const [CoinPackedVectorBase](#) &x, double \*y) const  
*Return  $A * x$  in  $y$ .*
- void [transposeTimes](#) (const double \*x, double \*y) const  
*Return  $x * A$  in  $y$ .*
- void [transposeTimes](#) (const [CoinPackedVectorBase](#) &x, double \*y) const  
*Return  $x * A$  in  $y$ .*

#### Queries

- int \* [countOrthoLength](#) () const  
*Count the number of entries in every minor-dimension vector and return an array containing these lengths.*
- void [countOrthoLength](#) (int \*counts) const  
*Count the number of entries in every minor-dimension vector and fill in an array containing these lengths.*
- int [getMajorDim](#) () const  
*Major dimension.*
- int [getMinorDim](#) () const  
*Minor dimension.*
- int [getMaxMajorDim](#) () const  
*Current maximum for major dimension.*
- void [dumpMatrix](#) (const char \*fname=NULL) const  
*Dump the matrix on stdout.*
- void [printMatrixElement](#) (const int row\_val, const int col\_val) const  
*Print a single matrix element.*

#### Append vectors

When compiled with `COIN_DEBUG` defined these methods throw an exception if the major (minor) vector contains an index that's invalid for the minor (major) dimension. Otherwise the methods assume that every index fits into the matrix.

- void [appendMajorVector](#) (const [CoinPackedVectorBase](#) &vec)  
*Append a major-dimension vector to the end of the matrix.*
- void [appendMajorVector](#) (const int vecsize, const int \*vecind, const double \*vecelem)  
*Append a major-dimension vector to the end of the matrix.*
- void [appendMajorVectors](#) (const int numvecs, const [CoinPackedVectorBase](#) \*const \*vecs)  
*Append several major-dimension vectors to the end of the matrix.*
- void [appendMinorVector](#) (const [CoinPackedVectorBase](#) &vec)  
*Append a minor-dimension vector to the end of the matrix.*
- void [appendMinorVector](#) (const int vecsize, const int \*vecind, const double \*vecelem)  
*Append a minor-dimension vector to the end of the matrix.*
- void [appendMinorVectors](#) (const int numvecs, const [CoinPackedVectorBase](#) \*const \*vecs)  
*Append several minor-dimension vectors to the end of the matrix.*
- void [appendMinorFast](#) (const int number, const [CoinBigIndex](#) \*starts, const int \*index, const double \*element)  
*Append a set of rows (columns) to the end of a column (row) ordered matrix.*

#### Append matrices

We'll document these methods assuming that the current matrix is column major ordered (Hence in the `...SameOrdered()` methods the argument is column ordered, in the `OrthoOrdered()` methods the argument is row ordered.)

- void [majorAppendSameOrdered](#) (const [CoinPackedMatrix](#) &matrix)  
*Append the columns of the argument to the right end of this matrix.*
- void [minorAppendSameOrdered](#) (const [CoinPackedMatrix](#) &matrix)  
*Append the columns of the argument to the bottom end of this matrix.*
- void [majorAppendOrthoOrdered](#) (const [CoinPackedMatrix](#) &matrix)  
*Append the rows of the argument to the right end of this matrix.*
- void [minorAppendOrthoOrdered](#) (const [CoinPackedMatrix](#) &matrix)  
*Append the rows of the argument to the bottom end of this matrix.*

#### Delete vectors

- void [deleteMajorVectors](#) (const int numDel, const int \*indDel)  
*Delete the major-dimension vectors whose indices are listed in `indDel`.*
- void [deleteMinorVectors](#) (const int numDel, const int \*indDel)  
*Delete the minor-dimension vectors whose indices are listed in `indDel`.*

#### Various dot products.

- void [timesMajor](#) (const double \*x, double \*y) const  
*Return  $A * x$  (multiplied from the "right" direction) in  $y$ .*
- void [timesMajor](#) (const [CoinPackedVectorBase](#) &x, double \*y) const  
*Return  $A * x$  (multiplied from the "right" direction) in  $y$ .*
- void [timesMinor](#) (const double \*x, double \*y) const  
*Return  $A * x$  (multiplied from the "right" direction) in  $y$ .*
- void [timesMinor](#) (const [CoinPackedVectorBase](#) &x, double \*y) const  
*Return  $A * x$  (multiplied from the "right" direction) in  $y$ .*

**Logical Operations.**

- `template<class FloatEqual >`  
`bool isEquivalent (const CoinPackedMatrix &rhs, const FloatEqual &eq) const`  
*Test for equivalence.*
- `bool isEquivalent2 (const CoinPackedMatrix &rhs) const`  
*Test for equivalence and report differences.*
- `bool isEquivalent (const CoinPackedMatrix &rhs) const`  
*Test for equivalence.*

**Non-const methods**

*These are to be used with great care when doing column generation, etc.*

- `double * getMutableElements () const`  
*A vector containing the elements in the packed matrix.*
- `int * getMutableIndices () const`  
*A vector containing the minor indices of the elements in the packed matrix.*
- `CoinBigIndex * getMutableVectorStarts () const`  
*The positions where the major-dimension vectors start in `element_` and `index_`.*
- `int * getMutableVectorLengths () const`  
*The lengths of the major-dimension vectors.*
- `void setNumElements (CoinBigIndex value)`  
*Change the size of the bulk store after modifying - be careful.*
- `void nullElementArray ()`  
*NULLify element array.*
- `void nullStartArray ()`  
*NULLify start array.*
- `void nullLengthArray ()`  
*NULLify length array.*
- `void nullIndexArray ()`  
*NULLify index array.*

**Constructors and destructors**

- `CoinPackedMatrix ()`  
*Default Constructor creates an empty column ordered packed matrix.*
- `CoinPackedMatrix (const bool colordered, const double extraMajor, const double extraGap)`  
*A constructor where the ordering and the gaps are specified.*
- `CoinPackedMatrix (const bool colordered, const int minor, const int major, const CoinBigIndex numels, const double *elem, const int *ind, const CoinBigIndex *start, const int *len, const double extraMajor, const double extraGap)`
- `CoinPackedMatrix (const bool colordered, const int minor, const int major, const CoinBigIndex numels, const double *elem, const int *ind, const CoinBigIndex *start, const int *len)`
- `CoinPackedMatrix (const bool colordered, const int *rowIndices, const int *colIndices, const double *elements, CoinBigIndex numels)`  
*Create packed matrix from triples.*

- [CoinPackedMatrix](#) (const [CoinPackedMatrix](#) &m)  
*Copy constructor.*
- [CoinPackedMatrix](#) (const [CoinPackedMatrix](#) &m, int extraForMajor, int extraElements, bool reverseOrdering=false)  
*Copy constructor - fine tuning - allowing extra space and/or reverse ordering.*
- [CoinPackedMatrix](#) (const [CoinPackedMatrix](#) &wholeModel, int numberOfRows, const int \*whichRows, int numberColumns, const int \*whichColumns)  
*Subset constructor (without gaps).*
- virtual [~CoinPackedMatrix](#) ()  
*Destructor.*

#### Debug Utilities

- int [verifyMtx](#) (int verbosity=1, bool zeroesAreError=false) const  
*Scan the matrix for anomalies.*

#### Protected Member Functions

- void [gutsOfCopyOfNoGaps](#) (const bool colordered, const int minor, const int major, const double \*elem, const int \*ind, const [CoinBigIndex](#) \*start)  
*When no gaps we can do faster.*
- int [appendMajor](#) (const int number, const [CoinBigIndex](#) \*starts, const int \*index, const double \*element, int numberOther=-1)  
*Append a set of rows (columns) to the end of a row (column) ordered matrix.*
- int [appendMinor](#) (const int number, const [CoinBigIndex](#) \*starts, const int \*index, const double \*element, int numberOther=-1)  
*Append a set of rows (columns) to the end of a column (row) ordered matrix.*

#### Protected Attributes

##### Data members

*The data members are protected to allow access for derived classes.*

- bool [colOrdered\\_](#)  
*A flag indicating whether the matrix is column or row major ordered.*
- double [extraGap\\_](#)  
*This much times more space should be allocated for each major-dimension vector (with respect to the number of entries in the vector) when the matrix is resized.*
- double [extraMajor\\_](#)  
*his much times more space should be allocated for major-dimension vectors when the matrix is resized.*
- double \* [element\\_](#)  
*List of nonzero element values.*
- int \* [index\\_](#)  
*List of nonzero element minor-dimension indices.*
- [CoinBigIndex](#) \* [start\\_](#)  
*Starting positions of major-dimension vectors.*

- int \* [length\\_](#)  
*Lengths of major-dimension vectors.*
- int [majorDim\\_](#)  
*number of vectors in matrix*
- int [minorDim\\_](#)  
*size of other dimension*
- CoinBigIndex [size\\_](#)  
*the number of nonzero entries*
- int [maxMajorDim\\_](#)  
*max space allocated for major-dimension*
- CoinBigIndex [maxSize\\_](#)  
*max space allocated for entries*

#### Friends

- void [CoinPackedMatrixUnitTest](#) ()  
*Test the methods in the [CoinPackedMatrix](#) class.*

#### 8.54.1 Detailed Description

Sparse Matrix Base Class.

This class is intended to represent sparse matrices using row-major or column-major ordering. The representation is very efficient for adding, deleting, or retrieving major-dimension vectors. Adding a minor-dimension vector is less efficient, but can be helped by providing "extra" space as described in the next paragraph. Deleting a minor-dimension vector requires inspecting all coefficients in the matrix. Retrieving a minor-dimension vector would incur the same cost and is not supported (except in the sense that you can write a loop to retrieve all coefficients one at a time). Consider physically transposing the matrix, or keeping a second copy with the other major-vector ordering.

The sparse representation can be completely compact or it can have "extra" space available at the end of each major vector. Incorporating extra space into the sparse matrix representation can improve performance in cases where new data needs to be inserted into the packed matrix against the major-vector orientation (e.g, inserting a row into a matrix stored in column-major order).

For example if the matrix:

```

3  1  0  -2  -1  0  0  -1
0  2  1.1  0  0  0  0  0
0  0  1  0  0  1  0  0
0  0  0  2.8  0  0  -1.2  0
5.6  0  0  0  1  0  0  1.9

```

```

was stored by rows (with no extra space) in
CoinPackedMatrix r then:
r.getElements() returns a vector containing:
  3 1 -2 -1 2 1.1 1 1 2.8 -1.2 5.6 1 1.9
r.getIndices() returns a vector containing:
  0 1 3 4 7 1 2 2 5 3 6 0 4 7
r.getVectorStarts() returns a vector containing:

```

```

0 5 7 9 11 14
r.getNumElements() returns 14.
r.getMajorDim() returns 5.
r.getVectorSize(0) returns 5.
r.getVectorSize(1) returns 2.
r.getVectorSize(2) returns 2.
r.getVectorSize(3) returns 2.
r.getVectorSize(4) returns 3.

```

If stored by columns (with no extra space) then:

```

c.getElements() returns a vector containing:
 3 5.6 1 2 1.1 1 -2 2.8 -1 1 1 -1.2 -1 1.9
c.getIndices() returns a vector containing:
 0 4 0 1 1 2 0 3 0 4 2 3 0 4
c.getVectorStarts() returns a vector containing:
 0 2 4 6 8 10 11 12 14
c.getNumElements() returns 14.
c.getMajorDim() returns 8.

```

Compiling this class with `CLP_NO_VECTOR` defined will excise all methods which use [CoinPackedVectorBase](#), [CoinPackedVector](#), or [CoinShallowPackedVector](#) as parameters or return types.

Compiling this class with `COIN_FAST_CODE` defined removes index range checks.

Definition at line 79 of file `CoinPackedMatrix.hpp`.

### 8.54.2 Constructor & Destructor Documentation

#### 8.54.2.1 `CoinPackedMatrix::CoinPackedMatrix ( const bool colordered, const int * rowIndices, const int * colIndices, const double * elements, CoinBigIndex numels )`

Create packed matrix from triples.

If `colordered` is true then the created matrix will be column ordered. Duplicate matrix elements are allowed. The created matrix will have the sum of the duplicates.

For example if:

```
rowIndices[0]=2; colIndices[0]=5; elements[0]=2.0
```

```
rowIndices[1]=2; colIndices[1]=5; elements[1]=0.5
```

then the created matrix will contain a value of 2.5 in row 2 and column 5.

The matrix is created without gaps.

#### 8.54.2.2 `CoinPackedMatrix::CoinPackedMatrix ( const CoinPackedMatrix & m, int extraForMajor, int extraElements, bool reverseOrdering = false )`

Copy constructor - fine tuning - allowing extra space and/or reverse ordering.

`extraForMajor` is exact extra after any possible reverse ordering. `extraMajor_` and `extraGap_` set to zero.

8.54.2.3 `CoinPackedMatrix::CoinPackedMatrix ( const CoinPackedMatrix & wholeModel, int numberRows, const int * whichRows, int numberColumns, const int * whichColumns )`

Subset constructor (without gaps).

Duplicates are allowed and order is as given

### 8.54.3 Member Function Documentation

8.54.3.1 `double CoinPackedMatrix::getExtraGap ( ) const [inline]`

Return the current setting of the extra gap.

Definition at line 89 of file CoinPackedMatrix.hpp.

8.54.3.2 `double CoinPackedMatrix::getExtraMajor ( ) const [inline]`

Return the current setting of the extra major.

Definition at line 91 of file CoinPackedMatrix.hpp.

8.54.3.3 `void CoinPackedMatrix::reserve ( const int newMaxMajorDim, const CoinBigIndex newMaxSize, bool create = false )`

Reserve sufficient space for appending major-ordered vectors.

If create is true, empty columns are created (for column generation)

8.54.3.4 `bool CoinPackedMatrix::isColOrdered ( ) const [inline]`

Whether the packed matrix is column major ordered or not.

Definition at line 101 of file CoinPackedMatrix.hpp.

8.54.3.5 `bool CoinPackedMatrix::hasGaps ( ) const [inline]`

Whether the packed matrix has gaps or not.

Definition at line 104 of file CoinPackedMatrix.hpp.

8.54.3.6 `CoinBigIndex CoinPackedMatrix::getNumElements ( ) const [inline]`

Number of entries in the packed matrix.

Definition at line 107 of file CoinPackedMatrix.hpp.

8.54.3.7 `int CoinPackedMatrix::getNumCols ( ) const [inline]`

Number of columns.

Definition at line 110 of file CoinPackedMatrix.hpp.

**8.54.3.8** `int CoinPackedMatrix::getNumRows ( ) const [inline]`

Number of rows.

Definition at line 114 of file CoinPackedMatrix.hpp.

**8.54.3.9** `const double* CoinPackedMatrix::getElements ( ) const [inline]`

A vector containing the elements in the packed matrix.

Returns `#elements_`. Note that there might be gaps in this vector, entries that do not belong to any major-dimension vector. To get the actual elements one should look at this vector together with `vectorStarts` ([start\\_](#)) and `vectorLengths` ([length\\_](#)).

Definition at line 124 of file CoinPackedMatrix.hpp.

**8.54.3.10** `const int* CoinPackedMatrix::getIndices ( ) const [inline]`

A vector containing the minor indices of the elements in the packed matrix.

Returns `index_`. Note that there might be gaps in this list, entries that do not belong to any major-dimension vector. To get the actual elements one should look at this vector together with `vectorStarts` ([start\\_](#)) and `vectorLengths` ([length\\_](#)).

Definition at line 134 of file CoinPackedMatrix.hpp.

**8.54.3.11** `int CoinPackedMatrix::getSizeVectorStarts ( ) const [inline]`

The size of the `vectorStarts` array.

See [start\\_](#).

Definition at line 140 of file CoinPackedMatrix.hpp.

**8.54.3.12** `int CoinPackedMatrix::getSizeVectorLengths ( ) const [inline]`

The size of the `vectorLengths` array.

See [length\\_](#).

Definition at line 147 of file CoinPackedMatrix.hpp.

**8.54.3.13** `const CoinBigIndex* CoinPackedMatrix::getVectorStarts ( ) const [inline]`

The positions where the major-dimension vectors start in elements and indices.

See [start\\_](#).

Definition at line 154 of file CoinPackedMatrix.hpp.

**8.54.3.14** `const int* CoinPackedMatrix::getVectorLengths ( ) const [inline]`

The lengths of the major-dimension vectors.

See [length\\_](#).

Definition at line 160 of file CoinPackedMatrix.hpp.

**8.54.3.15** `CoinBigIndex CoinPackedMatrix::getVectorLast ( const int i ) const [inline]`

The position of the last element (well, one entry *past* the last) in the *i*'th major-dimension vector.

Definition at line 173 of file CoinPackedMatrix.hpp.

**8.54.3.16** `int CoinPackedMatrix::getVectorSize ( const int i ) const [inline]`

The length of *i*'th vector.

Definition at line 181 of file CoinPackedMatrix.hpp.

**8.54.3.17** `const CoinShallowPackedVector CoinPackedMatrix::getVector ( int i ) const [inline]`

Return the *i*'th vector in matrix.

Definition at line 190 of file CoinPackedMatrix.hpp.

**8.54.3.18** `int* CoinPackedMatrix::getMajorIndices ( ) const`

Returns an array containing major indices.

The array is `getNumElements` long and if `getVectorStarts()` is 0,2,5 then the array would start 0,0,1,1,1,2... This method is provided to go back from a packed format to a triple format. It returns NULL if there are gaps in matrix so user should use `removeGaps()` if there are any gaps. It does this as this array has to match `getElements()` and `getIndices()` and because it makes no sense otherwise. The returned array is allocated with `new int []`, free it with `delete []`.

**8.54.3.19** `void CoinPackedMatrix::setDimensions ( int numRows, int numcols )`

Set the dimensions of the matrix.

The method name is deceptive; the effect is to append empty columns and/or rows to the matrix to reach the specified dimensions. A negative number for either dimension means that that dimension doesn't change. An exception will be thrown if the specified dimensions are smaller than the current dimensions.

**8.54.3.20** `void CoinPackedMatrix::setExtraGap ( const double newGap )`

Set the extra gap to be allocated to the specified value.

**8.54.3.21** `void CoinPackedMatrix::setExtraMajor ( const double newMajor )`

Set the extra major to be allocated to the specified value.

**8.54.3.22** `void CoinPackedMatrix::appendCol ( const CoinPackedVectorBase & vec )`

Append a column to the end of the matrix.

When compiled with `COIN_DEBUG` defined this method throws an exception if the column vector specifies a nonexistent row index. Otherwise the method assumes that every index fits into the matrix.

**8.54.3.23** void CoinPackedMatrix::appendCol ( const int *vecsize*, const int \* *vecind*, const double \* *vecelem* )

Append a column to the end of the matrix.

When compiled with COIN\_DEBUG defined this method throws an exception if the column vector specifies a nonexistent row index. Otherwise the method assumes that every index fits into the matrix.

**8.54.3.24** void CoinPackedMatrix::appendCols ( const int *numcols*, const CoinPackedVectorBase \*const \* *cols* )

Append a set of columns to the end of the matrix.

When compiled with COIN\_DEBUG defined this method throws an exception if any of the column vectors specify a nonexistent row index. Otherwise the method assumes that every index fits into the matrix.

**8.54.3.25** int CoinPackedMatrix::appendCols ( const int *numcols*, const CoinBigIndex \* *columnStarts*, const int \* *row*, const double \* *element*, int *numberOfRows* = -1 )

Append a set of columns to the end of the matrix.

Returns the number of errors (nonexistent or duplicate row index). No error checking is performed if *numberOfRows* < 0.

**8.54.3.26** void CoinPackedMatrix::appendRow ( const CoinPackedVectorBase & *vec* )

Append a row to the end of the matrix.

When compiled with COIN\_DEBUG defined this method throws an exception if the row vector specifies a nonexistent column index. Otherwise the method assumes that every index fits into the matrix.

**8.54.3.27** void CoinPackedMatrix::appendRow ( const int *vecsize*, const int \* *vecind*, const double \* *vecelem* )

Append a row to the end of the matrix.

When compiled with COIN\_DEBUG defined this method throws an exception if the row vector specifies a nonexistent column index. Otherwise the method assumes that every index fits into the matrix.

**8.54.3.28** void CoinPackedMatrix::appendRows ( const int *numrows*, const CoinPackedVectorBase \*const \* *rows* )

Append a set of rows to the end of the matrix.

When compiled with COIN\_DEBUG defined this method throws an exception if any of the row vectors specify a nonexistent column index. Otherwise the method assumes that every index fits into the matrix.

8.54.3.29 `int CoinPackedMatrix::appendRows ( const int numrows, const CoinBigIndex * rowStarts, const int * column, const double * element, int numberColumns = -1 )`

Append a set of rows to the end of the matrix.

Returns the number of errors (nonexistent or duplicate column index). No error checking is performed if `numberColumns < 0`.

8.54.3.30 `void CoinPackedMatrix::rightAppendPackedMatrix ( const CoinPackedMatrix & matrix )`

Append the argument to the "right" of the current matrix.

Imagine this as adding new columns (don't worry about how the matrices are ordered, that is taken care of). An exception is thrown if the number of rows is different in the matrices.

8.54.3.31 `void CoinPackedMatrix::bottomAppendPackedMatrix ( const CoinPackedMatrix & matrix )`

Append the argument to the "bottom" of the current matrix.

Imagine this as adding new rows (don't worry about how the matrices are ordered, that is taken care of). An exception is thrown if the number of columns is different in the matrices.

8.54.3.32 `void CoinPackedMatrix::deleteCols ( const int numDel, const int * indDel )`

Delete the columns whose indices are listed in `indDel`.

8.54.3.33 `void CoinPackedMatrix::deleteRows ( const int numDel, const int * indDel )`

Delete the rows whose indices are listed in `indDel`.

8.54.3.34 `void CoinPackedMatrix::replaceVector ( const int index, const int numReplace, const double * newElements )`

Replace the elements of a vector.

The indices remain the same. At most the number specified will be replaced. The index is between 0 and major dimension of matrix

8.54.3.35 `void CoinPackedMatrix::modifyCoefficient ( int row, int column, double newElement, bool keepZero = false )`

Modify one element of packed matrix.

An element may be added. This works for either ordering. If the new element is zero it will be deleted unless `keepZero` true

8.54.3.36 `double CoinPackedMatrix::getCoefficient ( int row, int column ) const`

Return one element of packed matrix.

This works for either ordering. If it is not present will return 0.0

#### 8.54.3.37 int CoinPackedMatrix::compress ( double *threshold* )

Eliminate all elements in matrix whose absolute value is less than threshold.

The column starts are not affected. Returns number of elements eliminated. Elements eliminated are at end of each vector

#### 8.54.3.38 int CoinPackedMatrix::eliminateDuplicates ( double *threshold* )

Eliminate all duplicate AND small elements in matrix The column starts are not affected.

Returns number of elements eliminated.

#### 8.54.3.39 int CoinPackedMatrix::cleanMatrix ( double *threshold* = 1.0e-20 )

Really clean up matrix.

a) eliminate all duplicate AND small elements in matrix b) remove all gaps and set extraGap\_ and extraMajor\_ to 0.0 c) reallocate arrays and make max lengths equal to lengths d) orders elements returns number of elements eliminated

#### 8.54.3.40 void CoinPackedMatrix::submatrixOf ( const CoinPackedMatrix & *matrix*, const int *numMajor*, const int \* *indMajor* )

Extract a submatrix from matrix.

Those major-dimension vectors of the matrix comprise the submatrix whose indices are given in the arguments. Does not allow duplicates.

#### 8.54.3.41 void CoinPackedMatrix::submatrixOfWithDuplicates ( const CoinPackedMatrix & *matrix*, const int *numMajor*, const int \* *indMajor* )

Extract a submatrix from matrix.

Those major-dimension vectors of the matrix comprise the submatrix whose indices are given in the arguments. Allows duplicates and keeps order.

#### 8.54.3.42 void CoinPackedMatrix::copyOf ( const CoinPackedMatrix & *rhs* )

Copy method.

This method makes an exact replica of the argument, including the extra space parameters.

#### 8.54.3.43 void CoinPackedMatrix::copyOf ( const bool *colordered*, const int *minor*, const int *major*, const CoinBigIndex *numels*, const double \* *elem*, const int \* *ind*, const CoinBigIndex \* *start*, const int \* *len*, const double *extraMajor* = 0.0, const double *extraGap* = 0.0 )

Copy the arguments to the matrix.

If *len* is a NULL pointer then the matrix is assumed to have no gaps in it and *len* will be created accordingly.

8.54.3.44 `void CoinPackedMatrix::copyReuseArrays ( const CoinPackedMatrix & rhs )`

Copy method.

This method makes an exact replica of the argument, including the extra space parameters. If there is room it will re-use arrays

8.54.3.45 `void CoinPackedMatrix::reverseOrderedCopyOf ( const CoinPackedMatrix & rhs )`

Make a reverse-ordered copy.

This method makes an exact replica of the argument with the major vector orientation changed from row (column) to column (row). The extra space parameters are also copied and reversed. (Cf. [reverseOrdering](#), which does the same thing in place.)

8.54.3.46 `void CoinPackedMatrix::assignMatrix ( const bool colordered, const int minor, const int major, const CoinBigIndex numels, double *& elem, int *& ind, CoinBigIndex *& start, int *& len, const int maxmajor = -1, const CoinBigIndex maxsize = -1 )`

Assign the arguments to the matrix.

If `len` is a NULL pointer then the matrix is assumed to have no gaps in it and `len` will be created accordingly.

**NOTE 1:** After this method returns the pointers passed to the method will be NULL pointers!

**NOTE 2:** When the matrix is eventually destructed the arrays will be deleted by `delete []`. Hence one should use this method ONLY if all array swere allocated by `new []`!

8.54.3.47 `CoinPackedMatrix& CoinPackedMatrix::operator= ( const CoinPackedMatrix & rhs )`

Assignment operator.

This copies out the data, but uses the current matrix's extra space parameters.

8.54.3.48 `void CoinPackedMatrix::reverseOrdering ( )`

Reverse the ordering of the packed matrix.

Change the major vector orientation of the matrix data structures from row (column) to column (row). (Cf. [reverseOrderedCopyOf](#), which does the same thing but produces a new matrix.)

8.54.3.49 `void CoinPackedMatrix::transpose ( )`

Transpose the matrix.

#### Note

If you start with a column-ordered matrix and invoke `transpose`, you will have a row-ordered transposed matrix. To change the major vector orientation (e.g., to transform a column-ordered matrix to a column-ordered transposed matrix), invoke `transpose()` followed by `reverseOrdering()`.

**8.54.3.50** void CoinPackedMatrix::swap ( CoinPackedMatrix & *matrix* )

Swap the content of two packed matrices.

**8.54.3.51** void CoinPackedMatrix::times ( const double \* *x*, double \* *y* ) const

Return  $A * x$  in *y*.

**Precondition**

*x* must be of size numColumns ()

*y* must be of size numRows ()

**8.54.3.52** void CoinPackedMatrix::times ( const CoinPackedVectorBase & *x*, double \* *y* ) const

Return  $A * x$  in *y*.

Same as the previous method, just *x* is given in the form of a packed vector.

**8.54.3.53** void CoinPackedMatrix::transposeTimes ( const double \* *x*, double \* *y* ) const

Return  $x * A$  in *y*.

**Precondition**

*x* must be of size numRows ()

*y* must be of size numColumns ()

**8.54.3.54** void CoinPackedMatrix::transposeTimes ( const CoinPackedVectorBase & *x*, double \* *y* ) const

Return  $x * A$  in *y*.

Same as the previous method, just *x* is given in the form of a packed vector.

**8.54.3.55** int\* CoinPackedMatrix::countOrthoLength ( ) const

Count the number of entries in every minor-dimension vector and return an array containing these lengths.

The returned array is allocated with `new int []`, free it with `delete []`.

**8.54.3.56** void CoinPackedMatrix::countOrthoLength ( int \* *counts* ) const

Count the number of entries in every minor-dimension vector and fill in an array containing these lengths.

**8.54.3.57** int CoinPackedMatrix::getMajorDim ( ) const [inline]

Major dimension.

For row ordered matrix this would be the number of rows.

Definition at line 498 of file CoinPackedMatrix.hpp.

8.54.3.58 `int CoinPackedMatrix::getMinorDim ( ) const [inline]`

Minor dimension.

For row ordered matrix this would be the number of columns.

Definition at line 501 of file CoinPackedMatrix.hpp.

8.54.3.59 `int CoinPackedMatrix::getMaxMajorDim ( ) const [inline]`

Current maximum for major dimension.

For row ordered matrix this many rows can be added without reallocating the vector related to the major dimension (`start_` and `length_`).

Definition at line 505 of file CoinPackedMatrix.hpp.

8.54.3.60 `void CoinPackedMatrix::dumpMatrix ( const char * fname = NULL ) const`

Dump the matrix on stdout.

When in dire straits this method can help.

8.54.3.61 `void CoinPackedMatrix::appendMajorVector ( const CoinPackedVectorBase & vec )`

Append a major-dimension vector to the end of the matrix.

8.54.3.62 `void CoinPackedMatrix::appendMajorVector ( const int vecsize, const int * vecind, const double * vecelem )`

Append a major-dimension vector to the end of the matrix.

8.54.3.63 `void CoinPackedMatrix::appendMinorVector ( const CoinPackedVectorBase & vec )`

Append a minor-dimension vector to the end of the matrix.

8.54.3.64 `void CoinPackedMatrix::appendMinorVector ( const int vecsize, const int * vecind, const double * vecelem )`

Append a minor-dimension vector to the end of the matrix.

8.54.3.65 `void CoinPackedMatrix::appendMinorFast ( const int number, const CoinBigIndex * starts, const int * index, const double * element )`

Append a set of rows (columns) to the end of a column (row) ordered matrix.

This case is when we know there are no gaps and `majorDim_` will not change.

8.54.3.66 `void CoinPackedMatrix::majorAppendSameOrdered ( const CoinPackedMatrix & matrix )`

Append the columns of the argument to the right end of this matrix.

**Precondition**

```
minorDim_ == matrix.minorDim_
```

This method throws an exception if the minor dimensions are not the same.

**8.54.3.67** void CoinPackedMatrix::minorAppendSameOrdered ( const CoinPackedMatrix & *matrix* )

Append the columns of the argument to the bottom end of this matrix.

**Precondition**

```
majorDim_ == matrix.majorDim_
```

This method throws an exception if the major dimensions are not the same.

**8.54.3.68** void CoinPackedMatrix::majorAppendOrthoOrdered ( const CoinPackedMatrix & *matrix* )

Append the rows of the argument to the right end of this matrix.

**Precondition**

```
minorDim_ == matrix.majorDim_
```

This method throws an exception if the minor dimension of the current matrix is not the same as the major dimension of the argument matrix.

**8.54.3.69** void CoinPackedMatrix::minorAppendOrthoOrdered ( const CoinPackedMatrix & *matrix* )

Append the rows of the argument to the bottom end of this matrix.

**Precondition**

```
majorDim_ == matrix.minorDim_
```

This method throws an exception if the major dimension of the current matrix is not the same as the minor dimension of the argument matrix.

**8.54.3.70** void CoinPackedMatrix::deleteMajorVectors ( const int *numDel*, const int \* *indDel* )

Delete the major-dimension vectors whose indices are listed in *indDel*.

**8.54.3.71** void CoinPackedMatrix::deleteMinorVectors ( const int *numDel*, const int \* *indDel* )

Delete the minor-dimension vectors whose indices are listed in *indDel*.

**8.54.3.72** void CoinPackedMatrix::timesMajor ( const double \* *x*, double \* *y* ) const

Return  $A * x$  (multiplied from the "right" direction) in *y*.

**Precondition**

*x* must be of size `majorDim()`

*y* must be of size `minorDim()`

**8.54.3.73** `void CoinPackedMatrix::timesMajor ( const CoinPackedVectorBase & x, double * y ) const`

Return  $A * x$  (multiplied from the "right" direction) in  $y$ .

Same as the previous method, just  $x$  is given in the form of a packed vector.

**8.54.3.74** `void CoinPackedMatrix::timesMinor ( const double * x, double * y ) const`

Return  $A * x$  (multiplied from the "right" direction) in  $y$ .

#### Precondition

$x$  must be of size `minorDim()`  
 $y$  must be of size `majorDim()`

**8.54.3.75** `void CoinPackedMatrix::timesMinor ( const CoinPackedVectorBase & x, double * y ) const`

Return  $A * x$  (multiplied from the "right" direction) in  $y$ .

Same as the previous method, just  $x$  is given in the form of a packed vector.

**8.54.3.76** `template<class FloatEqual > bool CoinPackedMatrix::isEquivalent ( const CoinPackedMatrix & rhs, const FloatEqual & eq ) const [inline]`

Test for equivalence.

Two matrices are equivalent if they are both row- or column-ordered, they have the same dimensions, and each (major) vector is equivalent. The operator used to test for equality can be specified using the `FloatEqual` template parameter.

Definition at line 650 of file `CoinPackedMatrix.hpp`.

**8.54.3.77** `bool CoinPackedMatrix::isEquivalent2 ( const CoinPackedMatrix & rhs ) const`

Test for equivalence and report differences.

Equivalence is defined as for [isEquivalent](#). In addition, this method will print differences to `std::cerr`. Intended for use in unit tests and for debugging.

**8.54.3.78** `bool CoinPackedMatrix::isEquivalent ( const CoinPackedMatrix & rhs ) const`

Test for equivalence.

The test for element equality is the default [CoinRelFltEq](#) operator.

**8.54.3.79** `double* CoinPackedMatrix::getMutableElements ( ) const [inline]`

A vector containing the elements in the packed matrix.

Note that there might be gaps in this list, entries that do not belong to any major-dimension vector. To get the actual elements one should look at this vector together with [start\\_](#) and [length\\_](#).

Definition at line 703 of file `CoinPackedMatrix.hpp`.

**8.54.3.80** `int* CoinPackedMatrix::getMutableIndices ( ) const [inline]`

A vector containing the minor indices of the elements in the packed matrix.

Note that there might be gaps in this list, entries that do not belong to any major-dimension vector. To get the actual elements one should look at this vector together with [start\\_](#) and [length\\_](#).

Definition at line 709 of file `CoinPackedMatrix.hpp`.

**8.54.3.81** `CoinBigIndex* CoinPackedMatrix::getMutableVectorStarts ( ) const [inline]`

The positions where the major-dimension vectors start in [element\\_](#) and [index\\_](#).

Definition at line 713 of file `CoinPackedMatrix.hpp`.

**8.54.3.82** `int* CoinPackedMatrix::getMutableVectorLengths ( ) const [inline]`

The lengths of the major-dimension vectors.

Definition at line 715 of file `CoinPackedMatrix.hpp`.

**8.54.3.83** `void CoinPackedMatrix::nullElementArray ( ) [inline]`

NULLify element array.

Used when space is very tight. Does not free the space!

Definition at line 723 of file `CoinPackedMatrix.hpp`.

**8.54.3.84** `void CoinPackedMatrix::nullStartArray ( ) [inline]`

NULLify start array.

Used when space is very tight. Does not free the space!

Definition at line 729 of file `CoinPackedMatrix.hpp`.

**8.54.3.85** `void CoinPackedMatrix::nullLengthArray ( ) [inline]`

NULLify length array.

Used when space is very tight. Does not free the space!

Definition at line 735 of file `CoinPackedMatrix.hpp`.

**8.54.3.86** `void CoinPackedMatrix::nullIndexArray ( ) [inline]`

NULLify index array.

Used when space is very tight. Does not free the space!

Definition at line 741 of file `CoinPackedMatrix.hpp`.

**8.54.3.87** `int CoinPackedMatrix::verifyMtx ( int verbosity = 1, bool zeroesAreError = false ) const`

Scan the matrix for anomalies.

Returns the number of anomalies. Scans the structure for gaps, obviously bogus indices and coefficients, and inconsistencies. Gaps are not an error unless `hasGaps()` says the matrix should be gap-free. Zeroes are not an error unless `zeroesAreError` is set to true.

Values for verbosity are:

- 0: No messages, just the return value
- 1: Messages about errors
- 2: If there are no errors, a message indicating the matrix was checked is printed (positive confirmation).
- 3: Adds a bit more information about the matrix.
- 4: Prints warnings about zeroes even if they're not considered errors.

Obviously bogus coefficients are coefficients that are NaN or have absolute value greater than 1e50. Zeros have absolute value less than 1e-50.

```
8.54.3.88 int CoinPackedMatrix::appendMajor ( const int number, const CoinBigIndex *
      starts, const int * index, const double * element, int numberOther = -1 )
      [protected]
```

Append a set of rows (columns) to the end of a row (column) ordered matrix.

If `numberOther > 0` the method will check if any of the new rows (columns) contain duplicate indices or invalid indices and return the number of errors. A valid minor index must satisfy

$$0 \leq k < \text{numberOther}$$

If `numberOther < 0` no checking is performed.

```
8.54.3.89 int CoinPackedMatrix::appendMinor ( const int number, const CoinBigIndex *
      starts, const int * index, const double * element, int numberOther = -1 )
      [protected]
```

Append a set of rows (columns) to the end of a column (row) ordered matrix.

If `numberOther > 0` the method will check if any of the new rows (columns) contain duplicate indices or indices outside the current range for the major dimension and return the number of violations. If `numberOther <= 0` the major dimension will be expanded as necessary and there are no checks for duplicate indices.

#### 8.54.4 Friends And Related Function Documentation

```
8.54.4.1 void CoinPackedMatrixUnitTest ( ) [friend]
```

Test the methods in the `CoinPackedMatrix` class.

The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging.

### 8.54.5 Member Data Documentation

#### 8.54.5.1 `bool CoinPackedMatrix::colOrdered_` [protected]

A flag indicating whether the matrix is column or row major ordered.

Definition at line 882 of file `CoinPackedMatrix.hpp`.

#### 8.54.5.2 `double CoinPackedMatrix::extraGap_` [protected]

This much times more space should be allocated for each major-dimension vector (with respect to the number of entries in the vector) when the matrix is resized.

The purpose of these gaps is to allow fast insertion of new minor-dimension vectors.

Definition at line 887 of file `CoinPackedMatrix.hpp`.

#### 8.54.5.3 `double CoinPackedMatrix::extraMajor_` [protected]

his much times more space should be allocated for major-dimension vectors when the matrix is resized.

The purpose of these gaps is to allow fast addition of new major-dimension vectors.

Definition at line 891 of file `CoinPackedMatrix.hpp`.

#### 8.54.5.4 `double* CoinPackedMatrix::element_` [protected]

List of nonzero element values.

The entries in the gaps between major-dimension vectors are undefined.

Definition at line 895 of file `CoinPackedMatrix.hpp`.

#### 8.54.5.5 `int* CoinPackedMatrix::index_` [protected]

List of nonzero element minor-dimension indices.

The entries in the gaps between major-dimension vectors are undefined.

Definition at line 898 of file `CoinPackedMatrix.hpp`.

#### 8.54.5.6 `CoinBigIndex* CoinPackedMatrix::start_` [protected]

Starting positions of major-dimension vectors.

Definition at line 900 of file `CoinPackedMatrix.hpp`.

#### 8.54.5.7 `int* CoinPackedMatrix::length_` [protected]

Lengths of major-dimension vectors.

Definition at line 902 of file `CoinPackedMatrix.hpp`.

The documentation for this class was generated from the following file:

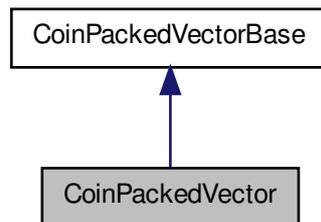
- `CoinPackedMatrix.hpp`

## 8.55 CoinPackedVector Class Reference

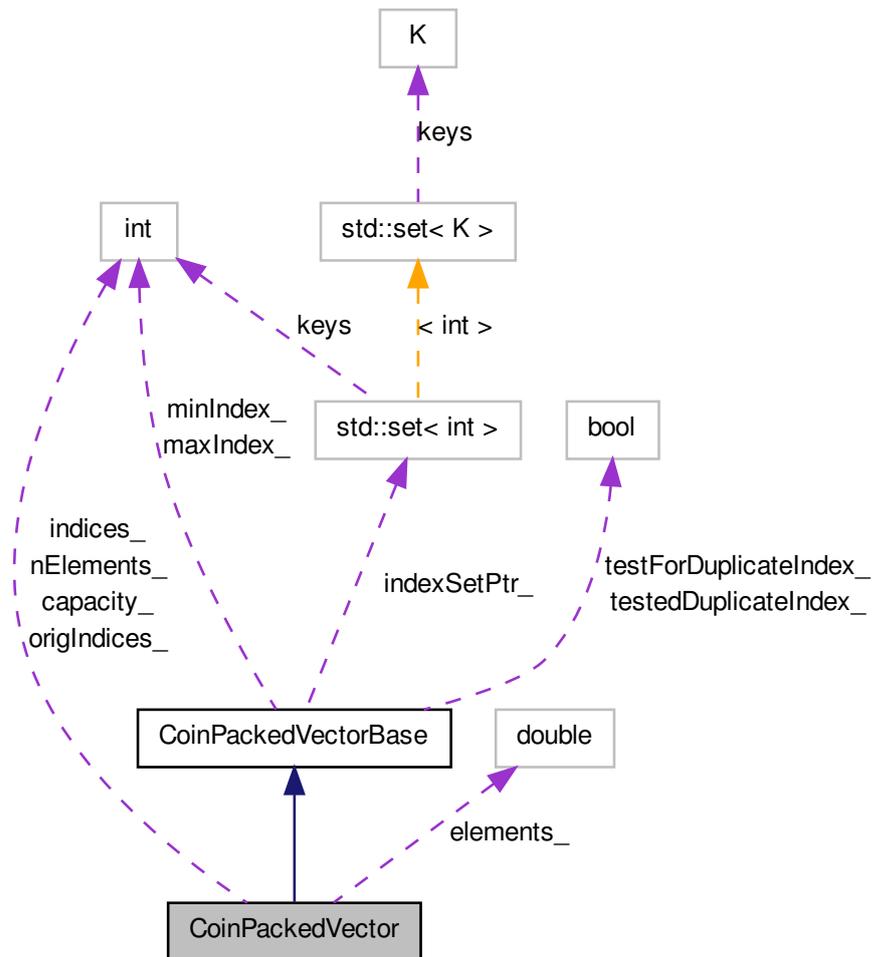
Sparse Vector.

```
#include <CoinPackedVector.hpp>
```

Inheritance diagram for CoinPackedVector:



Collaboration diagram for CoinPackedVector:



### Public Member Functions

#### Get methods.

- virtual int [getNumElements](#) () const  
*Get the size.*
- virtual const int \* [getIndices](#) () const  
*Get indices of elements.*

- virtual const double \* [getElements](#) () const  
*Get element values.*
- int \* [getIndices](#) ()  
*Get indices of elements.*
- double \* [getElements](#) ()  
*Get element values.*
- const int \* [getOriginalPosition](#) () const  
*Get pointer to int \* vector of original postions.*

#### Set methods

- void [clear](#) ()  
*Reset the vector (as if were just created an empty vector)*
- [CoinPackedVector](#) & [operator=](#) (const [CoinPackedVector](#) &)  
*Assignment operator.*
- [CoinPackedVector](#) & [operator=](#) (const [CoinPackedVectorBase](#) &rhs)  
*Assignment operator from a [CoinPackedVectorBase](#).*
- void [assignVector](#) (int size, int \*&inds, double \*&elems, bool testForDuplicateIndex=COIN\_-DEFAULT\_VALUE\_FOR\_DUPLICATE)  
*Assign the ownership of the arguments to this vector.*
- void [setVector](#) (int size, const int \*inds, const double \*elems, bool testForDuplicateIndex=COIN\_-DEFAULT\_VALUE\_FOR\_DUPLICATE)  
*Set vector size, indices, and elements.*
- void [setConstant](#) (int size, const int \*inds, double elems, bool testForDuplicateIndex=COIN\_-DEFAULT\_VALUE\_FOR\_DUPLICATE)  
*Elements set to have the same scalar value.*
- void [setFull](#) (int size, const double \*elems, bool testForDuplicateIndex=COIN\_-DEFAULT\_VALUE\_FOR\_DUPLICATE)  
*Indices are not specified and are taken to be 0,1,...,size-1.*
- void [setFullNonZero](#) (int size, const double \*elems, bool testForDuplicateIndex=COIN\_-DEFAULT\_VALUE\_FOR\_DUPLICATE)  
*Indices are not specified and are taken to be 0,1,...,size-1, but only where non zero.*
- void [setElement](#) (int index, double element)  
*Set an existing element in the packed vector The first argument is the "index" into the elements() array.*
- void [insert](#) (int index, double element)  
*Insert an element into the vector.*
- void [append](#) (const [CoinPackedVectorBase](#) &caboose)  
*Append a [CoinPackedVector](#) to the end.*
- void [swap](#) (int i, int j)  
*Swap values in positions i and j of indices and elements.*
- void [truncate](#) (int newSize)  
*Resize the packed vector to be the first newSize elements.*

#### Arithmetic operators.

- void [operator+=](#) (double value)  
*add value to every entry*
- void [operator-=](#) (double value)  
*subtract value from every entry*
- void [operator\\*=](#) (double value)  
*multiply every entry by value*
- void [operator/=](#) (double value)  
*divide every entry by value*

### Sorting

- `template<class CoinCompare3 >`  
`void sort (const CoinCompare3 &tc)`  
*Sort the packed storage vector.*
- `void sortIncrIndex ()`
- `void sortDecrIndex ()`
- `void sortIncrElement ()`
- `void sortDecrElement ()`
- `void sortOriginalOrder ()`  
*Sort in original order.*

### Memory usage

- `void reserve (int n)`  
*Reserve space.*
- `int capacity () const`  
*capacity returns the size which could be accomodated without having to reallocate storage.*

### Constructors and destructors

- `CoinPackedVector (bool testForDuplicateIndex=COIN_DEFAULT_VALUE_FOR_DUPLICATE)`  
*Default constructor.*
- `CoinPackedVector (int size, const int *inds, const double *elems, bool testForDuplicateIndex=COIN_DEFAULT_VALUE_FOR_DUPLICATE)`  
*Alternate Constructors - set elements to vector of doubles.*
- `CoinPackedVector (int capacity, int size, int *&inds, double *&elems, bool testForDuplicateIndex=COIN_DEFAULT_VALUE_FOR_DUPLICATE)`  
*Alternate Constructors - set elements to vector of doubles.*
- `CoinPackedVector (int size, const int *inds, double element, bool testForDuplicateIndex=COIN_DEFAULT_VALUE_FOR_DUPLICATE)`  
*Alternate Constructors - set elements to same scalar value.*
- `CoinPackedVector (int size, const double *elements, bool testForDuplicateIndex=COIN_DEFAULT_VALUE_FOR_DUPLICATE)`  
*Alternate Constructors - construct full storage with indices 0 through size-1.*
- `CoinPackedVector (const CoinPackedVector &)`  
*Copy constructor.*
- `CoinPackedVector (const CoinPackedVectorBase &rhs)`  
*Copy constructor from a PackedVectorBase.*
- `virtual ~CoinPackedVector ()`  
*Destructor.*

### Friends

- `void CoinPackedVectorUnitTest ()`  
*A function that tests the methods in the CoinPackedVector class.*

### 8.55.1 Detailed Description

#### Sparse Vector.

Stores vector of indices and associated element values. Supports sorting of vector while maintaining the original indices.

Here is a sample usage:

```
const int ne = 4;
int inx[ne] = { 1, 4, 0, 2 }
double el[ne] = { 10., 40., 1., 50. }

// Create vector and set its value
CoinPackedVector r(ne,inx,el);

// access each index and element
assert( r.indices () [0]== 1 );
assert( r.elements () [0]==10. );
assert( r.indices () [1]== 4 );
assert( r.elements () [1]==40. );
assert( r.indices () [2]== 0 );
assert( r.elements () [2]== 1. );
assert( r.indices () [3]== 2 );
assert( r.elements () [3]==50. );

// access original position of index
assert( r.originalPosition () [0]==0 );
assert( r.originalPosition () [1]==1 );
assert( r.originalPosition () [2]==2 );
assert( r.originalPosition () [3]==3 );

// access as a full storage vector
assert( r [ 0]==1. );
assert( r [ 1]==10.);
assert( r [ 2]==50.);
assert( r [ 3]==0. );
assert( r [ 4]==40.);

// sort Elements in increasing order
r.sortIncrElement ();

// access each index and element
assert( r.indices () [0]== 0 );
assert( r.elements () [0]== 1. );
assert( r.indices () [1]== 1 );
assert( r.elements () [1]==10. );
assert( r.indices () [2]== 4 );
assert( r.elements () [2]==40. );
assert( r.indices () [3]== 2 );
assert( r.elements () [3]==50. );

// access original position of index
assert( r.originalPosition () [0]==2 );
assert( r.originalPosition () [1]==0 );
assert( r.originalPosition () [2]==1 );
assert( r.originalPosition () [3]==3 );

// access as a full storage vector
assert( r [ 0]==1. );
assert( r [ 1]==10.);
assert( r [ 2]==50.);
```

```

assert( r[ 3]==0. );
assert( r[ 4]==40.);

// Restore original sort order
r.sortOriginalOrder();

assert( r.indices ()[0]== 1 );
assert( r.elements()[0]==10. );
assert( r.indices ()[1]== 4 );
assert( r.elements()[1]==40. );
assert( r.indices ()[2]== 0 );
assert( r.elements()[2]== 1. );
assert( r.indices ()[3]== 2 );
assert( r.elements()[3]==50. );

// Tests for equality and equivalence
CoinPackedVector r1;
r1=r;
assert( r==r1 );
assert( r.equivalent(r1) );
r.sortIncrElement();
assert( r!=r1 );
assert( r.equivalent(r1) );

// Add packed vectors.
// Similarly for subtraction, multiplication,
// and division.
CoinPackedVector add = r + r1;
assert( add[0] == 1.+ 1. );
assert( add[1] == 10.+10. );
assert( add[2] == 50.+50. );
assert( add[3] == 0.+ 0. );
assert( add[4] == 40.+40. );

assert( r.sum() == 10.+40.+1.+50. );

```

Definition at line 123 of file CoinPackedVector.hpp.

### 8.55.2 Constructor & Destructor Documentation

#### 8.55.2.1 CoinPackedVector::CoinPackedVector ( int size, const int \* inds, const double \* elems, bool testForDuplicateIndex = COIN\_DEFAULT\_VALUE\_FOR\_DUPLICATE )

Alternate Constructors - set elements to vector of doubles.

This constructor copies the vectors provided as parameters.

#### 8.55.2.2 CoinPackedVector::CoinPackedVector ( int capacity, int size, int \*& inds, double \*& elems, bool testForDuplicateIndex = COIN\_DEFAULT\_VALUE\_FOR\_DUPLICATE )

Alternate Constructors - set elements to vector of doubles.

This constructor takes ownership of the vectors passed as parameters. *inds* and *elems* will be NULL on return.

8.55.2.3 `CoinPackedVector::CoinPackedVector ( int size, const double * elements, bool testForDuplicateIndex = COIN_DEFAULT_VALUE_FOR_DUPLICATE )`

Alternate Constructors - construct full storage with indices 0 through size-1.

8.55.2.4 `CoinPackedVector::CoinPackedVector ( const CoinPackedVector & )`

Copy constructor.

8.55.2.5 `CoinPackedVector::CoinPackedVector ( const CoinPackedVectorBase & rhs )`

Copy constructor *from a PackedVectorBase*.

### 8.55.3 Member Function Documentation

8.55.3.1 `const int* CoinPackedVector::getOriginalPosition ( ) const [inline]`

Get pointer to int \* vector of original positions.

If the packed vector has not been sorted then this function returns the vector: 0, 1, 2, ..., size()-1.

Definition at line 142 of file CoinPackedVector.hpp.

8.55.3.2 `CoinPackedVector& CoinPackedVector::operator= ( const CoinPackedVector & )`

Assignment operator.

**NOTE:** This operator keeps the current `testForDuplicateIndex` setting, and after copying the data it acts accordingly.

8.55.3.3 `CoinPackedVector& CoinPackedVector::operator= ( const CoinPackedVectorBase & rhs )`

Assignment operator from a [CoinPackedVectorBase](#).

**NOTE:** This operator keeps the current `testForDuplicateIndex` setting, and after copying the data it acts accordingly.

Reimplemented from [CoinPackedVectorBase](#).

8.55.3.4 `void CoinPackedVector::assignVector ( int size, int *& inds, double *& elems, bool testForDuplicateIndex = COIN_DEFAULT_VALUE_FOR_DUPLICATE )`

Assign the ownership of the arguments to this vector.

Size is the length of both the indices and elements vectors. The indices and elements vectors are copied into this class instance's member data. The last argument indicates whether this vector will have to be tested for duplicate indices.

**8.55.3.5** `void CoinPackedVector::setVector ( int size, const int * inds, const double * elems, bool testForDuplicateIndex = COIN_DEFAULT_VALUE_FOR_DUPLICATE )`

Set vector size, indices, and elements.

Size is the length of both the indices and elements vectors. The indices and elements vectors are copied into this class instance's member data. The last argument specifies whether this vector will have to be checked for duplicate indices whenever that can happen.

**8.55.3.6** `void CoinPackedVector::truncate ( int newSize )`

Resize the packed vector to be the first newSize elements.

Problem with truncate: what happens with origIndices\_ ???

**8.55.3.7** `template<class CoinCompare3 > void CoinPackedVector::sort ( const CoinCompare3 & tc ) [inline]`

Sort the packed storage vector.

Typical usages:

```
packedVector.sort(CoinIncrIndexOrdered()); //increasing indices
packedVector.sort(CoinIncrElementOrdered()); // increasing elements
```

Definition at line 233 of file CoinPackedVector.hpp.

**8.55.3.8** `void CoinPackedVector::sortOriginalOrder ( )`

Sort in original order.

If the vector has been sorted, then this method restores to its original sort order.

**8.55.3.9** `void CoinPackedVector::reserve ( int n )`

Reserve space.

If one knows the eventual size of the packed vector, then it may be more efficient to reserve the space.

## 8.55.4 Friends And Related Function Documentation

**8.55.4.1** `void CoinPackedVectorUnitTest ( ) [friend]`

A function that tests the methods in the [CoinPackedVector](#) class.

The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging.

The documentation for this class was generated from the following file:

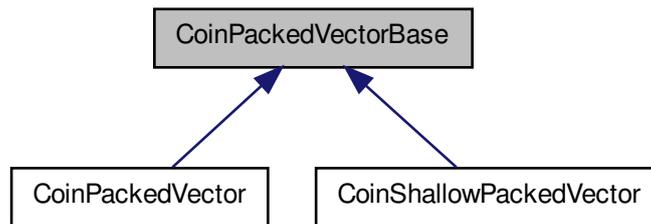
- CoinPackedVector.hpp

### 8.56 CoinPackedVectorBase Class Reference

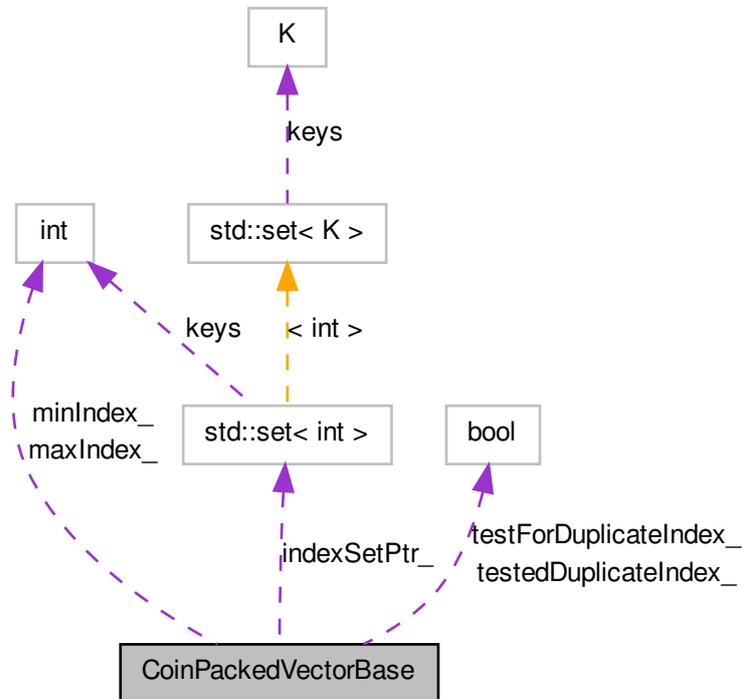
Abstract base class for various sparse vectors.

```
#include <CoinPackedVectorBase.hpp>
```

Inheritance diagram for CoinPackedVectorBase:



Collaboration diagram for CoinPackedVectorBase:



### Public Member Functions

Virtual methods that the derived classes must provide

- virtual int [getNumElements](#) () const =0  
*Get length of indices and elements vectors.*
- virtual const int \* [getIndices](#) () const =0  
*Get indices of elements.*
- virtual const double \* [getElements](#) () const =0  
*Get element values.*

Methods related to whether duplicate-index checking is performed.

*If the checking for duplicate indices is turned off, then some [CoinPackedVector](#) methods may not work correctly if there are duplicate indices.*

*Turning off the checking for duplicate indices may result in better run time performance.*

- void `setTestForDuplicateIndex` (bool test) const  
*Set to the argument value whether to test for duplicate indices in the vector whenever they can occur.*
- void `setTestForDuplicateIndexWhenTrue` (bool test) const  
*Set to the argument value whether to test for duplicate indices in the vector whenever they can occur BUT we know that right now the vector has no duplicate indices.*
- bool `testForDuplicateIndex` () const  
*Returns true if the vector should be tested for duplicate indices when they can occur.*
- void `setTestsOff` () const  
*Just sets test stuff false without a try etc.*

#### Methods for getting info on the packed vector as a full vector

- double \* `denseVector` (int denseSize) const  
*Get the vector as a dense vector.*
- double `operator[]` (int i) const  
*Access the i'th element of the full storage vector.*

#### Index methods

- int `getMaxIndex` () const  
*Get value of maximum index.*
- int `getMinIndex` () const  
*Get value of minimum index.*
- void `duplicateIndex` (const char \*methodName=NULL, const char \*className=NULL) const  
*Throw an exception if there are duplicate indices.*
- bool `isExistingIndex` (int i) const  
*Return true if the i'th element of the full storage vector exists in the packed storage vector.*
- int `findIndex` (int i) const  
*Return the position of the i'th element of the full storage vector.*

#### Comparison operators on two packed vectors

- bool `operator==` (const `CoinPackedVectorBase` &rhs) const  
*Equal.*
- bool `operator!=` (const `CoinPackedVectorBase` &rhs) const  
*Not equal.*
- int `compare` (const `CoinPackedVectorBase` &rhs) const  
*This method establishes an ordering on packed vectors.*
- template<class FloatEqual >  
bool `isEquivalent` (const `CoinPackedVectorBase` &rhs, const FloatEqual &eq) const  
*equivalent - If shallow packed vector A & B are equivalent, then they are still equivalent no matter how they are sorted.*
- bool `isEquivalent` (const `CoinPackedVectorBase` &rhs) const

**Arithmetic operators.**

- double [dotProduct](#) (const double \*dense) const  
*Create the dot product with a full vector.*
- double [oneNorm](#) () const  
*Return the 1-norm of the vector.*
- double [normSquare](#) () const  
*Return the square of the 2-norm of the vector.*
- double [twoNorm](#) () const  
*Return the 2-norm of the vector.*
- double [infNorm](#) () const  
*Return the infinity-norm of the vector.*
- double [sum](#) () const  
*Sum elements of vector.*

**Protected Member Functions****Protected methods**

- void [findMaxMinIndices](#) () const  
*Find Maximum and Minimum Indices.*
- std::set< int > \* [indexSet](#) (const char \*methodName=NULL, const char \*className=NULL) const  
*Return indexSetPtr\_ (create it if necessary).*
- void [clearIndexSet](#) () const  
*Delete the indexSet.*
- void [clearBase](#) () const
- void [copyMaxMinIndex](#) (const [CoinPackedVectorBase](#) &x) const

**Constructors, destructor**

**NOTE:** All constructors are protected.

There's no need to expose them, after all, this is an abstract class.

- virtual [~CoinPackedVectorBase](#) ()  
*Destructor.*
- [CoinPackedVectorBase](#) ()  
*Default constructor.*

**8.56.1 Detailed Description**

Abstract base class for various sparse vectors.

Since this class is abstract, no object of this type can be created. The sole purpose of this class is to provide access to a *constant* packed vector. All members of this class are const methods, they can't change the object.

Definition at line 23 of file [CoinPackedVectorBase.hpp](#).

## 8.56.2 Constructor & Destructor Documentation

### 8.56.2.1 CoinPackedVectorBase::CoinPackedVectorBase ( ) [protected]

Default constructor.

## 8.56.3 Member Function Documentation

### 8.56.3.1 void CoinPackedVectorBase::setTestForDuplicateIndex ( bool *test* ) const

Set to the argument value whether to test for duplicate indices in the vector whenever they can occur.

Calling this method with `test` set to true will trigger an immediate check for duplicate indices.

### 8.56.3.2 void CoinPackedVectorBase::setTestForDuplicateIndexWhenTrue ( bool *test* ) const

Set to the argument value whether to test for duplicate indices in the vector whenever they can occur BUT we know that right now the vector has no duplicate indices.

Calling this method with `test` set to true will *not* trigger an immediate check for duplicate indices; instead, it's assumed that the result of the test will be true.

### 8.56.3.3 bool CoinPackedVectorBase::testForDuplicateIndex ( ) const [inline]

Returns true if the vector should be tested for duplicate indices when they can occur.

Definition at line 63 of file `CoinPackedVectorBase.hpp`.

### 8.56.3.4 double\* CoinPackedVectorBase::denseVector ( int *denseSize* ) const

Get the vector as a dense vector.

The argument specifies how long this dense vector is.

**NOTE:** The user needs to `delete []` this pointer after it's not needed anymore.

### 8.56.3.5 double CoinPackedVectorBase::operator[] ( int *i* ) const

Access the *i*'th element of the full storage vector.

If the *i*'th is not stored, then zero is returned. The initial use of this method has some computational and storage overhead associated with it.

**NOTE:** This is *very* expensive. It is probably much better to use `denseVector()`.

### 8.56.3.6 bool CoinPackedVectorBase::isExistingIndex ( int *i* ) const

Return true if the *i*'th element of the full storage vector exists in the packed storage vector.

8.56.3.7 `int CoinPackedVectorBase::findIndex ( int i ) const`

Return the position of the *i*'th element of the full storage vector.

If index does not exist then -1 is returned

8.56.3.8 `bool CoinPackedVectorBase::operator==( const CoinPackedVectorBase & rhs ) const`

Equal.

Returns true if vectors have same length and corresponding element of each vector is equal.

8.56.3.9 `int CoinPackedVectorBase::compare ( const CoinPackedVectorBase & rhs ) const`

This method establishes an ordering on packed vectors.

It is complete ordering, but not the same as lexicographic ordering. However, it is quick and dirty to compute and thus it is useful to keep packed vectors in a heap when all we care is to quickly check whether a particular vector is already in the heap or not. Returns negative/0/positive depending on whether `this` is smaller/equal.greater than `rhs`.

8.56.3.10 `template<class FloatEqual > bool CoinPackedVectorBase::isEquivalent ( const CoinPackedVectorBase & rhs, const FloatEqual & eq ) const [inline]`

equivalent - If shallow packed vector A & B are equivalent, then they are still equivalent no matter how they are sorted.

In this method the `FloatEqual` function operator can be specified. The default equivalence test is that the entries are relatively equal.

**NOTE:** This is a relatively expensive method as it sorts the two shallow packed vectors.

Definition at line 140 of file `CoinPackedVectorBase.hpp`.

The documentation for this class was generated from the following file:

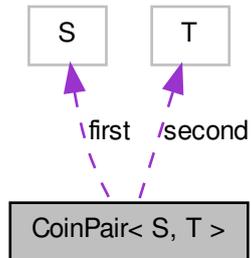
- `CoinPackedVectorBase.hpp`

## 8.57 CoinPair< S, T > Struct Template Reference

An ordered pair.

```
#include <CoinSort.hpp>
```

Collaboration diagram for `CoinPair< S, T >`:



#### Public Member Functions

- `CoinPair` (const S &s, const T &t)  
*Construct from ordered pair.*

#### Public Attributes

- S `first`  
*First member of pair.*
- T `second`  
*Second member of pair.*

#### 8.57.1 Detailed Description

```
template<class S, class T>struct CoinPair< S, T >
```

An ordered pair.

It's the same as `std::pair`, just this way it'll have the same look as the triple sorting.

Definition at line 30 of file `CoinSort.hpp`.

The documentation for this struct was generated from the following file:

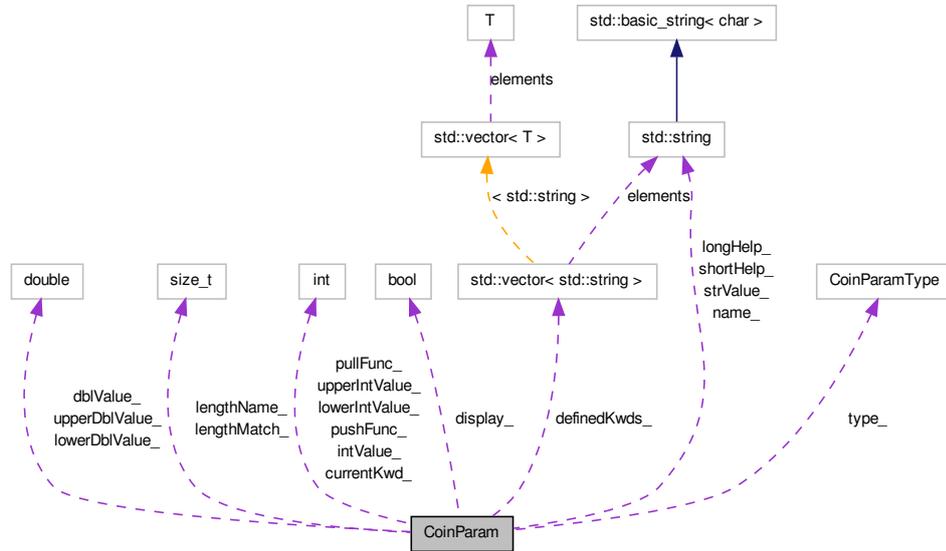
- `CoinSort.hpp`

## 8.58 CoinParam Class Reference

A base class for 'keyword value' command line parameters.

```
#include <CoinParam.hpp>
```

Collaboration diagram for CoinParam:



## Public Types

### Subtypes

- enum [CoinParamType](#)  
*Enumeration for the types of parameters supported by [CoinParam](#).*
- typedef `int(* CoinParamFunc)(CoinParam *param)`  
*Type declaration for push and pull functions.*

## Public Member Functions

### Constructors and Destructors

*Be careful how you specify parameters for the constructors! Some compilers are entirely too willing to convert almost anything to bool.*

- [CoinParam](#) ()  
*Default constructor.*
- [CoinParam](#) (std::string name, std::string help, double lower, double upper, double dflt=0.0, bool display=true)  
*Constructor for a parameter with a double value.*
- [CoinParam](#) (std::string name, std::string help, int lower, int upper, int dflt=0, bool display=true)

*Constructor for a parameter with an integer value.*

- [CoinParam](#) (std::string name, std::string help, std::string firstValue, int dflt, bool display=true)

*Constructor for a parameter with keyword values.*

- [CoinParam](#) (std::string name, std::string help, std::string dflt, bool display=true)

*Constructor for a string parameter.*

- [CoinParam](#) (std::string name, std::string help, bool display=true)

*Constructor for an action parameter.*

- [CoinParam](#) (const [CoinParam](#) &orig)

*Copy constructor.*

- virtual [CoinParam](#) \* [clone](#) ()

*Clone.*

- [CoinParam](#) & [operator=](#) (const [CoinParam](#) &rhs)

*Assignment.*

- virtual [~CoinParam](#) ()

*Destructor.*

#### Methods to query and manipulate the value(s) of a parameter

- void [appendKwd](#) (std::string kwd)  
*Add an additional value-keyword to a keyword parameter.*
- int [kwdIndex](#) (std::string kwd) const  
*Return the integer associated with the specified value-keyword.*
- std::string [kwdVal](#) () const  
*Return the value-keyword that is the current value of the keyword parameter.*
- void [setKwdVal](#) (int value, bool printIt=false)  
*Set the value of the keyword parameter using the integer associated with a value-keyword.*
- void [setKwdVal](#) (const std::string value)  
*Set the value of the keyword parameter using a value-keyword string.*
- void [printKwds](#) () const  
*Prints the set of value-keywords defined for this keyword parameter.*
- void [setStrVal](#) (std::string value)  
*Set the value of a string parameter.*
- std::string [strVal](#) () const  
*Get the value of a string parameter.*
- void [setDbIVal](#) (double value)  
*Set the value of a double parameter.*
- double [dblVal](#) () const  
*Get the value of a double parameter.*
- void [setIntVal](#) (int value)  
*Set the value of a integer parameter.*
- int [intVal](#) () const  
*Get the value of a integer parameter.*
- void [setShortHelp](#) (const std::string help)  
*Add a short help string to a parameter.*
- std::string [shortHelp](#) () const

- Retrieve the short help string.*
- void [setLongHelp](#) (const std::string help)
  - Add a long help message to a parameter.*
- std::string [longHelp](#) () const
  - Retrieve the long help message.*
- void [printLongHelp](#) () const
  - Print long help.*

#### Methods to query and manipulate a parameter object

- [CoinParamType type](#) () const
  - Return the type of the parameter.*
- void [setType](#) ([CoinParamType type](#))
  - Set the type of the parameter.*
- std::string [name](#) () const
  - Return the parameter keyword (name) string.*
- void [setName](#) (std::string name)
  - Set the parameter keyword (name) string.*
- int [matches](#) (std::string input) const
  - Check if the specified string matches the parameter keyword (name) string.*
- std::string [matchName](#) () const
  - Return the parameter keyword (name) string formatted to show the minimum match length.*
- void [setDisplay](#) (bool display)
  - Set visibility of parameter.*
- bool [display](#) () const
  - Get visibility of parameter.*
- [CoinParamFunc pushFunc](#) ()
  - Get push function.*
- void [setPushFunc](#) ([CoinParamFunc func](#))
  - Set push function.*
- [CoinParamFunc pullFunc](#) ()
  - Get pull function.*
- void [setPullFunc](#) ([CoinParamFunc func](#))
  - Set pull function.*

#### Related Functions

(Note that these are not member functions.)

- typedef std::vector< [CoinParam \\*](#) > [CoinParamVec](#)
  - A type for a parameter vector.*
- std::ostream & [operator<<](#) (std::ostream &s, const [CoinParam](#) &param)
  - A stream output function for a [CoinParam](#) object.*
- void [setInputSrc](#) (FILE \*src)
  - Take command input from the file specified by src.*
- bool [isCommandLine](#) ()

- Returns true if command line parameters are being processed.*

  - bool `isInteractive` ()
- Returns true if parameters are being obtained from stdin.*

  - std::string `getStringField` (int argc, const char \*argv[], int \*valid)

*Attempt to read a string from the input.*
- int `getIntField` (int argc, const char \*argv[], int \*valid)

*Attempt to read an integer from the input.*
- double `getDoubleField` (int argc, const char \*argv[], int \*valid)

*Attempt to read a real (double) from the input.*
- int `matchParam` (const `CoinParamVec` &paramVec, std::string name, int &matchNdx, int &shortCnt)

*Scan a parameter vector for parameters whose keyword (name) string matches name using minimal match rules.*
- std::string `getCommand` (int argc, const char \*argv[], const std::string prompt, std::string \*pfx=0)

*Get the next command keyword (name)*
- int `lookupParam` (std::string name, `CoinParamVec` &paramVec, int \*matchCnt=0, int \*shortCnt=0, int \*queryCnt=0)

*Look up the command keyword (name) in the parameter vector. Print help if requested.*
- void `printIt` (const char \*msg)

*Utility to print a long message as filled lines of text.*
- void `shortOrHelpOne` (`CoinParamVec` &paramVec, int matchNdx, std::string name, int numQuery)

*Utility routine to print help given a short match or explicit request for help.*
- void `shortOrHelpMany` (`CoinParamVec` &paramVec, std::string name, int numQuery)

*Utility routine to print help given multiple matches.*
- void `printGenericHelp` ()

*Print a generic 'how to use the command interface' help message.*
- void `printHelp` (`CoinParamVec` &paramVec, int firstParam, int lastParam, std::string prefix, bool shortHelp, bool longHelp, bool hidden)

*Utility routine to print help messages for one or more parameters.*

### 8.58.1 Detailed Description

A base class for 'keyword value' command line parameters.

The underlying paradigm is that a parameter specifies an action to be performed on a target object. The base class provides two function pointers, a 'push' function and a 'pull' function. By convention, a push function will set some value in the target object or perform some action using the target object. A 'pull' function will retrieve some value from the target object. This is only a convention, however; `CoinParam` and associated utilities make no use of these functions and have no hardcoded notion of how they should be used.

The action to be performed, and the target object, will be specific to a particular application. It is expected that users will derive application-specific parameter classes from this

base class. A derived class will typically add fields and methods to set/get a code for the action to be performed (often, an enum class) and the target object (often, a pointer or reference).

Facilities provided by the base class and associated utility routines include:

- Support for common parameter types with numeric, string, or keyword values.
- Support for short and long help messages.
- Pointers to 'push' and 'pull' functions as described above.
- Command line parsing and keyword matching.

All utility routines are declared in the [CoinParamUtils](#) namespace.

The base class recognises five types of parameters: actions (which require no value); numeric parameters with integer or real (double) values; keyword parameters, where the value is one of a defined set of value-keywords; and string parameters (where the value is a string). The base class supports the definition of a valid range, a default value, and short and long help messages for a parameter.

As defined by the [CoinParamFunc](#) typedef, push and pull functions should take a single parameter, a pointer to a [CoinParam](#). Typically this object will actually be a derived class as described above, and the implementation function will have access to all capabilities of [CoinParam](#) and of the derived class.

When specified as command line parameters, the expected syntax is '-keyword value' or '-keyword=value'. You can also use the Gnu double-dash style, '--keyword'. Spaces around the '=' will *not* work.

The keyword (name) for a parameter can be defined with an '!' to mark the minimal match point. For example, allow!ableGap will be considered matched by the strings 'allow', 'allowa', 'allowab', *etc.* Similarly, the value-keyword strings for keyword parameters can be defined with '!' to mark the minimal match point. Matching of keywords and value-keywords is *not* case sensitive.

Definition at line 75 of file CoinParam.hpp.

### 8.58.2 Member Typedef Documentation

#### 8.58.2.1 typedef int(\* CoinParam::CoinParamFunc)(CoinParam \*param)

Type declaration for push and pull functions.

By convention, a return code of 0 indicates execution without error, >0 indicates nonfatal error, and <0 indicates fatal error. This is only convention, however; the base class makes no use of the push and pull functions and has no hardcoded interpretation of the return code.

Definition at line 106 of file CoinParam.hpp.

### 8.58.3 Member Enumeration Documentation

### 8.58.3.1 enum CoinParam::CoinParamType

Enumeration for the types of parameters supported by [CoinParam](#).

[CoinParam](#) provides support for several types of parameters:

- Action parameters, which require no value.
- Integer and double numeric parameters, with upper and lower bounds.
- String parameters that take an arbitrary string value.
- Keyword parameters that take a defined set of string (value-keyword) values. Value-keywords are associated with integers in the order in which they are added, starting from zero.

Definition at line 95 of file `CoinParam.hpp`.

### 8.58.4 Constructor & Destructor Documentation

#### 8.58.4.1 CoinParam::CoinParam ( std::string name, std::string help, double lower, double upper, double dflt = 0.0, bool display = true )

Constructor for a parameter with a double value.

The default value is 0.0. Be careful to clearly indicate that `lower` and `upper` are real (double) values to distinguish this constructor from the constructor for an integer parameter.

#### 8.58.4.2 CoinParam::CoinParam ( std::string name, std::string help, int lower, int upper, int dflt = 0, bool display = true )

Constructor for a parameter with an integer value.

The default value is 0.

#### 8.58.4.3 CoinParam::CoinParam ( std::string name, std::string help, std::string firstValue, int dflt, bool display = true )

Constructor for a parameter with keyword values.

The string supplied as `firstValue` becomes the first value-keyword. Additional value-keywords can be added using [appendKwd\(\)](#). It's necessary to specify both the first value-keyword (`firstValue`) and the default value-keyword index (`dflt`) in order to distinguish this constructor from the constructors for string and action parameters.

Value-keywords are associated with an integer, starting with zero and increasing as each keyword is added. The value-keyword given as `firstValue` will be associated with the integer zero. The integer supplied for `dflt` can be any value, as long as it will be valid once all value-keywords have been added.

**8.58.4.4** `CoinParam::CoinParam ( std::string name, std::string help, std::string dflt, bool display = true )`

Constructor for a string parameter.

For some compilers, the default value (`dflt`) must be specified explicitly with type `std::string` to distinguish the constructor for a string parameter from the constructor for an action parameter. For example, use `std::string("default")` instead of simply "default", or use a variable of type `std::string`.

### 8.58.5 Member Function Documentation

**8.58.5.1** `int CoinParam::kwdIndex ( std::string kwd ) const`

Return the integer associated with the specified value-keyword.

Returns -1 if no value-keywords match the specified string.

**8.58.5.2** `void CoinParam::setKwdVal ( int value, bool printIt = false )`

Set the value of the keyword parameter using the integer associated with a value-keyword.

If `printIt` is true, the corresponding value-keyword string will be echoed to `std::cout`.

**8.58.5.3** `void CoinParam::setKwdVal ( const std::string value )`

Set the value of the keyword parameter using a value-keyword string.

The given string will be tested against the set of value-keywords for the parameter using the shortest match rules.

**8.58.5.4** `void CoinParam::setLongHelp ( const std::string help ) [inline]`

Add a long help message to a parameter.

See [printLongHelp\(\)](#) for a description of how messages are broken into lines.

Definition at line 270 of file `CoinParam.hpp`.

**8.58.5.5** `void CoinParam::printLongHelp ( ) const`

Print long help.

Prints the long help string, plus the valid range and/or keywords if appropriate. The routine makes a best effort to break the message into lines appropriate for an 80-character line. Explicit line breaks in the message will be observed. The short help string will be used if long help is not available.

**8.58.5.6** `int CoinParam::matches ( std::string input ) const`

Check if the specified string matches the parameter keyword (name) string.

Returns 1 if the string matches and meets the minimum match length, 2 if the string

matches but doesn't meet the minimum match length, and 0 if the string doesn't match. Matches are *not* case-sensitive.

#### 8.58.5.7 `std::string CoinParam::matchName ( ) const`

Return the parameter keyword (name) string formatted to show the minimum match length.

For example, if the parameter name was defined as `allow!ableGap`, the string returned by `matchName` would be `allow(ableGap)`.

#### 8.58.5.8 `void CoinParam::setDisplay ( bool display ) [inline]`

Set visibility of parameter.

Intended to control whether the parameter is shown when a list of parameters is processed. Used by `CoinParamUtils::printHelp` when printing help messages for a list of parameters.

Definition at line 330 of file `CoinParam.hpp`.

### 8.58.6 Friends And Related Function Documentation

#### 8.58.6.1 `void setInputSrc ( FILE * src ) [related]`

Take command input from the file specified by `src`.

Use `stdin` for `src` to specify interactive prompting for commands.

#### 8.58.6.2 `std::string getStringField ( int argc, const char * argv[], int * valid ) [related]`

Attempt to read a string from the input.

`argc` and `argv` are used only if `isCommandLine()` would return true. If `valid` is supplied, it will be set to 0 if a string is parsed without error, 2 if no field is present.

#### 8.58.6.3 `int getIntField ( int argc, const char * argv[], int * valid ) [related]`

Attempt to read an integer from the input.

`argc` and `argv` are used only if `isCommandLine()` would return true. If `valid` is supplied, it will be set to 0 if an integer is parsed without error, 1 if there's a parse error, and 2 if no field is present.

#### 8.58.6.4 `double getDoubleField ( int argc, const char * argv[], int * valid ) [related]`

Attempt to read a real (double) from the input.

`argc` and `argv` are used only if `isCommandLine()` would return true. If `valid` is supplied, it will be set to 0 if a real number is parsed without error, 1 if there's a parse error, and 2 if no field is present.

**8.58.6.5** `int matchParam ( const CoinParamVec & paramVec, std::string name, int & matchNdx, int & shortCnt )` [related]

Scan a parameter vector for parameters whose keyword (name) string matches `name` using minimal match rules.

`matchNdx` is set to the index of the last parameter that meets the minimal match criteria (but note there should be at most one matching parameter if the parameter vector is properly configured). `shortCnt` is set to the number of short matches (should be zero for a properly configured parameter vector if a minimal match is found). The return value is the number of matches satisfying the minimal match requirement (should be 0 or 1 in a properly configured vector).

**8.58.6.6** `std::string getCommand ( int argc, const char * argv[], const std::string prompt, std::string * pfx = 0 )` [related]

Get the next command keyword (name)

To be precise, return the next field from the current command input source, after a bit of processing. In command line mode (`isCommandLine()` returns true) the next field will normally be of the form `'-keyword'` or `'--keyword'` (*i.e.*, a parameter keyword), and the string returned would be `'keyword'`. In interactive mode (`isInteractive()` returns true), the user will be prompted if necessary. It is assumed that the user knows not to use the `'-'` or `'--'` prefixes unless specifying parameters on the command line.

There are a number of special cases if we're in command line mode. The order of processing of the raw string goes like this:

- A stand-alone `'-'` is forced to `'stdin'`.
- A stand-alone `'--'` is returned as a word; interpretation is up to the client.
- A prefix of `'-'` or `'--'` is stripped from the string.

If the result is the string `'stdin'`, command processing shifts to interactive mode and the user is immediately prompted for a new command.

Whatever results from the above sequence is returned to the user as the return value of the function. An empty string indicates end of input.

`prompt` will be used only if it's necessary to prompt the user in interactive mode.

**8.58.6.7** `int lookupParam ( std::string name, CoinParamVec & paramVec, int * matchCnt = 0, int * shortCnt = 0, int * queryCnt = 0 )` [related]

Look up the command keyword (name) in the parameter vector. Print help if requested.

In the most straightforward use, `name` is a string without `'?'`, and the value returned is the index in `paramVec` of the single parameter that matched `name`. One or more `'?'` characters at the end of `name` is a query for information. The routine prints short (one `'?'`) or long (more than one `'?'`) help messages for a query. Help is also printed in the case where the name is ambiguous (some of the matches did not meet the minimal match length requirement).

Note that multiple matches meeting the minimal match requirement is a configuration error. The minimal match length for the parameters involved is too short.

If provided as parameters, on return

- `matchCnt` will be set to the number of matches meeting the minimal match requirement
- `shortCnt` will be set to the number of matches that did not meet the minimal match requirement
- `queryCnt` will be set to the number of '?' characters at the end of the name

The return values are:

- >0: index in `paramVec` of the single unique match for `name`
- -1: a query was detected (one or more '?' characters at the end of `name`)
- -2: one or more short matches, not a query
- -3: no matches, not a query
- -4: multiple matches meeting the minimal match requirement (configuration error)

#### 8.58.6.8 void printIt ( const char \* msg ) [related]

Utility to print a long message as filled lines of text.

The routine makes a best effort to break lines without exceeding the standard 80 character line length. Explicit newlines in `msg` will be obeyed.

#### 8.58.6.9 void shortOrHelpOne ( CoinParamVec & paramVec, int matchNdx, std::string name, int numQuery ) [related]

Utility routine to print help given a short match or explicit request for help.

The two really are related, in that a query (a string that ends with one or more '?' characters) will often result in a short match. The routine expects that `name` matches a single parameter, and does not look for multiple matches.

If called with `matchNdx < 0`, the routine will look up `name` in `paramVec` and print the full name from the parameter. If called with `matchNdx > 0`, it just prints the name from the specified parameter. If the name is a query, short (one '?') or long (more than one '?') help is printed.

#### 8.58.6.10 void shortOrHelpMany ( CoinParamVec & paramVec, std::string name, int numQuery ) [related]

Utility routine to print help given multiple matches.

If the name is not a query, or asks for short help (*i.e.*, contains zero or one '?' characters), the list of matching names is printed. If the name asks for long help (contains two or more '?' characters), short help is printed for each matching name.

8.58.6.11 `void printGenericHelp ( )` [related]

Print a generic 'how to use the command interface' help message.

The message is hard coded to match the behaviour of the parsing utilities.

8.58.6.12 `void printHelp ( CoinParamVec & paramVec, int firstParam, int lastParam, std::string prefix, bool shortHelp, bool longHelp, bool hidden )` [related]

Utility routine to print help messages for one or more parameters.

Intended as a utility to implement explicit 'help' commands. Help will be printed for all parameters in `paramVec` from `firstParam` to `lastParam`, inclusive. If `shortHelp` is true, short help messages will be printed. If `longHelp` is true, long help messages are printed. `shortHelp` overrules `longHelp`. If neither is true, only command keywords are printed. `prefix` is printed before each line; it's an imperfect attempt at indentation.

The documentation for this class was generated from the following file:

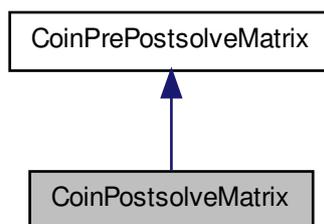
- [CoinParam.hpp](#)

## 8.59 CoinPostsolveMatrix Class Reference

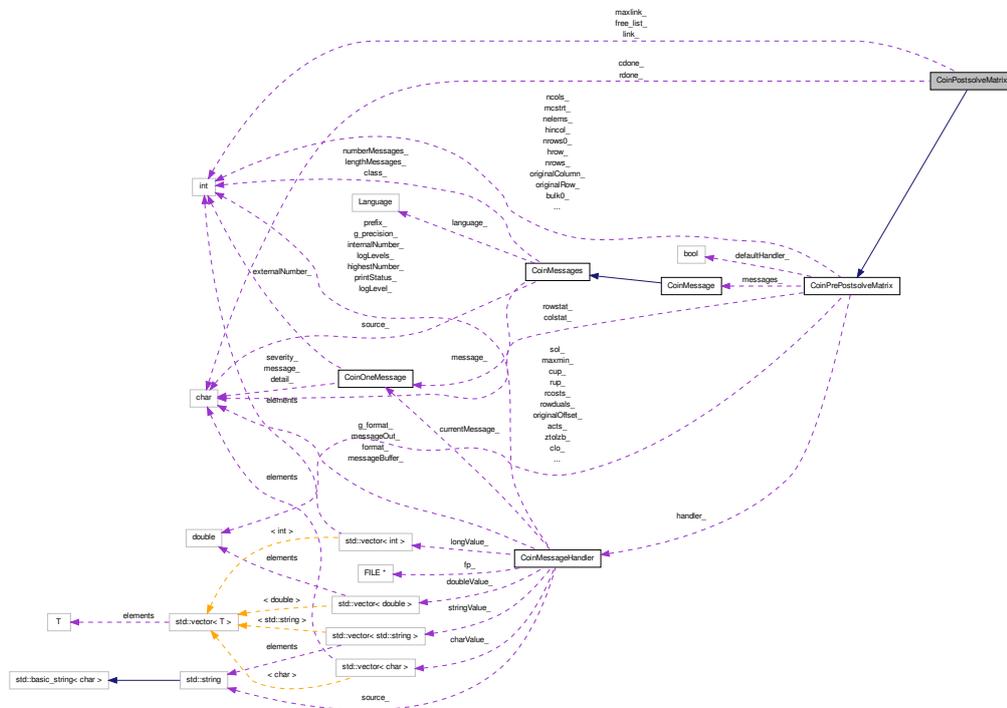
Augments [CoinPrePostsolveMatrix](#) with information about the problem that is only needed during postsolve.

```
#include <CoinPresolveMatrix.hpp>
```

Inheritance diagram for `CoinPostsolveMatrix`:



Collaboration diagram for CoinPostsolveMatrix:



### Public Member Functions

- `CoinPostsolveMatrix` (`int ncols_alloc`, `int nrows_alloc`, `CoinBigIndex nelems_alloc`)  
*'Native' constructor*
- `CoinPostsolveMatrix` (`ClpSimplex *si`, `int ncols0`, `int nrows0`, `CoinBigIndex nelems0`, `double maxmin_`, `double *sol`, `double *acts`, `unsigned char *colstat`, `unsigned char *rowstat`)  
*Clp OSI constructor.*
- `CoinPostsolveMatrix` (`OsiSolverInterface *si`, `int ncols0`, `int nrows0`, `CoinBigIndex nelems0`, `double maxmin_`, `double *sol`, `double *acts`, `unsigned char *colstat`, `unsigned char *rowstat`)  
*Generic OSI constructor.*
- `void assignPresolveToPostsolve` (`CoinPresolveMatrix *preObj`)  
*Load an empty CoinPostsolveMatrix from a CoinPresolveMatrix.*
- `~CoinPostsolveMatrix` ()  
*Destructor.*
- `void check_nbasic` ()  
*debug*

## Public Attributes

## Column thread structures

As mentioned in the class documentation, the entries for a given column do not necessarily occupy a contiguous block of space. The `link_` array is used to maintain the threading. There is one thread for each column, and a single thread for all free entries in `hrow_` and `colels_`. The allocated size of `link_` must be at least as large as the allocated size of `hrow_` and `colels_`.

- CoinBigIndex `free_list_`  
First entry in free entries thread.
- int `maxlink_`  
Allocated size of `link_`.
- CoinBigIndex \* `link_`  
Thread array.

## Debugging aids

These arrays are allocated only when `CoinPresolve` is compiled with `PRESOLVE_ - DEBUG` defined.

They hold codes which track the reason that a column or row is added to the problem during postsolve.

- char \* `cdone_`
- char \* `rdone_`

## Related Functions

(Note that these are not member functions.)

- CoinBigIndex `presolve_find_col` (int col, CoinBigIndex krs, CoinBigIndex kre, const int \*hcol)  
Find position of a column in a row in a row-major matrix.
- CoinBigIndex `presolve_find_minor2` (int tgt, CoinBigIndex ks, int majlen, const int \*minndx, const CoinBigIndex \*majlinks)  
Find position of a minor index in a major vector in a threaded matrix.
- CoinBigIndex `presolve_find_row2` (int row, CoinBigIndex kcs, int collen, const int \*hrow, const CoinBigIndex \*clinks)  
Find position of a row in a column in a column-major threaded matrix.
- CoinBigIndex `presolve_find_minor3` (int tgt, CoinBigIndex ks, int majlen, const int \*minndx, const CoinBigIndex \*majlinks)  
Find position of a minor index in a major vector in a threaded matrix.
- CoinBigIndex `presolve_find_row3` (int row, CoinBigIndex kcs, int collen, const int \*hrow, const CoinBigIndex \*clinks)  
Find position of a row in a column in a column-major threaded matrix.
- void `presolve_delete_from_major2` (int majndx, int minndx, CoinBigIndex \*majstrts, int \*majlens, int \*minndx, int \*majlinks, CoinBigIndex \*free\_listp)

*Delete the entry for a minor index from a major vector in a threaded matrix.*

- void [presolve\\_delete\\_from\\_col2](#) (int row, int col, CoinBigIndex \*mcstrt, int \*hincol, int \*hrow, int \*clinks, CoinBigIndex \*free\_listp)

*Delete the entry for row row from column col in a column-major threaded matrix.*

- void [presolve\\_check\\_threads](#) (const [CoinPostsolveMatrix](#) \*obj)

*Checks that column threads agree with column lengths.*

- void [presolve\\_check\\_free\\_list](#) (const [CoinPostsolveMatrix](#) \*obj, bool chkElemCnt=false)

*Checks the free list.*

- void [presolve\\_check\\_reduced\\_costs](#) (const [CoinPostsolveMatrix](#) \*obj)

*Check stored reduced costs for accuracy and consistency with variable status.*

- void [presolve\\_check\\_duals](#) (const [CoinPostsolveMatrix](#) \*postObj)

*Check the dual variables for consistency with row activity.*

- void [presolve\\_check\\_sol](#) (const [CoinPostsolveMatrix](#) \*postObj, int chkColSol=2, int chkRowAct=2, int chkStatus=1)

*Check primal solution and architectural variable status.*

- void [presolve\\_check\\_nbasic](#) (const [CoinPostsolveMatrix](#) \*postObj)

*Check for the proper number of basic variables.*

### 8.59.1 Detailed Description

Augments [CoinPrePostsolveMatrix](#) with information about the problem that is only needed during postsolve.

The notable point is that the matrix representation is threaded. The representation is column-major and starts with the standard two pairs of arrays: one pair to hold the row indices and coefficients, the second pair to hold the column starting positions and lengths. But the row indices and coefficients for a column do not necessarily occupy a contiguous block in their respective arrays. Instead, a link array gives the position of the next (row index,coefficient) pair. If the row index and value of a coefficient  $a_{\langle p,j \rangle}$  occupy position  $k_p$  in their arrays, then the position of the next coefficient  $a_{\langle q,j \rangle}$  is found as  $k_q = \text{link}[k_p]$ .

This threaded representation allows for efficient expansion of columns as rows are reintroduced during postsolve transformations. The basic packed structures are allocated to the expected size of the postsolved matrix, and as new coefficients are added, their location is simply added to the thread for the column.

There is no provision to convert the threaded representation to a packed representation. In the context of postsolve, it's not required. (You did keep a copy of the original matrix, eh?)

Definition at line 1334 of file [CoinPresolveMatrix.hpp](#).

### 8.59.2 Constructor & Destructor Documentation

8.59.2.1 `CoinPostsolveMatrix::CoinPostsolveMatrix ( int ncols_alloc, int nrows_alloc,  
CoinBigIndex nelems_alloc )`

'Native' constructor

This constructor creates an empty object which must then be loaded. On the other hand, it doesn't assume that the client is an `OsiSolverInterface`.

8.59.2.2 `CoinPostsolveMatrix::CoinPostsolveMatrix ( ClpSimplex * si, int ncols0, int nrows0,  
CoinBigIndex nelems0, double maxmin_, double * sol, double * acts, unsigned char *  
colstat, unsigned char * rowstat )`

Clp OSI constructor.

See Clp code for the definition.

8.59.2.3 `CoinPostsolveMatrix::CoinPostsolveMatrix ( OsiSolverInterface * si, int ncols0, int  
nrows0, CoinBigIndex nelems0, double maxmin_, double * sol, double * acts,  
unsigned char * colstat, unsigned char * rowstat )`

Generic OSI constructor.

See OSI code for the definition.

### 8.59.3 Member Function Documentation

8.59.3.1 `void CoinPostsolveMatrix::assignPresolveToPostsolve ( CoinPresolveMatrix * &  
preObj )`

Load an empty `CoinPostsolveMatrix` from a `CoinPresolveMatrix`.

This routine transfers the contents of the `CoinPrePostsolveMatrix` object from the `CoinPresolveMatrix` object to the `CoinPostsolveMatrix` object and completes initialisation of the `CoinPostsolveMatrix` object. The empty shell of the `CoinPresolveMatrix` object is destroyed.

The routine expects an empty `CoinPostsolveMatrix` object. If handed a loaded object, a lot of memory will leak.

### 8.59.4 Member Data Documentation

8.59.4.1 `CoinBigIndex* CoinPostsolveMatrix::link_`

Thread array.

Within a thread, `link_[k]` points to the next entry in the thread.

Definition at line 1421 of file `CoinPresolveMatrix.hpp`.

The documentation for this class was generated from the following files:

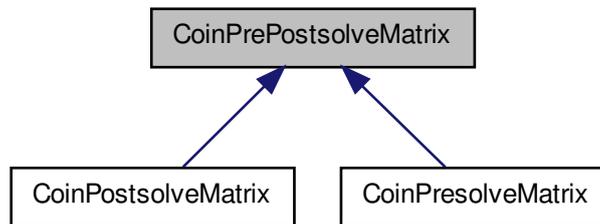
- [CoinPresolveMatrix.hpp](#)
- [CoinPresolvePsdebug.hpp](#)

## 8.60 CoinPrePostsolveMatrix Class Reference

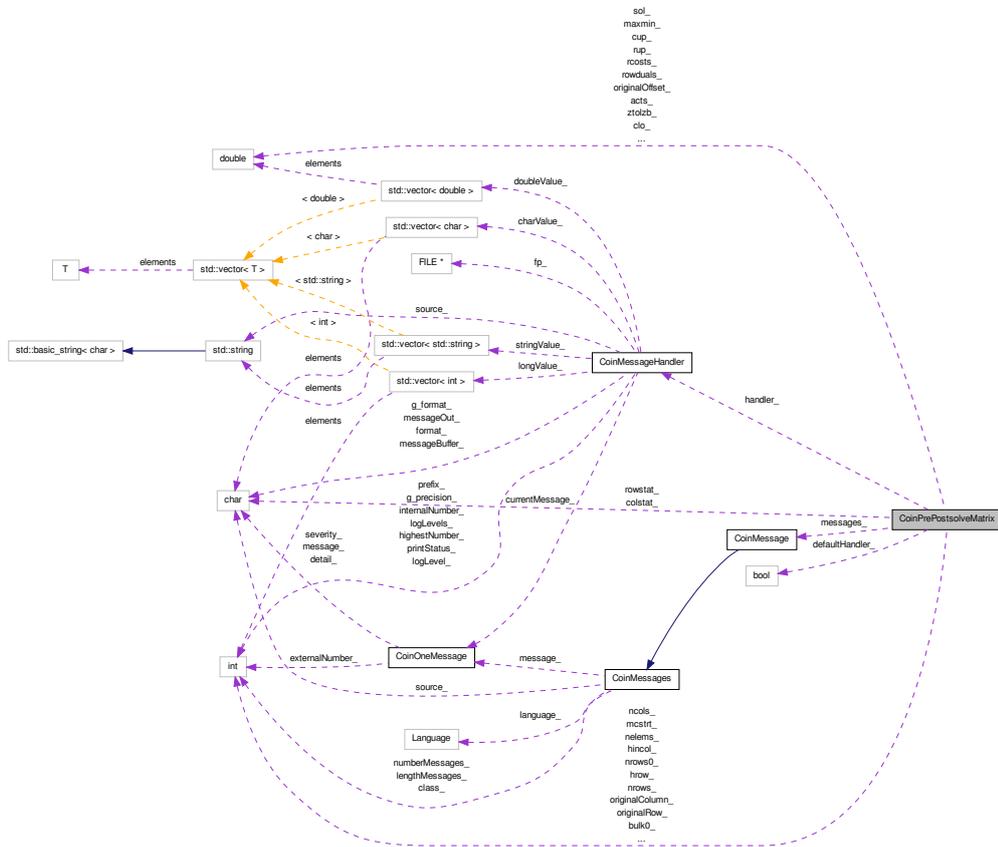
Collects all the information about the problem that is needed in both presolve and postsolve.

```
#include <CoinPresolveMatrix.hpp>
```

Inheritance diagram for CoinPrePostsolveMatrix:



Collaboration diagram for CoinPrePostsolveMatrix:



**Public Types**

- enum [Status](#)  
*Enum for status of various sorts.*

**Public Member Functions**

**Constructors & Destructors**

- [CoinPrePostsolveMatrix](#) (int ncols\_alloc, int nrows\_alloc, CoinBigIndex nelems\_alloc)  
*'Native' constructor*
- [CoinPrePostsolveMatrix](#) (const OsiSolverInterface \*si, int ncols\_, int nrows\_, CoinBigIndex nelems\_)  
*Generic OSI constructor.*

- [CoinPrePostsolveMatrix](#) (const ClpSimplex \*si, int ncols\_, int nrows\_, CoinBigIndex nelems\_, double bulkRatio)  
*ClpOsi constructor.*
- [~CoinPrePostsolveMatrix](#) ()  
*Destructor.*

#### Functions to work with variable status

Functions to work with the [CoinPrePostsolveMatrix::Status](#) enum and related vectors.

- void [setRowStatus](#) (int sequence, [Status](#) status)  
*Set row status (i.e., status of artificial for this row)*
- [Status](#) [getRowStatus](#) (int sequence) const  
*Get row status.*
- bool [rowsBasic](#) (int sequence) const  
*Check if artificial for this row is basic.*
- void [setColumnStatus](#) (int sequence, [Status](#) status)  
*Set column status (i.e., status of primal variable)*
- [Status](#) [getColumnStatus](#) (int sequence) const  
*Get column (structural variable) status.*
- bool [columnsBasic](#) (int sequence) const  
*Check if column (structural variable) is basic.*
- void [setRowStatusUsingValue](#) (int iRow)  
*Set status of row (artificial variable) to the correct nonbasic status given bounds and current value.*
- void [setColumnStatusUsingValue](#) (int iColumn)  
*Set status of column (structural variable) to the correct nonbasic status given bounds and current value.*
- void [setStructuralStatus](#) (const char \*strucStatus, int lenParam)  
*Set column (structural variable) status vector.*
- void [setArtificialStatus](#) (const char \*artifStatus, int lenParam)  
*Set row (artificial variable) status vector.*
- void [setStatus](#) (const [CoinWarmStartBasis](#) \*basis)  
*Set the status of all variables from a basis.*
- [CoinWarmStartBasis](#) \* [getStatus](#) ()  
*Get status in the form of a [CoinWarmStartBasis](#).*
- const char \* [columnStatusString](#) (int j) const  
*Return a print string for status of a column (structural variable)*
- const char \* [rowStatusString](#) (int i) const  
*Return a print string for status of a row (artificial variable)*

#### Functions to load problem and solution information

These functions can be used to load portions of the problem definition and solution. See also the [CoinPresolveMatrix](#) and [CoinPostsolveMatrix](#) classes.

- void [setObjOffset](#) (double offset)

- Set the objective function offset for the original system.*

  - void [setObjSense](#) (double objSense)

*Set the objective sense (max/min)*

- void [setPrimalTolerance](#) (double primTol)

*Set the primal feasibility tolerance.*

- void [setDualTolerance](#) (double dualTol)

*Set the dual feasibility tolerance.*

- void [setColLower](#) (const double \*colLower, int lenParam)

*Set column lower bounds.*

- void [setColUpper](#) (const double \*colUpper, int lenParam)

*Set column upper bounds.*

- void [setColSolution](#) (const double \*colSol, int lenParam)

*Set column solution.*

- void [setCost](#) (const double \*cost, int lenParam)

*Set objective coefficients.*

- void [setReducedCost](#) (const double \*redCost, int lenParam)

*Set reduced costs.*

- void [setRowLower](#) (const double \*rowLower, int lenParam)

*Set row lower bounds.*

- void [setRowUpper](#) (const double \*rowUpper, int lenParam)

*Set row upper bounds.*

- void [setRowPrice](#) (const double \*rowSol, int lenParam)

*Set row solution.*

- void [setRowActivity](#) (const double \*rowAct, int lenParam)

*Set row activity.*

#### Functions to retrieve problem and solution information

- int [getNumCols](#) ()

*Get current number of columns.*

- int [getNumRows](#) ()

*Get current number of rows.*

- int [getNumElems](#) ()

*Get current number of non-zero coefficients.*

- const CoinBigIndex \* [getColStarts](#) () const

*Get column start vector for column-major packed matrix.*

- const int \* [getColLengths](#) () const

*Get column length vector for column-major packed matrix.*

- const int \* [getRowIndicesByCol](#) () const

*Get vector of row indices for column-major packed matrix.*

- const double \* [getElementsByCol](#) () const

*Get vector of elements for column-major packed matrix.*

- const double \* [getColLower](#) () const

*Get column lower bounds.*

- const double \* [getColUpper](#) () const

*Get column upper bounds.*

- const double \* [getCost](#) () const

*Get objective coefficients.*

- const double \* [getRowLower](#) () const  
*Get row lower bounds.*
- const double \* [getRowUpper](#) () const  
*Get row upper bounds.*
- const double \* [getColSolution](#) () const  
*Get column solution (primal variable values)*
- const double \* [getRowActivity](#) () const  
*Get row activity (constraint lhs values)*
- const double \* [getRowPrice](#) () const  
*Get row solution (dual variables)*
- const double \* [getReducedCost](#) () const  
*Get reduced costs.*
- int [countEmptyCols](#) ()  
*Count empty columns.*

#### Public Attributes

##### Current and Allocated Size

*During pre- and postsolve, the matrix will change in size. During presolve it will shrink; during postsolve it will grow. Hence there are two sets of size variables, one for the current size and one for the allocated size. (See the general comments for the [CoinPrePostsolveMatrix](#) class for more information.)*

- int [ncols\\_](#)  
*current number of columns*
- int [nrows\\_](#)  
*current number of rows*
- CoinBigIndex [nelems\\_](#)  
*current number of coefficients*
- int [ncols0\\_](#)  
*Allocated number of columns.*
- int [nrows0\\_](#)  
*Allocated number of rows.*
- CoinBigIndex [nelems0\\_](#)  
*Allocated number of coefficients.*
- CoinBigIndex [bulk0\\_](#)  
*Allocated size of bulk storage for row indices and coefficients.*
- double [bulkRatio\\_](#)  
*Ratio of [bulk0\\_](#) to [nelems0\\_](#); default is 2.*

##### Problem representation

*The matrix is the common column-major format: A pair of vectors with positional correspondence to hold coefficients and row indices, and a second pair of vectors giving the starting position and length of each column in the first pair.*

- CoinBigIndex \* [mcstrt\\_](#)

- *Vector of column start positions in [hrow\\_](#), [colels\\_](#).*
- int \* [hincol\\_](#)  
*Vector of column lengths.*
- int \* [hrow\\_](#)  
*Row indices (positional correspondence with [colels\\_](#))*
- double \* [colels\\_](#)  
*Coefficients (positional correspondence with [hrow\\_](#))*
- double \* [cost\\_](#)  
*Objective coefficients.*
- double [originalOffset\\_](#)  
*Original objective offset.*
- double \* [clo\\_](#)  
*Column (primal variable) lower bounds.*
- double \* [cup\\_](#)  
*Column (primal variable) upper bounds.*
- double \* [rlo\\_](#)  
*Row (constraint) lower bounds.*
- double \* [rup\\_](#)  
*Row (constraint) upper bounds.*
- int \* [originalColumn\\_](#)  
*Original column numbers.*
- int \* [originalRow\\_](#)  
*Original row numbers.*
- double [ztolzb\\_](#)  
*Primal feasibility tolerance.*
- double [ztoldj\\_](#)  
*Dual feasibility tolerance.*
- double [maxmin\\_](#)  
*Maximization/minimization.*

#### Problem solution information

The presolve phase will work without any solution information (appropriate for initial optimisation) or with solution information (appropriate for reoptimisation).

When solution information is supplied, presolve will maintain it to the best of its ability. [colstat\\_](#) is checked to determine the presence/absence of status information. [sol\\_](#) is checked for primal solution information, and [rowduals\\_](#) for dual solution information.

The postsolve phase requires the complete solution information from the presolved problem (status, primal and dual solutions). It will be transformed into a correct solution for the original problem.

- double \* [sol\\_](#)  
*Vector of primal variable values.*
- double \* [rowduals\\_](#)  
*Vector of dual variable values.*
- double \* [acts\\_](#)  
*Vector of constraint left-hand-side values (row activity)*

- double \* [rcosts\\_](#)  
*Vector of reduced costs.*
- unsigned char \* [colstat\\_](#)  
*Status of primal variables.*
- unsigned char \* [rowstat\\_](#)  
*Status of constraints.*

### Related Functions

(Note that these are not member functions.)

- void [presolve\\_make\\_memlists](#) (int \*lengths, [presolvehlink](#) \*link, int n)  
*Initialise linked list for major vector order in bulk storage.*
- bool [presolve\\_expand\\_major](#) (CoinBigIndex \*majstrts, double \*majels, int \*minndxs, int \*majlens, [presolvehlink](#) \*majlinks, int nmaj, int k)  
*Make sure a major-dimension vector k has room for one more coefficient.*
- bool [presolve\\_expand\\_col](#) (CoinBigIndex \*mcstrt, double \*colels, int \*hrow, int \*hincol, [presolvehlink](#) \*clink, int ncols, int colx)  
*Make sure a column (colx) in a column-major matrix has room for one more coefficient.*
- bool [presolve\\_expand\\_row](#) (CoinBigIndex \*mrstrt, double \*rowels, int \*hcol, int \*hinrow, [presolvehlink](#) \*rlink, int nrows, int rowx)  
*Make sure a row (rowx) in a row-major matrix has room for one more coefficient.*
- CoinBigIndex [presolve\\_find\\_minor](#) (int tgt, CoinBigIndex ks, CoinBigIndex ke, const int \*minndxs)  
*Find position of a minor index in a major vector.*
- CoinBigIndex [presolve\\_find\\_row](#) (int row, CoinBigIndex kcs, CoinBigIndex kce, const int \*hrow)  
*Find position of a row in a column in a column-major matrix.*
- CoinBigIndex [presolve\\_find\\_minor1](#) (int tgt, CoinBigIndex ks, CoinBigIndex ke, const int \*minndxs)  
*Find position of a minor index in a major vector.*
- CoinBigIndex [presolve\\_find\\_row1](#) (int row, CoinBigIndex kcs, CoinBigIndex kce, const int \*hrow)  
*Find position of a row in a column in a column-major matrix.*
- CoinBigIndex [presolve\\_find\\_col1](#) (int col, CoinBigIndex krs, CoinBigIndex kre, const int \*hcol)  
*Find position of a column in a row in a row-major matrix.*
- void [presolve\\_delete\\_from\\_major](#) (int majndx, int minndx, const CoinBigIndex \*majstrts, int \*majlens, int \*minndxs, double \*els)  
*Delete the entry for a minor index from a major vector.*
- void [presolve\\_delete\\_from\\_col](#) (int row, int col, const CoinBigIndex \*mcstrt, int \*hincol, int \*hrow, double \*colels)  
*Delete the entry for row row from column col in a column-major matrix.*
- void [presolve\\_delete\\_from\\_row](#) (int row, int col, const CoinBigIndex \*mrstrt, int \*hinrow, int \*hcol, double \*rowels)  
*Delete the entry for column col from row row in a row-major matrix.*

### Message handling

Uses the standard COIN approach: a default handler is installed, and the [CoinPrePost-solveMatrix](#) object takes responsibility for it.

If the client replaces the handler with one of their own, it becomes their responsibility.

- [CoinMessageHandler \\* handler\\_](#)  
*Message handler.*
- `bool defaultHandler_`  
*Indicates if the current [handler\\_](#) is default (true) or not (false).*
- [CoinMessage messages\\_](#)  
*Standard COIN messages.*
- [CoinMessageHandler \\* messageHandler \(\)](#) const  
*Return message handler.*
- `void setMessageHandler (CoinMessageHandler *handler)`  
*Set message handler.*
- [CoinMessages messages \(\)](#) const  
*Return messages.*

#### 8.60.1 Detailed Description

Collects all the information about the problem that is needed in both presolve and post-solve.

In a bit more detail, a column-major representation of the constraint matrix and upper and lower bounds on variables and constraints, plus row and column solutions, reduced costs, and status. There's also a set of arrays holding the original row and column numbers.

As presolve and postsolve transform the matrix, it will occasionally be necessary to expand the number of entries in a column. There are two aspects:

- During postsolve, the constraint system is expected to grow as the smaller pre-solved system is transformed back to the original system.
- During both pre- and postsolve, transforms can increase the number of coefficients in a row or column. (See the variable substitution, doubleton, and tripleton transforms.)

The first is addressed by the members [ncols0\\_](#), [nrows0\\_](#), and [nelems0\\_](#). These should be set (via constructor parameters) to values large enough for the largest size taken on by the constraint system. Typically, this will be the size of the original constraint system.

The second is addressed by a generous allocation of extra (empty) space for the arrays used to hold coefficients and row indices. When columns must be expanded, they are moved into the empty space. When it is used up, the arrays are compacted. When compaction fails to produce sufficient space, presolve/postsolve will fail.

[CoinPrePostsolveMatrix](#) isn't really intended to be used 'bare' --- the expectation is that it'll be used through [CoinPresolveMatrix](#) or [CoinPostsolveMatrix](#). Some of the functions needed to load a problem are defined in the derived classes.

When [CoinPresolve](#) is applied when reoptimising, we need to be prepared to accept a basis and modify it in step with the presolve actions (otherwise we throw away all the advantages of warm start for reoptimization). But other solution components ([acts\\_](#) , [rowduals\\_](#) , [sol\\_](#) , and [rcosts\\_](#) ) are needed only for postsolve, where they're used in places to determine the proper action(s) when restoring rows or columns. If presolve is provided with a solution, it will modify it in step with the presolve actions. Moving the solution components from [CoinPrePostsolveMatrix](#) to [CoinPostsolveMatrix](#) would break a lot of code. It's not clear that it's worth it, and it would preclude upgrades to the presolve side that might make use of any of these. -- lh, 080501 --

Definition at line 244 of file [CoinPresolveMatrix.hpp](#).

### 8.60.2 Member Enumeration Documentation

#### 8.60.2.1 enum [CoinPrePostsolveMatrix::Status](#)

Enum for status of various sorts.

Matches [CoinWarmStartBasis::Status](#) and adds `superBasic`. Most code that converts between [CoinPrePostsolveMatrix::Status](#) and [CoinWarmStartBasis::Status](#) will break if this correspondence is broken.

`superBasic` is an unresolved problem: there's no analogue in [CoinWarmStartBasis::Status](#).

Definition at line 292 of file [CoinPresolveMatrix.hpp](#).

### 8.60.3 Constructor & Destructor Documentation

#### 8.60.3.1 [CoinPrePostsolveMatrix::CoinPrePostsolveMatrix](#) ( *int ncols\_alloc*, *int nrows\_alloc*, *CoinBigIndex nelems\_alloc* )

'Native' constructor

This constructor creates an empty object which must then be loaded. On the other hand, it doesn't assume that the client is an [OsiSolverInterface](#).

#### 8.60.3.2 [CoinPrePostsolveMatrix::CoinPrePostsolveMatrix](#) ( *const OsiSolverInterface \* si*, *int ncols\_*, *int nrows\_*, *CoinBigIndex nelems\_* )

Generic OSI constructor.

See OSI code for the definition.

#### 8.60.3.3 [CoinPrePostsolveMatrix::CoinPrePostsolveMatrix](#) ( *const ClpSimplex \* si*, *int ncols\_*, *int nrows\_*, *CoinBigIndex nelems\_*, *double bulkRatio* )

ClpOsi constructor.

See Clp code for the definition.

#### 8.60.4 Member Function Documentation

##### 8.60.4.1 void CoinPrePostsolveMatrix::setObjSense ( double *objSense* )

Set the objective sense (max/min)

Coded as 1.0 for min, -1.0 for max.

##### 8.60.4.2 void CoinPrePostsolveMatrix::setMessageHandler ( CoinMessageHandler \* *handler* ) [inline]

Set message handler.

The client retains responsibility for the handler --- it will not be destroyed with the [CoinPrePostsolveMatrix](#) object.

Definition at line 498 of file [CoinPresolveMatrix.hpp](#).

#### 8.60.5 Member Data Documentation

##### 8.60.5.1 CoinBigIndex CoinPrePostsolveMatrix::bulk0\_

Allocated size of bulk storage for row indices and coefficients.

This is the space allocated for [hrow\\_](#) and [coels\\_](#). This must be large enough to allow columns to be copied into empty space when they need to be expanded. For efficiency (to minimize the number of times the representation must be compressed) it's recommended that this be at least  $2 * \text{nelems0}_$ .

Definition at line 539 of file [CoinPresolveMatrix.hpp](#).

##### 8.60.5.2 int\* CoinPrePostsolveMatrix::originalColumn\_

Original column numbers.

Over the current range of column numbers in the presolved problem, the entry for column *j* will contain the index of the corresponding column in the original problem.

Definition at line 582 of file [CoinPresolveMatrix.hpp](#).

##### 8.60.5.3 int\* CoinPrePostsolveMatrix::originalRow\_

Original row numbers.

Over the current range of row numbers in the presolved problem, the entry for row *i* will contain the index of the corresponding row in the original problem.

Definition at line 589 of file [CoinPresolveMatrix.hpp](#).

##### 8.60.5.4 double\* CoinPrePostsolveMatrix::sol\_

Vector of primal variable values.

If [sol\\_](#) exists, it is assumed that primal solution information should be updated and that [acts\\_](#) also exists.

Definition at line 620 of file CoinPresolveMatrix.hpp.

#### 8.60.5.5 double\* CoinPrePostsolveMatrix::rowduals\_

Vector of dual variable values.

If [rowduals\\_](#) exists, it is assumed that dual solution information should be updated and that [rcosts\\_](#) also exists.

Definition at line 626 of file CoinPresolveMatrix.hpp.

#### 8.60.5.6 double\* CoinPrePostsolveMatrix::acts\_

Vector of constraint left-hand-side values (row activity)

Produced by evaluating constraints according to [sol\\_](#). Updated iff [sol\\_](#) exists.

Definition at line 632 of file CoinPresolveMatrix.hpp.

#### 8.60.5.7 double\* CoinPrePostsolveMatrix::rcosts\_

Vector of reduced costs.

Produced by evaluating dual constraints according to [rowduals\\_](#). Updated iff [rowduals\\_](#) exists.

Definition at line 638 of file CoinPresolveMatrix.hpp.

#### 8.60.5.8 unsigned char\* CoinPrePostsolveMatrix::colstat\_

Status of primal variables.

Coded with `CoinPrePostSolveMatrix::Status`, one code per char. `colstat_` and `rowstat_` **MUST** be allocated as a single vector. This is to maintain compatibility with `ClpPresolve` and `OsiPresolve`, which do it this way.

Definition at line 646 of file CoinPresolveMatrix.hpp.

#### 8.60.5.9 unsigned char\* CoinPrePostsolveMatrix::rowstat\_

Status of constraints.

More accurately, the status of the logical variable associated with the constraint. Coded with `CoinPrePostSolveMatrix::Status`, one code per char. Note that this must be allocated as a single vector with `colstat_`.

Definition at line 654 of file CoinPresolveMatrix.hpp.

The documentation for this class was generated from the following file:

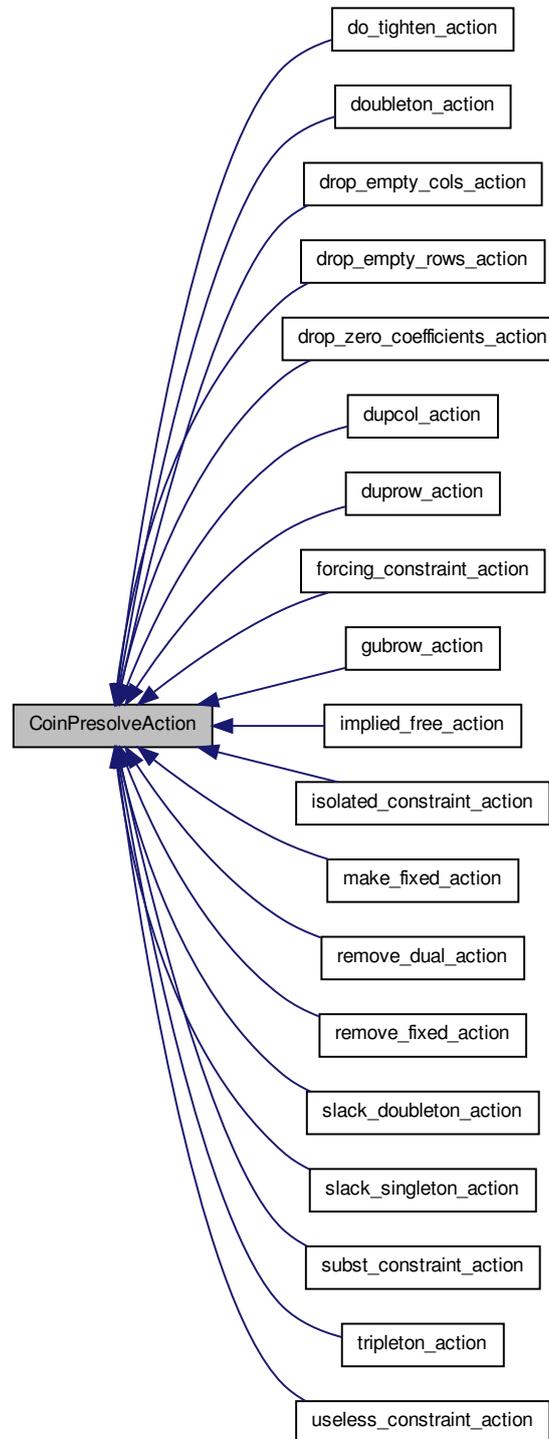
- [CoinPresolveMatrix.hpp](#)

## 8.61 CoinPresolveAction Class Reference

Abstract base class of all presolve routines.

```
#include <CoinPresolveMatrix.hpp>
```

Inheritance diagram for CoinPresolveAction:



Collaboration diagram for CoinPresolveAction:



### Public Member Functions

- [CoinPresolveAction](#) (const [CoinPresolveAction](#) \*next)  
*Construct a postsolve object and add it to the transformation list.*
- void [setNext](#) (const [CoinPresolveAction](#) \*nextAction)  
*modify next (when building rather than passing)*
- virtual const char \* [name](#) () const =0  
*A name for debug printing.*
- virtual void [postsolve](#) ([CoinPostsolveMatrix](#) \*prob) const =0  
*Apply the postsolve transformation for this particular presolve action.*
- virtual [~CoinPresolveAction](#) ()  
*Virtual destructor.*

### Static Public Member Functions

- static void [throwCoinError](#) (const char \*error, const char \*ps\_routine)  
*Stub routine to throw exceptions.*

### Public Attributes

- const [CoinPresolveAction](#) \* [next](#)  
*The next presolve transformation.*

#### 8.61.1 Detailed Description

Abstract base class of all presolve routines.

The details will make more sense after a quick overview of the grand plan: A presolve object is handed a problem object, which it is expected to modify in some useful way. Assuming that it succeeds, the presolve object should create a postsolve object, *i.e.*, an object that contains instructions for backing out the presolve transform to recover the original problem. These postsolve objects are accumulated in a linked list, with each successive presolve action adding its postsolve action to the head of the list. The

end result of all this is a presolved problem object, and a list of postsolve objects. The presolved problem object is then handed to a solver for optimization, and the problem object augmented with the results. The list of postsolve objects is then traversed. Each of them (un)modifies the problem object, with the end result being the original problem, augmented with solution information.

The problem object representation is [CoinPrePostsolveMatrix](#) and subclasses. Check there for details. The [CoinPresolveAction](#) class and subclasses represent the presolve and postsolve objects.

In spite of the name, the only information held in a [CoinPresolveAction](#) object is the information needed to postsolve (*i.e.*, the information needed to back out the presolve transformation). This information is not expected to change, so the fields are all `const`.

A subclass of [CoinPresolveAction](#), implementing a specific pre/postsolve action, is expected to declare a static function that attempts to perform a presolve transformation. This function will be handed a [CoinPresolveMatrix](#) to transform, and a pointer to the head of the list of postsolve objects. If the transform is successful, the function will create a new [CoinPresolveAction](#) object, link it at the head of the list of postsolve objects, and return a pointer to the postsolve object it has just created. Otherwise, it should return 0. It is expected that these static functions will be the only things that can create new [CoinPresolveAction](#) objects; this is expressed by making each subclass' constructor(s) private.

Every subclass must also define a `postsolve` method. This function will be handed a [CoinPostsolveMatrix](#) to transform.

It is the client's responsibility to implement presolve and postsolve driver routines. See [OsiPresolve](#) for examples.

#### Note

Since the only fields in a [CoinPresolveAction](#) are `const`, anything one can do with a variable declared `CoinPresolveAction*` can also be done with a variable declared `const CoinPresolveAction*`. It is expected that all derived subclasses of [CoinPresolveAction](#) also have this property.

Definition at line 137 of file [CoinPresolveMatrix.hpp](#).

### 8.61.2 Constructor & Destructor Documentation

#### 8.61.2.1 [CoinPresolveAction::CoinPresolveAction \( const \[CoinPresolveAction\]\(#\) \\* next \)](#) [inline]

Construct a postsolve object and add it to the transformation list.

This is an 'add to head' operation. This object will point to the one passed as the parameter.

Definition at line 161 of file [CoinPresolveMatrix.hpp](#).

8.61.2.2 `virtual CoinPresolveAction::~~CoinPresolveAction ( ) [inline, virtual]`

Virtual destructor.

Definition at line 178 of file `CoinPresolveMatrix.hpp`.

### 8.61.3 Member Function Documentation

8.61.3.1 `static void CoinPresolveAction::throwCoinError ( const char * error, const char * ps_routine ) [inline, static]`

Stub routine to throw exceptions.

Exceptions are inefficient, particularly with g++. Even with xIC, the use of exceptions adds a long prologue to a routine. Therefore, rather than use `throw` directly in the routine, I use it in a stub routine.

Definition at line 146 of file `CoinPresolveMatrix.hpp`.

8.61.3.2 `virtual const char* CoinPresolveAction::name ( ) const [pure virtual]`

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implemented in `doubleton_action`, `dupcol_action`, `duprow_action`, `gubrow_action`, `drop_empty_cols_action`, `drop_empty_rows_action`, `remove_fixed_action`, `make_fixed_action`, `forcing_constraint_action`, `implied_free_action`, `isolated_constraint_action`, `slack_doubleton_action`, `slack_singleton_action`, `subst_constraint_action`, `do_tighten_action`, `tripleton_action`, `useless_constraint_action`, and `drop_zero_coefficients_action`.

### 8.61.4 Member Data Documentation

8.61.4.1 `const CoinPresolveAction* CoinPresolveAction::next`

The next presolve transformation.

Set at object construction.

Definition at line 154 of file `CoinPresolveMatrix.hpp`.

The documentation for this class was generated from the following file:

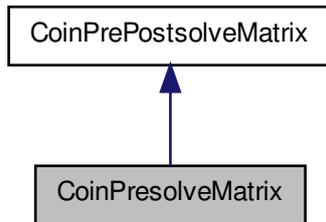
- [CoinPresolveMatrix.hpp](#)

## 8.62 CoinPresolveMatrix Class Reference

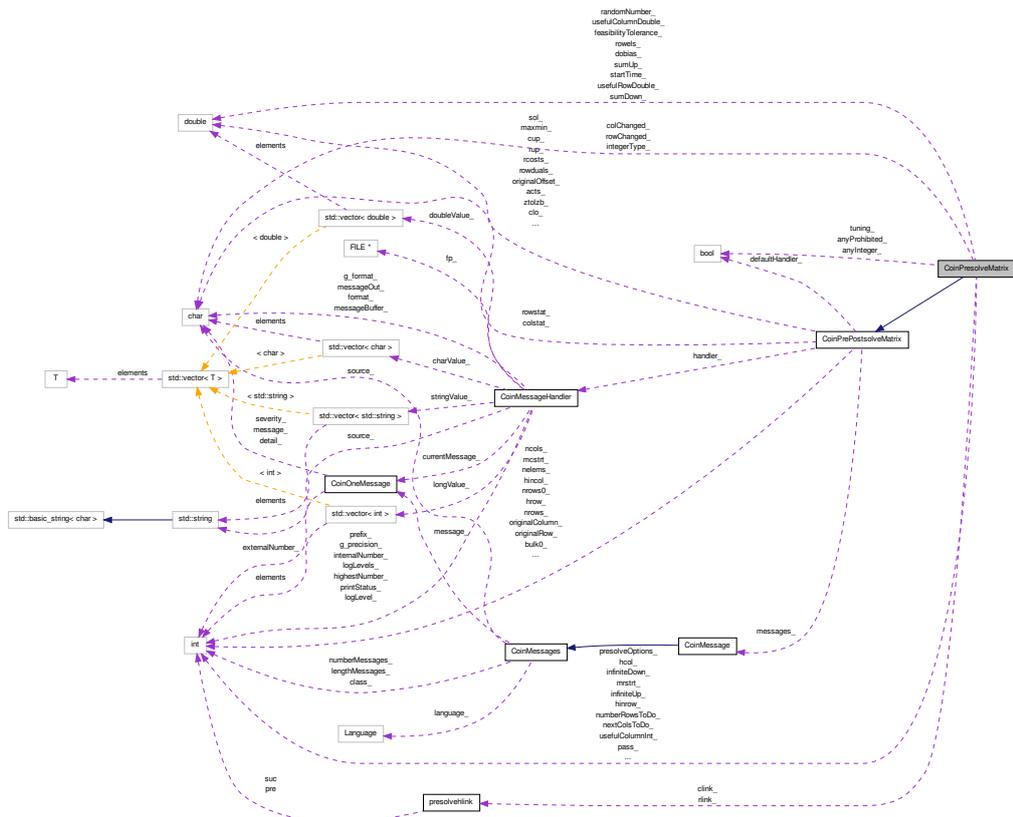
Augments [CoinPrePostsolveMatrix](#) with information about the problem that is only needed during presolve.

```
#include <CoinPresolveMatrix.hpp>
```

Inheritance diagram for CoinPresolveMatrix:



Collaboration diagram for CoinPresolveMatrix:



## Public Member Functions

- [CoinPresolveMatrix](#) (int ncols\_alloc, int nrows\_alloc, CoinBigIndex nelems\_alloc)
  - 'Native' constructor*
- [CoinPresolveMatrix](#) (int ncols0, double maxmin, ClpSimplex \*si, int nrows, CoinBigIndex nelems, bool doStatus, double nonLinearVariable, double bulkRatio)
  - Clp OSI constructor.*
- void [update\\_model](#) (ClpSimplex \*si, int nrows0, int ncols0, CoinBigIndex nelems0)
  - Update the model held by a Clp OSI.*
- [CoinPresolveMatrix](#) (int ncols0, double maxmin, OsiSolverInterface \*si, int nrows, CoinBigIndex nelems, bool doStatus, double nonLinearVariable, const char \*prohibited, const char \*rowProhibited=NULL)
  - Generic OSI constructor.*
- void [update\\_model](#) (OsiSolverInterface \*si, int nrows0, int ncols0, CoinBigIndex nelems0)
  - Update the model held by a generic OSI.*
- [~CoinPresolveMatrix](#) ()
  - Destructor.*
- void [change\\_bias](#) (double change\_amount)
  - Adjust objective function constant offset.*
- void [statistics](#) ()
  - Say we want statistics - also set time.*
- double [feasibilityTolerance](#) ()
  - Return feasibility tolerance.*
- void [setFeasibilityTolerance](#) (double val)
  - Set feasibility tolerance.*
- int [status](#) ()
  - Returns problem status (0 = feasible, 1 = infeasible, 2 = unbounded)*
- void [setStatus](#) (int status)
  - Set problem status.*
- void [setPass](#) (int pass=0)
  - Set pass number.*
- void [setMaximumSubstitutionLevel](#) (int level)
  - Set Maximum substitution level (normally 3)*

## Functions to load the problem representation

- void [setMatrix](#) (const [CoinPackedMatrix](#) \*mtx)
  - Load the coefficient matrix.*
- int [countEmptyRows](#) ()
  - Count number of empty rows.*
- void [setVariableType](#) (int i, int variableType)
  - Set variable type information for a single variable.*
- void [setVariableType](#) (const unsigned char \*variableType, int lenParam)

- Set variable type information for all variables.*
- void [setVariableType](#) (bool allIntegers, int lenParam)
  - Set the type of all variables.*
- void [setAnyInteger](#) (bool anyInteger=true)
  - Set a flag for presence (true) or absence (false) of integer variables.*

#### Functions to retrieve problem information

- const CoinBigIndex \* [getRowStarts](#) () const
  - Get row start vector for row-major packed matrix.*
- const int \* [getColIndicesByRow](#) () const
  - Get vector of column indices for row-major packed matrix.*
- const double \* [getElementsByRow](#) () const
  - Get vector of elements for row-major packed matrix.*
- bool [isInteger](#) (int i) const
  - Check for integrality of the specified variable.*
- bool [anyInteger](#) () const
  - Check if there are any integer variables.*
- int [presolveOptions](#) () const
  - Picks up any special options.*
- void [setPresolveOptions](#) (int value)
  - Sets any special options (see [presolveOptions\\_](#))*

#### Functions to manipulate row and column processing status

- void [initColsToDo](#) ()
  - Initialise the column ToDo lists.*
- int [stepColsToDo](#) ()
  - Step column ToDo lists.*
- int [numberColsToDo](#) ()
  - Return the number of columns on the [colsToDo\\_](#) list.*
- bool [colChanged](#) (int i) const
  - Has column been changed?*
- void [unsetColChanged](#) (int i)
  - Mark column as not changed.*
- void [setColChanged](#) (int i)
  - Mark column as changed.*
- void [addCol](#) (int i)
  - Mark column as changed and add to list of columns to process next.*
- bool [colProhibited](#) (int i) const
  - Test if column is eligible for preprocessing.*
- bool [colProhibited2](#) (int i) const
  - Test if column is eligible for preprocessing.*
- void [setColProhibited](#) (int i)
  - Mark column as ineligible for preprocessing.*
- bool [colUsed](#) (int i) const
  - Test if column is marked as used.*
- void [setColUsed](#) (int i)
  - Mark column as used.*

- void [unsetColUsed](#) (int i)  
*Mark column as unused.*
- bool [collInfinite](#) (int i) const  
*Has column infinite ub (originally)*
- void [unsetCollInfinite](#) (int i)  
*Mark column as not infinite ub (originally)*
- void [setCollInfinite](#) (int i)  
*Mark column as infinite ub (originally)*
- void [initRowsToDo](#) ()  
*Initialise the row ToDo lists.*
- int [stepRowsToDo](#) ()  
*Step row ToDo lists.*
- int [numberRowsToDo](#) ()  
*Return the number of rows on the [rowsToDo\\_](#) list.*
- bool [rowChanged](#) (int i) const  
*Has row been changed?*
- void [unsetRowChanged](#) (int i)  
*Mark row as not changed.*
- void [setRowChanged](#) (int i)  
*Mark row as changed.*
- void [addRow](#) (int i)  
*Mark row as changed and add to list of rows to process next.*
- bool [rowProhibited](#) (int i) const  
*Test if row is eligible for preprocessing.*
- bool [rowProhibited2](#) (int i) const  
*Test if row is eligible for preprocessing.*
- void [setRowProhibited](#) (int i)  
*Mark row as ineligible for preprocessing.*
- bool [rowUsed](#) (int i) const  
*Test if row is marked as used.*
- void [setRowUsed](#) (int i)  
*Mark row as used.*
- void [unsetRowUsed](#) (int i)  
*Mark row as unused.*
- bool [anyProhibited](#) () const  
*Check if there are any prohibited rows or columns.*
- void [setAnyProhibited](#) (bool val=true)  
*Set a flag for presence of prohibited rows or columns.*
- int [recomputeSums](#) (int iRow)  
*Recompute ups and downs for a row (nonzero if infeasible).*
- int [initializeStuff](#) ()  
*Initialize random numbers etc (nonzero if infeasible)*
- void [deleteStuff](#) ()  
*Delete useful arrays.*

**Public Attributes**

- double [dobias\\_](#)  
*Objective function offset introduced during presolve.*
- unsigned char \* [integerType\\_](#)  
*Tracks integrality of columns (1 for integer, 0 for continuous)*
- bool [anyInteger\\_](#)  
*Flag to say if any variables are integer.*
- bool [tuning\\_](#)  
*Print statistics for tuning.*
- double [startTime\\_](#)  
*Start time of presolve.*
- double [feasibilityTolerance\\_](#)  
*Bounds can be moved by this to retain feasibility.*
- int [status\\_](#)  
*Output status: 0 = feasible, 1 = infeasible, 2 = unbounded.*
- int [pass\\_](#)  
*Pass number.*
- int [maxSubstLevel\\_](#)  
*Maximum substitution level.*

**Matrix storage management links**

*Linked lists, modelled after the linked lists used in OSL factorization.*

*They are used for management of the bulk coefficient and minor index storage areas.*

- [presolvehlink](#) \* [clink\\_](#)  
*Linked list for the column-major representation.*
- [presolvehlink](#) \* [rlink\\_](#)  
*Linked list for the row-major representation.*

**Row-major representation**

*Common row-major format: A pair of vectors with positional correspondence to hold coefficients and column indices, and a second pair of vectors giving the starting position and length of each row in the first pair.*

- CoinBigIndex \* [mrstrt\\_](#)  
*Vector of row start positions in #hcol, [rowels\\_](#).*
- int \* [hinrow\\_](#)  
*Vector of row lengths.*
- double \* [rowels\\_](#)  
*Coefficients (positional correspondence with [hcol\\_](#))*
- int \* [hcol\\_](#)  
*Column indices (positional correspondence with [rowels\\_](#))*

### Row and column processing status

Information used to determine if rows or columns can be changed and if they require further processing due to changes.

There are four major lists: the `[row,col]ToDo` list, and the `[row,col]NextToDo` list. In general, a transform processes entries from the `ToDo` list and adds entries to the `NextToDo` list.

There are two vectors, `[row,col]Changed`, which track the status of individual rows and columns.

- unsigned char \* `colChanged_`  
Column change status information.
- int \* `colsToDo_`  
Input list of columns to process.
- int `numberColsToDo_`  
Length of `colsToDo_`.
- int \* `nextColsToDo_`  
Output list of columns to process next.
- int `numberNextColsToDo_`  
Length of `nextColsToDo_`.
- unsigned char \* `rowChanged_`  
Row change status information.
- int \* `rowsToDo_`  
Input list of rows to process.
- int `numberRowsToDo_`  
Length of `rowsToDo_`.
- int \* `nextRowsToDo_`  
Output list of rows to process next.
- int `numberNextRowsToDo_`  
Length of `nextRowsToDo_`.
- int `presolveOptions_`  
Presolve options.
- bool `anyProhibited_`  
Flag to say if any rows or columns are marked as prohibited.
- int \* `usefulRowInt_`  
Useful int array 3\* number rows.
- double \* `usefulRowDouble_`  
Useful double array number rows.
- int \* `usefulColumnInt_`  
Useful int array 2\* number columns.
- double \* `usefulColumnDouble_`  
Useful double array number columns.
- double \* `randomNumber_`  
Array of random numbers (max row,column)
- int \* `infiniteUp_`  
Array giving number of infinite ups on a row.
- double \* `sumUp_`  
Array giving sum of non-infinite ups on a row.
- int \* `infiniteDown_`  
Array giving number of infinite downs on a row.
- double \* `sumDown_`  
Array giving sum of non-infinite downs on a row.

## Friends

- void [assignPresolveToPostsolve](#) (CoinPresolveMatrix \*preObj)  
*Initialize a [CoinPostsolveMatrix](#) object, destroying the [CoinPresolveMatrix](#) object.*

## Related Functions

(Note that these are not member functions.)

- void [presolve\\_no\\_dups](#) (const CoinPresolveMatrix \*preObj, bool doCol=true, bool doRow=true)  
*Check column-major and/or row-major matrices for duplicate entries in the major vectors.*
- void [presolve\\_links\\_ok](#) (const CoinPresolveMatrix \*preObj, bool doCol=true, bool doRow=false)  
*Check the links which track storage order for major vectors in the bulk storage area.*
- void [presolve\\_no\\_zeros](#) (const CoinPresolveMatrix \*preObj, bool doCol=true, bool doRow=true)  
*Check for explicit zeros in the column- and/or row-major matrices.*
- void [presolve\\_consistent](#) (const CoinPresolveMatrix \*preObj, bool chkvals=true)  
  
*Checks for equivalence of the column- and row-major matrices.*
- void [presolve\\_check\\_sol](#) (const CoinPresolveMatrix \*preObj, int chkColSol=2, int chkRowAct=1, int chkStatus=1)  
*Check primal solution and architectural variable status.*
- void [presolve\\_check\\_nbasic](#) (const CoinPresolveMatrix \*preObj)  
*Check for the proper number of basic variables.*

## 8.62.1 Detailed Description

Augments [CoinPrePostsolveMatrix](#) with information about the problem that is only needed during presolve.

For problem manipulation, this class adds a row-major matrix representation, linked lists that allow for easy manipulation of the matrix when applying presolve transforms, and vectors to track row and column processing status (changed, needs further processing, change prohibited)

For problem representation, this class adds information about variable type (integer or continuous), an objective offset, and a feasibility tolerance.

**NOTE** that the [anyInteger\\_](#) and [anyProhibited\\_](#) flags are independent of the vectors used to track this information for individual variables ([integerType\\_](#) and [rowChanged\\_](#) and [colChanged\\_](#), respectively).

**NOTE** also that at the end of presolve the column-major and row-major matrix representations are loosely packed (*i.e.*, there may be gaps between columns in the bulk storage arrays).

Definition at line 787 of file CoinPresolveMatrix.hpp.

### 8.62.2 Constructor & Destructor Documentation

**8.62.2.1** `CoinPresolveMatrix::CoinPresolveMatrix ( int ncols_alloc, int nrows_alloc, CoinBigIndex nelems_alloc )`

'Native' constructor

This constructor creates an empty object which must then be loaded. On the other hand, it doesn't assume that the client is an OsiSolverInterface.

**8.62.2.2** `CoinPresolveMatrix::CoinPresolveMatrix ( int ncols0, double maxmin, ClpSimplex * si, int nrows, CoinBigIndex nelems, bool doStatus, double nonLinearVariable, double bulkRatio )`

Clp OSI constructor.

See Clp code for the definition.

**8.62.2.3** `CoinPresolveMatrix::CoinPresolveMatrix ( int ncols0, double maxmin, OsiSolverInterface * si, int nrows, CoinBigIndex nelems, bool doStatus, double nonLinearVariable, const char * prohibited, const char * rowProhibited = NULL )`

Generic OSI constructor.

See OSI code for the definition.

### 8.62.3 Member Function Documentation

**8.62.3.1** `void CoinPresolveMatrix::setMatrix ( const CoinPackedMatrix * mtx )`

Load the coefficient matrix.

Load the coefficient matrix before loading the other vectors (bounds, objective, variable type) required to define the problem.

**8.62.3.2** `void CoinPresolveMatrix::setVariableType ( int i, int variableType ) [inline]`

Set variable type information for a single variable.

Set `variableType` to 0 for continuous, 1 for integer. Does not manipulate the [anyInteger\\_](#) flag.

Definition at line 875 of file `CoinPresolveMatrix.hpp`.

**8.62.3.3** `void CoinPresolveMatrix::setVariableType ( const unsigned char * variableType, int lenParam )`

Set variable type information for all variables.

Set `variableType[i]` to 0 for continuous, 1 for integer. Does not manipulate the [anyInteger\\_](#) flag.

**8.62.3.4** void CoinPresolveMatrix::setVariableType ( bool *allIntegers*, int *lenParam* )

Set the type of all variables.

*allIntegers* should be true to set the type to integer, false to set the type to continuous.

**8.62.3.5** bool CoinPresolveMatrix::isInteger ( int *i* ) const [inline]

Check for integrality of the specified variable.

Consults the [integerType\\_](#) vector if present; fallback is the [anyInteger\\_](#) flag.

Definition at line 917 of file CoinPresolveMatrix.hpp.

**8.62.3.6** bool CoinPresolveMatrix::anyInteger ( ) const [inline]

Check if there are any integer variables.

Consults the [anyInteger\\_](#) flag

Definition at line 930 of file CoinPresolveMatrix.hpp.

**8.62.3.7** void CoinPresolveMatrix::initColsToDo ( )

Initialise the column ToDo lists.

Places all columns in the [colsToDo\\_](#) list except for columns marked as prohibited (*viz.* [colChanged\\_](#)).

**8.62.3.8** int CoinPresolveMatrix::stepColsToDo ( )

Step column ToDo lists.

Moves columns on the [nextColsToDo\\_](#) list to the [colsToDo\\_](#) list, emptying [nextColsToDo\\_](#). Returns the number of columns transferred.

**8.62.3.9** bool CoinPresolveMatrix::colProhibited2 ( int *i* ) const [inline]

Test if column is eligible for preprocessing.

The difference between this method and [colProhibited\(\)](#) is that this method first tests [anyProhibited\\_](#) before examining the specific entry for the specified column.

Definition at line 1179 of file CoinPresolveMatrix.hpp.

**8.62.3.10** bool CoinPresolveMatrix::colUsed ( int *i* ) const [inline]

Test if column is marked as used.

This is for doing faster lookups to see where two columns have entries in common.

Definition at line 1194 of file CoinPresolveMatrix.hpp.

**8.62.3.11** void CoinPresolveMatrix::initRowsToDo ( )

Initialise the row ToDo lists.

Places all rows in the [rowsToDo\\_](#) list except for rows marked as prohibited (*viz.* [rowChanged\\_](#)).

).

**8.62.3.12** `int CoinPresolveMatrix::stepRowsToDo ( )`

Step row ToDo lists.

Moves rows on the [nextRowsToDo\\_](#) list to the [rowsToDo\\_](#) list, emptying [nextRowsToDo\\_](#) . Returns the number of rows transferred.

**8.62.3.13** `bool CoinPresolveMatrix::rowProhibited2 ( int i ) const` `[inline]`

Test if row is eligible for preprocessing.

The difference between this method and [rowProhibited\(\)](#) is that this method first tests [anyProhibited\\_](#) before examining the specific entry for the specified row.

Definition at line 1265 of file [CoinPresolveMatrix.hpp](#).

**8.62.3.14** `bool CoinPresolveMatrix::rowUsed ( int i ) const` `[inline]`

Test if row is marked as used.

This is for doing faster lookups to see where two rows have entries in common. It can be used anywhere as long as it ends up zeroed out.

Definition at line 1280 of file [CoinPresolveMatrix.hpp](#).

**8.62.3.15** `int CoinPresolveMatrix::recomputeSums ( int iRow )`

Recompute ups and downs for a row (nonzero if infeasible).

If *iRow* -1 then recompute all

## 8.62.4 Friends And Related Function Documentation

**8.62.4.1** `void assignPresolveToPostsolve ( CoinPresolveMatrix * & preObj )` `[friend]`

Initialize a [CoinPostsolveMatrix](#) object, destroying the [CoinPresolveMatrix](#) object.

See [CoinPostsolveMatrix::assignPresolveToPostsolve](#).

## 8.62.5 Member Data Documentation

**8.62.5.1** `bool CoinPresolveMatrix::anyInteger_`

Flag to say if any variables are integer.

Note that this flag is *not* manipulated by the various `setVariableType` routines.

Definition at line 993 of file [CoinPresolveMatrix.hpp](#).

**8.62.5.2** `int CoinPresolveMatrix::status_`

Output status: 0 = feasible, 1 = infeasible, 2 = unbounded.

Actually implemented as single bit flags:  $1^0 = \text{infeasible}$ ,  $1^1 = \text{unbounded}$ .

Definition at line 1015 of file CoinPresolveMatrix.hpp.

#### 8.62.5.3 int CoinPresolveMatrix::pass\_

Pass number.

Used to control the execution of testRedundant (evoked by the implied\_free transform).

Definition at line 1028 of file CoinPresolveMatrix.hpp.

#### 8.62.5.4 int CoinPresolveMatrix::maxSubstLevel\_

Maximum substitution level.

Used to control the execution of subst from implied\_free

Definition at line 1037 of file CoinPresolveMatrix.hpp.

#### 8.62.5.5 unsigned char\* CoinPresolveMatrix::colChanged\_

Column change status information.

Coded using the following bits:

- 0x01: Column has changed
- 0x02: preprocessing prohibited
- 0x04: Column has been used
- 0x08: Column originally had infinite ub

Definition at line 1066 of file CoinPresolveMatrix.hpp.

#### 8.62.5.6 unsigned char\* CoinPresolveMatrix::rowChanged\_

Row change status information.

Coded using the following bits:

- 0x01: Row has changed
- 0x02: preprocessing prohibited
- 0x04: Row has been used

Definition at line 1085 of file CoinPresolveMatrix.hpp.

#### 8.62.5.7 int CoinPresolveMatrix::presolveOptions\_

Presolve options.

- 1 set if allow duplicate column tests for integer variables
- 2 set to allow code to try and fix infeasibilities

- 4 set to inhibit  $x+y+z=1$  mods
- 8 not used
- 16 set to allow stuff which won't unroll easily
- 0x80000000 set by presolve to say `dupcol_action` compressed columns

Definition at line 1102 of file `CoinPresolveMatrix.hpp`.

#### 8.62.5.8 bool CoinPresolveMatrix::anyProhibited\_

Flag to say if any rows or columns are marked as prohibited.

Note that this flag is *not* manipulated by any of the various `set*Prohibited` routines.

Definition at line 1108 of file `CoinPresolveMatrix.hpp`.

The documentation for this class was generated from the following files:

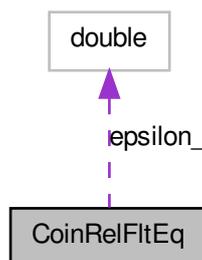
- [CoinPresolveMatrix.hpp](#)
- [CoinPresolvePsdebug.hpp](#)

## 8.63 CoinRelFitEq Class Reference

Equality to a scaled tolerance.

```
#include <CoinFloatEqual.hpp>
```

Collaboration diagram for `CoinRelFitEq`:



### Public Member Functions

- bool [operator\(\)](#) (const double f1, const double f2) const  
*Compare function.*

#### Constructors and destructors

- [CoinRelFltEq](#) ()  
*Default constructor.*
- [CoinRelFltEq](#) (const double epsilon)  
*Alternate constructor with epsilon as a parameter.*
- virtual [~CoinRelFltEq](#) ()  
*Destructor.*
- [CoinRelFltEq](#) (const [CoinRelFltEq](#) &src)  
*Copy constructor.*
- [CoinRelFltEq](#) & operator= (const [CoinRelFltEq](#) &rhs)  
*Assignment.*

#### 8.63.1 Detailed Description

Equality to a scaled tolerance.

Operands are considered equal if their difference is within a scaled epsilon calculated as  $\text{epsilon\_} * (1 + \text{CoinMax}(|f1|, |f2|))$ .

Definition at line 110 of file CoinFloatEqual.hpp.

#### 8.63.2 Constructor & Destructor Documentation

##### 8.63.2.1 [CoinRelFltEq::CoinRelFltEq](#) ( ) [`inline`]

Default constructor.

Default tolerance is 1.0e-10.

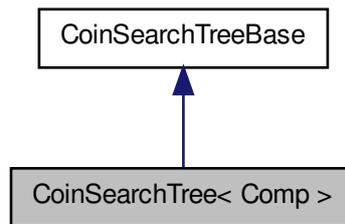
Definition at line 134 of file CoinFloatEqual.hpp.

The documentation for this class was generated from the following file:

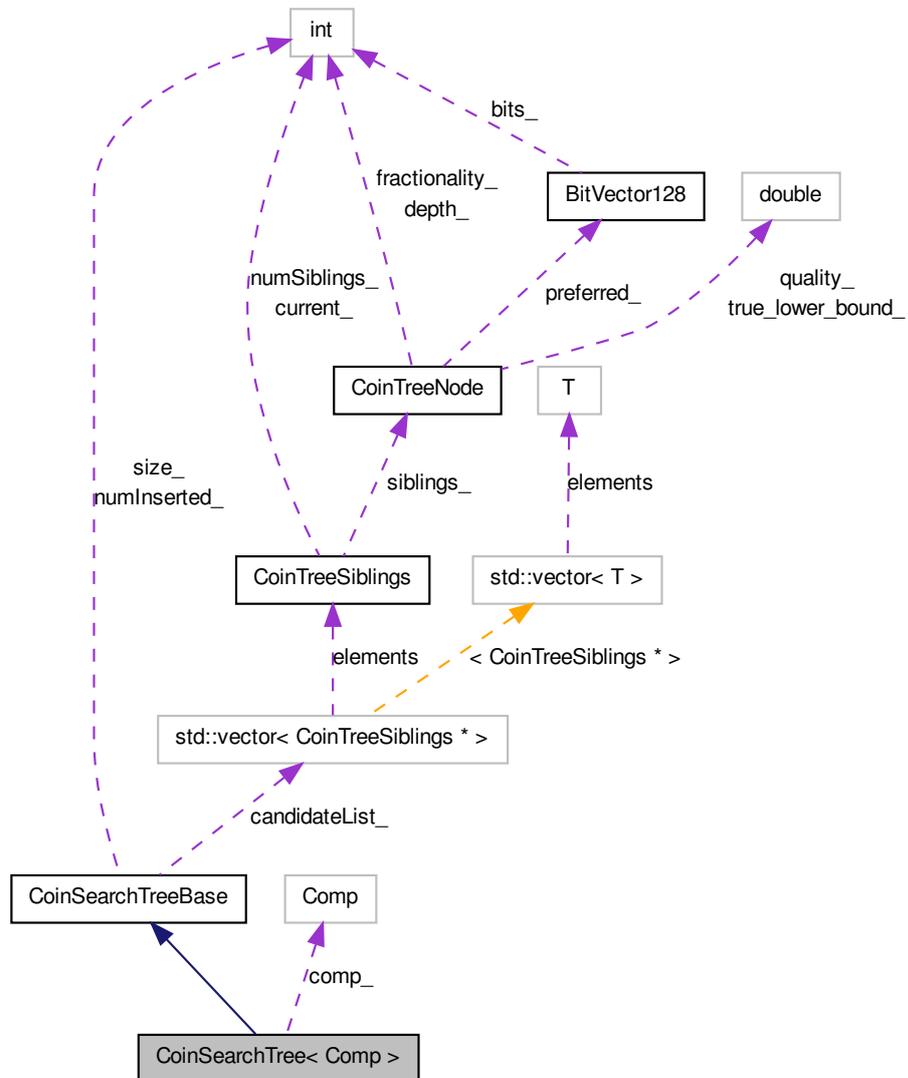
- [CoinFloatEqual.hpp](#)

## 8.64 CoinSearchTree&lt; Comp &gt; Class Template Reference

Inheritance diagram for CoinSearchTree< Comp >:



Collaboration diagram for CoinSearchTree< Comp >:



#### Protected Member Functions

- virtual void `fixTop ()`

*After changing data in the top node, fix the heap.*

## 8.64.1 Detailed Description

```
template<class Comp>class CoinSearchTree< Comp >
```

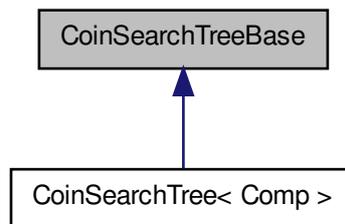
Definition at line 329 of file CoinSearchTree.hpp.

The documentation for this class was generated from the following file:

- CoinSearchTree.hpp

## 8.65 CoinSearchTreeBase Class Reference

Inheritance diagram for CoinSearchTreeBase:





### 8.65.1 Detailed Description

Definition at line 215 of file CoinSearchTree.hpp.

### 8.65.2 Member Function Documentation

#### 8.65.2.1 void CoinSearchTreeBase::pop( ) [inline]

pop will advance the `next` pointer among the siblings on the top and then moves the top to its correct position.

`#realpop` is the method that actually removes the element from the heap

Definition at line 257 of file CoinSearchTree.hpp.

The documentation for this class was generated from the following file:

- CoinSearchTree.hpp

## 8.66 CoinSearchTreeCompareBest Struct Reference

Best first search.

```
#include <CoinSearchTree.hpp>
```

### 8.66.1 Detailed Description

Best first search.

Definition at line 205 of file CoinSearchTree.hpp.

The documentation for this struct was generated from the following file:

- CoinSearchTree.hpp

## 8.67 CoinSearchTreeCompareBreadth Struct Reference

### 8.67.1 Detailed Description

Definition at line 195 of file CoinSearchTree.hpp.

The documentation for this struct was generated from the following file:

- CoinSearchTree.hpp

## 8.68 CoinSearchTreeCompareDepth Struct Reference

Depth First Search.

```
#include <CoinSearchTree.hpp>
```

**8.68.1 Detailed Description**

Depth First Search.

Definition at line 176 of file CoinSearchTree.hpp.

The documentation for this struct was generated from the following file:

- CoinSearchTree.hpp

**8.69 CoinSearchTreeComparePreferred Struct Reference**

Function objects to compare search tree nodes.

```
#include <CoinSearchTree.hpp>
```

**8.69.1 Detailed Description**

Function objects to compare search tree nodes.

The comparison function must return true if the first argument is "better" than the second one, i.e., it should be processed first. Depth First Search.

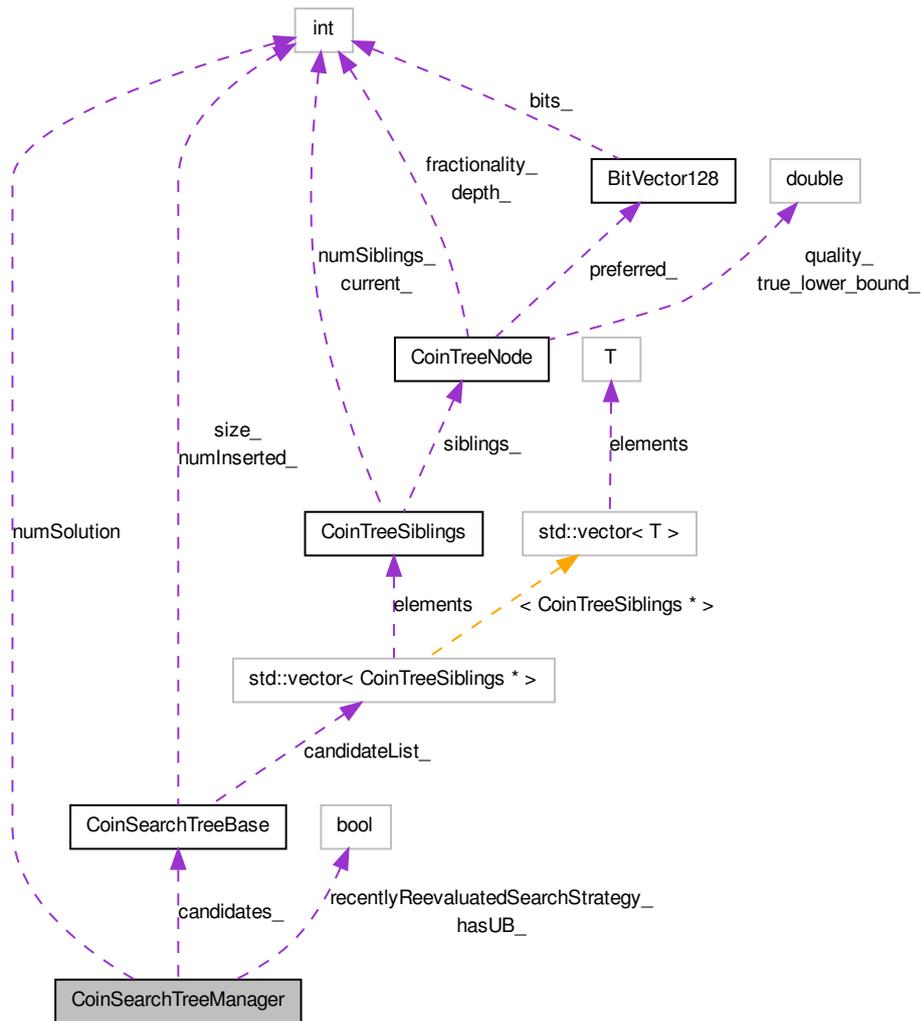
Definition at line 150 of file CoinSearchTree.hpp.

The documentation for this struct was generated from the following file:

- CoinSearchTree.hpp

8.70 CoinSearchTreeManager Class Reference

Collaboration diagram for CoinSearchTreeManager:



8.70.1 Detailed Description

Definition at line 402 of file `CoinSearchTree.hpp`.

The documentation for this class was generated from the following file:

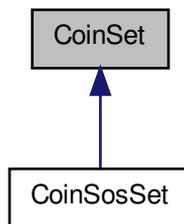
- CoinSearchTree.hpp

## 8.71 CoinSet Class Reference

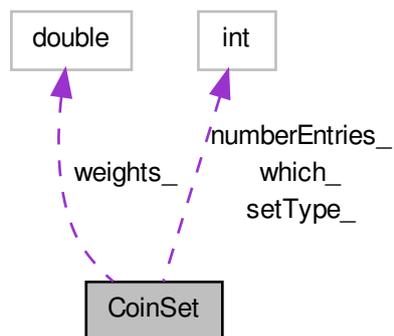
Very simple class for containing data on set.

```
#include <CoinMpsIO.hpp>
```

Inheritance diagram for CoinSet:



Collaboration diagram for CoinSet:



### Public Member Functions

### Constructor and destructor

- [CoinSet](#) ()  
*Default constructor.*
- [CoinSet](#) (int numberEntries, const int \*which)  
*Constructor.*
- [CoinSet](#) (const [CoinSet](#) &)  
*Copy constructor.*
- [CoinSet](#) & [operator=](#) (const [CoinSet](#) &rhs)  
*Assignment operator.*
- virtual [~CoinSet](#) ()  
*Destructor.*

### gets

- int [numberEntries](#) () const  
*Returns number of entries.*
- int [setType](#) () const  
*Returns type of set - 1 =SOS1, 2 =SOS2.*
- const int \* [which](#) () const  
*Returns list of variables.*
- const double \* [weights](#) () const  
*Returns weights.*

### Protected Attributes

#### data

- int [numberEntries\\_](#)  
*Number of entries.*
- int [setType\\_](#)  
*type of set*
- int \* [which\\_](#)  
*Which variables are in set.*
- double \* [weights\\_](#)  
*Weights.*

#### 8.71.1 Detailed Description

Very simple class for containing data on set.

Definition at line 220 of file CoinMpsIO.hpp.

The documentation for this class was generated from the following file:

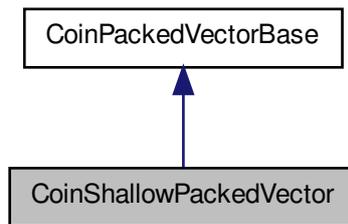
- CoinMpsIO.hpp

## 8.72 CoinShallowPackedVector Class Reference

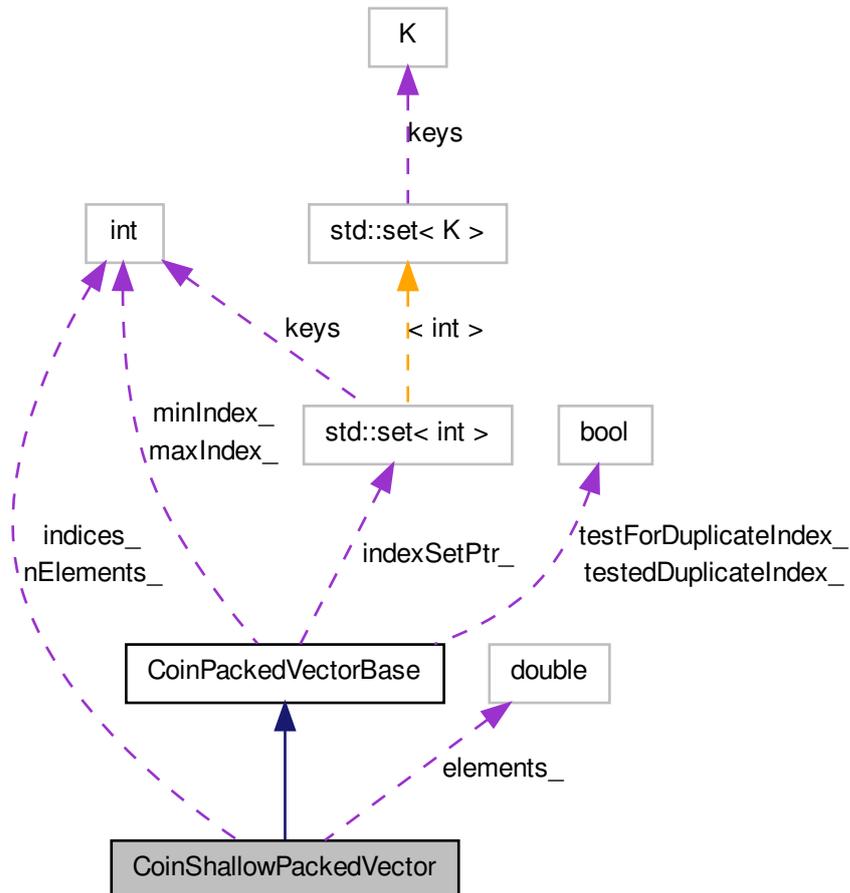
Shallow Sparse Vector.

```
#include <CoinShallowPackedVector.hpp>
```

Inheritance diagram for CoinShallowPackedVector:



Collaboration diagram for CoinShallowPackedVector:



### Public Member Functions

#### Get methods

- virtual int [getNumElements](#) () const  
*Get length of indices and elements vectors.*
- virtual const int \* [getIndices](#) () const  
*Get indices of elements.*
- virtual const double \* [getElements](#) () const  
*Get element values.*

**Set methods**

- void `clear` ()  
*Reset the vector (as if were just created an empty vector)*
- `CoinShallowPackedVector` & `operator=` (const `CoinShallowPackedVector` &x)  
*Assignment operator.*
- `CoinShallowPackedVector` & `operator=` (const `CoinPackedVectorBase` &x)  
*Assignment operator from a `CoinPackedVectorBase`.*
- void `setVector` (int size, const int \*indices, const double \*elements, bool testForDuplicateIndex=true)  
*just like the explicit constructor*

**Methods to create, set and destroy**

- `CoinShallowPackedVector` (bool testForDuplicateIndex=true)  
*Default constructor.*
- `CoinShallowPackedVector` (int size, const int \*indices, const double \*elements, bool testForDuplicateIndex=true)  
*Explicit Constructor.*
- `CoinShallowPackedVector` (const `CoinPackedVectorBase` &)  
*Copy constructor from the base class.*
- `CoinShallowPackedVector` (const `CoinShallowPackedVector` &)  
*Copy constructor.*
- `~CoinShallowPackedVector` ()  
*Destructor.*
- void `print` ()  
*Print vector information.*

**Friends**

- void `CoinShallowPackedVectorUnitTest` ()  
*A function that tests the methods in the `CoinShallowPackedVector` class.*

**8.72.1 Detailed Description**

Shallow Sparse Vector.

This class is for sparse vectors where the indices and elements are stored elsewhere. This class only maintains pointers to the indices and elements. Since this class does not own the index and element data it provides read only access to to the data. An `CoinSparsePackedVector` must be used when the sparse vector's data will be altered.

This class stores pointers to the vectors. It does not actually contain the vectors.

Here is a sample usage:

```
const int ne = 4;
int inx[ne] = { 1, 4, 0, 2 };
double el[ne] = { 10., 40., 1., 50. };
```

```

// Create vector and set its value
CoinShallowPackedVector r(ne,inx,el);

// access each index and element
assert( r.indices () [0]== 1 );
assert( r.elements() [0]==10. );
assert( r.indices () [1]== 4 );
assert( r.elements() [1]==40. );
assert( r.indices () [2]== 0 );
assert( r.elements() [2]== 1. );
assert( r.indices () [3]== 2 );
assert( r.elements() [3]==50. );

// access as a full storage vector
assert( r[ 0]==1. );
assert( r[ 1]==10.);
assert( r[ 2]==50.);
assert( r[ 3]==0. );
assert( r[ 4]==40.);

// Tests for equality and equivalence
CoinShallowPackedVector r1;
r1=r;
assert( r==r1 );
r.sort(CoinIncrElementOrdered());
assert( r!=r1 );

// Add packed vectors.
// Similarly for subtraction, multiplication,
// and division.
CoinPackedVector add = r + r1;
assert( add[0] == 1.+ 1. );
assert( add[1] == 10.+10. );
assert( add[2] == 50.+50. );
assert( add[3] == 0.+ 0. );
assert( add[4] == 40.+40. );
assert( r.sum() == 10.+40.+1.+50. );

```

Definition at line 74 of file CoinShallowPackedVector.hpp.

### 8.72.2 Constructor & Destructor Documentation

#### 8.72.2.1 CoinShallowPackedVector::CoinShallowPackedVector ( bool *testForDuplicateIndex* = true )

Default constructor.

#### 8.72.2.2 CoinShallowPackedVector::CoinShallowPackedVector ( int *size*, const int \* *indices*, const double \* *elements*, bool *testForDuplicateIndex* = true )

Explicit Constructor.

Set vector size, indices, and elements. Size is the length of both the indices and elements vectors. The indices and elements vectors are not copied into this class instance. The ShallowPackedVector only maintains the pointers to the indices and elements vectors.

The last argument specifies whether the creator of the object knows in advance that

there are no duplicate indices.

**8.72.2.3** `CoinShallowPackedVector::CoinShallowPackedVector ( const  
CoinPackedVectorBase & )`

Copy constructor from the base class.

**8.72.2.4** `CoinShallowPackedVector::CoinShallowPackedVector ( const  
CoinShallowPackedVector & )`

Copy constructor.

**8.72.2.5** `CoinShallowPackedVector::~~CoinShallowPackedVector ( ) [inline]`

Destructor.

Definition at line 122 of file `CoinShallowPackedVector.hpp`.

### 8.72.3 Member Function Documentation

**8.72.3.1** `CoinShallowPackedVector& CoinShallowPackedVector::operator= ( const  
CoinShallowPackedVector & x )`

Assignment operator.

**8.72.3.2** `CoinShallowPackedVector& CoinShallowPackedVector::operator= ( const  
CoinPackedVectorBase & x )`

Assignment operator from a [CoinPackedVectorBase](#).

Reimplemented from [CoinPackedVectorBase](#).

### 8.72.4 Friends And Related Function Documentation

**8.72.4.1** `void CoinShallowPackedVectorUnitTest ( ) [friend]`

A function that tests the methods in the [CoinShallowPackedVector](#) class.

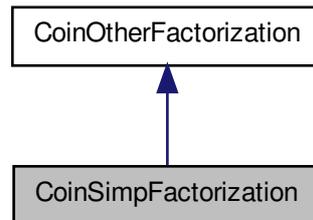
The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging.

The documentation for this class was generated from the following file:

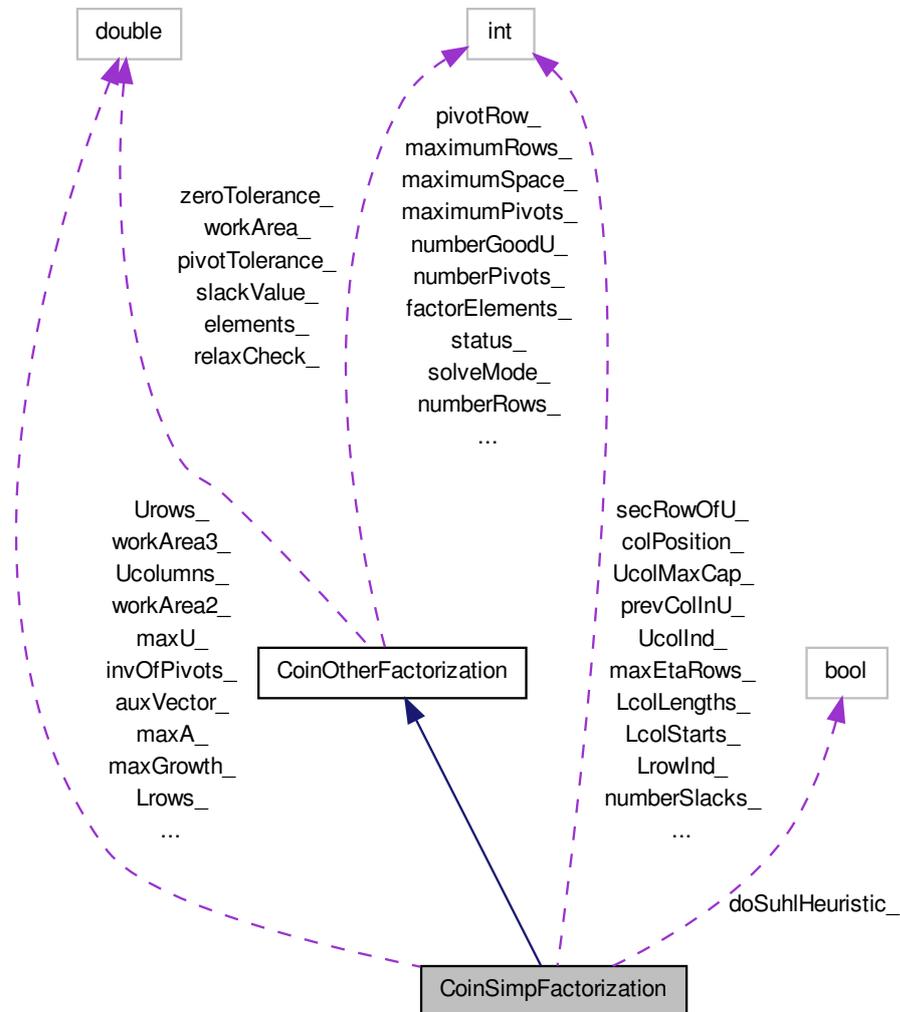
- `CoinShallowPackedVector.hpp`

## 8.73 CoinSimpFactorization Class Reference

Inheritance diagram for CoinSimpFactorization:



Collaboration diagram for CoinSimpFactorization:



#### Public Member Functions

- void [gutsOfDestructor](#) ()  
*The real work of destructor.*
- void [gutsOfInitialize](#) ()  
*The real work of constructor.*
- void [gutsOfCopy](#) (const [CoinSimpFactorization](#) &other)

*The real work of copy.*

- void [factorize](#) (int numberOfRows, int numberOfColumns, const int colStarts[], const int indicesRow[], const double elements[])  
*calls factorization*
- int [mainLoopFactor](#) ([FactorPointers](#) &pointers)  
*main loop of factorization*
- void [copyLbyRows](#) ()  
*copies L by rows*
- void [copyUbyColumns](#) ()  
*copies U by columns*
- int [findPivot](#) ([FactorPointers](#) &pointers, int &r, int &s, bool &ifSlack)  
*finds a pivot element using Markowitz count*
- int [findPivotShCol](#) ([FactorPointers](#) &pointers, int &r, int &s)  
*finds a pivot in a shortest column*
- int [findPivotSimp](#) ([FactorPointers](#) &pointers, int &r, int &s)  
*finds a pivot in the first column available*
- void [GaussEliminate](#) ([FactorPointers](#) &pointers, int &r, int &s)  
*does Gauss elimination*
- int [findShortRow](#) (const int column, const int length, int &minRow, int &minRowLength, [FactorPointers](#) &pointers)  
*finds short row that intersects a given column*
- int [findShortColumn](#) (const int row, const int length, int &minCol, int &minColLength, [FactorPointers](#) &pointers)  
*finds short column that intersects a given row*
- double [findMaxInRow](#) (const int row, [FactorPointers](#) &pointers)  
*finds maximum absolute value in a row*
- void [pivoting](#) (const int pivotRow, const int pivotColumn, const double invPivot, [FactorPointers](#) &pointers)  
*does pivoting*
- void [updateCurrentRow](#) (const int pivotRow, const int row, const double multiplier, [FactorPointers](#) &pointers, int &newNonZeros)  
*part of pivoting*
- void [increaseLsize](#) ()  
*allocates more space for L*
- void [increaseRowSize](#) (const int row, const int newSize)  
*allocates more space for a row of U*
- void [increaseColSize](#) (const int column, const int newSize, const bool b)  
*allocates more space for a column of U*
- void [enlargeUrow](#) (const int numNewElements)  
*allocates more space for rows of U*
- void [enlargeUcol](#) (const int numNewElements, const bool b)  
*allocates more space for columns of U*
- int [findInRow](#) (const int row, const int column)  
*finds a given row in a column*

- int [findInColumn](#) (const int column, const int row)  
*finds a given column in a row*
- void [removeRowFromActSet](#) (const int row, [FactorPointers](#) &pointers)  
*declares a row inactive*
- void [removeColumnFromActSet](#) (const int column, [FactorPointers](#) &pointers)  
*declares a column inactive*
- void [allocateSpaceForU](#) ()  
*allocates space for U*
- void [allocateSomeArrays](#) ()  
*allocates several working arrays*
- void [initialSomeNumbers](#) ()  
*initializes some numbers*
- void [Lxeqb](#) (double \*b) const  
*solves  $Lx = b$*
- void [Lxeqb2](#) (double \*b1, double \*b2) const  
*same as above but with two rhs*
- void [Uxeqb](#) (double \*b, double \*sol) const  
*solves  $Ux = b$*
- void [Uxeqb2](#) (double \*b1, double \*sol1, double \*sol2, double \*b2) const  
*same as above but with two rhs*
- void [xLeqb](#) (double \*b) const  
*solves  $xL = b$*
- void [xUeqb](#) (double \*b, double \*sol) const  
*solves  $xU = b$*
- int [LUupdate](#) (int newBasicCol)  
*updates factorization after a Simplex iteration*
- void [newEta](#) (int row, int numNewElements)  
*creates a new eta vector*
- void [copyRowPermutations](#) ()  
*makes a copy of row permutations*
- void [Hxeqb](#) (double \*b) const  
*solves  $Hx = b$ , where H is a product of eta matrices*
- void [Hxeqb2](#) (double \*b1, double \*b2) const  
*same as above but with two rhs*
- void [xHeqb](#) (double \*b) const  
*solves  $xH = b$*
- void [ftran](#) (double \*b, double \*sol, bool save) const  
*does FTRAN*
- void [ftran2](#) (double \*b1, double \*sol1, double \*b2, double \*sol2) const  
*same as above but with two columns*
- void [btran](#) (double \*b, double \*sol) const  
*does BTRAN*

**Constructors and destructor and copy**

- [CoinSimpFactorization](#) ()  
*Default constructor.*
- [CoinSimpFactorization](#) (const [CoinSimpFactorization](#) &other)  
*Copy constructor.*
- virtual [~CoinSimpFactorization](#) ()  
*Destructor.*
- [CoinSimpFactorization](#) & [operator=](#) (const [CoinSimpFactorization](#) &other)  
*= copy*
- virtual [CoinOtherFactorization](#) \* [clone](#) () const  
*Clone.*

**Do factorization - public**

- virtual void [getAreas](#) (int numberOfRows, int numberColumns, CoinBigIndex maximumL, CoinBigIndex maximumU)  
*Gets space for a factorization.*
- virtual void [preProcess](#) ()  
*PreProcesses column ordered copy of basis.*
- virtual int [factor](#) ()  
*Does most of factorization returning status 0 - OK.*
- virtual void [postProcess](#) (const int \*sequence, int \*pivotVariable)  
*Does post processing on valid factorization - putting variables on correct rows.*
- virtual void [makeNonSingular](#) (int \*sequence, int numberColumns)  
*Makes a non-singular basis by replacing variables.*

**general stuff such as status**

- virtual int [numberElements](#) () const  
*Total number of elements in factorization.*
- double [maximumCoefficient](#) () const  
*Returns maximum absolute value in factorization.*

**rank one updates which do exist**

- virtual int [replaceColumn](#) ([CoinIndexedVector](#) \*regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying=false, double acceptablePivot=1.0e-8)  
*Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.*

**various uses of factorization (return code number elements)**

*which user may want to know about*

- virtual int [updateColumnFT](#) ([CoinIndexedVector](#) \*regionSparse, [CoinIndexedVector](#) \*regionSparse2, bool noPermute=false)  
*Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.*

- virtual int `updateColumn` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*regionSparse2, bool noPermute=false) const  
*This version has same effect as above with FTUpdate==false so number returned is always >=0.*
- virtual int `updateTwoColumnsFT` (`CoinIndexedVector` \*regionSparse1, `CoinIndexedVector` \*regionSparse2, `CoinIndexedVector` \*regionSparse3, bool noPermute=false)  
*does FTRAN on two columns*
- int `upColumn` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*regionSparse2, bool noPermute=false, bool save=false) const  
*does updatecolumn if save==true keeps column for replace column*
- virtual int `updateColumnTranspose` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*regionSparse2) const  
*Updates one column (BTRAN) from regionSparse2 regionSparse starts as zero and is zero at end Note - if regionSparse2 packed on input - will be packed on output.*
- int `upColumnTranspose` (`CoinIndexedVector` \*regionSparse, `CoinIndexedVector` \*regionSparse2) const  
*does updateColumnTranspose, the other is a wrapper*

#### various uses of factorization

\*\*\* Below this user may not want to know about

which user may not want to know about (left over from my LP code)

- void `clearArrays` ()  
*Get rid of all memory.*
- int \* `indices` () const  
*Returns array to put basis indices in.*
- virtual int \* `permute` () const  
*Returns permute in.*

#### Protected Member Functions

- int `checkPivot` (double saveFromU, double oldPivot) const  
*Returns accuracy status of replaceColumn returns 0=OK, 1=Probably OK, 2=singular.*

#### Protected Attributes

##### data

- double \* `denseVector_`  
*work array (should be initialized to zero)*
- double \* `workArea2_`  
*work array*
- double \* `workArea3_`  
*work array*
- int \* `veclabels_`

- array of labels (should be initialized to zero)*
- int \* [indVector\\_](#)  
*array of indices*
- double \* [auxVector\\_](#)  
*auxiliary vector*
- int \* [auxInd\\_](#)  
*auxiliary vector*
- double \* [vecKeep\\_](#)  
*vector to keep for LUupdate*
- int \* [indKeep\\_](#)  
*indices of this vector*
- int [keepSize\\_](#)  
*number of nonzeros*
- int \* [LrowStarts\\_](#)  
*Starts of the rows of L.*
- int \* [LrowLengths\\_](#)  
*Lengths of the rows of L.*
- double \* [Lrows\\_](#)  
*L by rows.*
- int \* [LrowInd\\_](#)  
*indices in the rows of L*
- int [LrowSize\\_](#)  
*Size of Lrows\_.*
- int [LrowCap\\_](#)  
*Capacity of Lrows\_.*
- int \* [LcolStarts\\_](#)  
*Starts of the columns of L.*
- int \* [LcolLengths\\_](#)  
*Lengths of the columns of L.*
- double \* [Lcolumns\\_](#)  
*L by columns.*
- int \* [LcolInd\\_](#)  
*indices in the columns of L*
- int [LcolSize\\_](#)  
*numbers of elements in L*
- int [LcolCap\\_](#)  
*maximum capacity of L*
- int \* [UrowStarts\\_](#)  
*Starts of the rows of U.*
- int \* [UrowLengths\\_](#)  
*Lengths of the rows of U.*
- double \* [Urows\\_](#)  
*U by rows.*
- int \* [UrowInd\\_](#)  
*Indices in the rows of U.*
- int [UrowMaxCap\\_](#)  
*maximum capacity of Urows*

- int [UrowEnd\\_](#)  
*number of used places in Urows*
- int [firstRowInU\\_](#)  
*first row in U*
- int [lastRowInU\\_](#)  
*last row in U*
- int \* [prevRowInU\\_](#)  
*previous row in U*
- int \* [nextRowInU\\_](#)  
*next row in U*
- int \* [UcolStarts\\_](#)  
*Starts of the columns of U.*
- int \* [UcolLengths\\_](#)  
*Lengths of the columns of U.*
- double \* [Ucolumns\\_](#)  
*U by columns.*
- int \* [UcolInd\\_](#)  
*Indices in the columns of U.*
- int \* [prevColInU\\_](#)  
*previous column in U*
- int \* [nextColInU\\_](#)  
*next column in U*
- int [firstColInU\\_](#)  
*first column in U*
- int [lastColInU\\_](#)  
*last column in U*
- int [UcolMaxCap\\_](#)  
*maximum capacity of Ucolumns\_*
- int [UcolEnd\\_](#)  
*last used position in Ucolumns\_*
- int \* [colSlack\\_](#)  
*indicator of slack variables*
- double \* [invOfPivots\\_](#)  
*inverse values of the elements of diagonal of U*
- int \* [colOfU\\_](#)  
*permutation of columns*
- int \* [colPosition\\_](#)  
*position of column after permutation*
- int \* [rowOfU\\_](#)  
*permutations of rows*
- int \* [rowPosition\\_](#)  
*position of row after permutation*
- int \* [secRowOfU\\_](#)  
*permutations of rows during LUupdate*
- int \* [secRowPosition\\_](#)  
*position of row after permutation during LUupdate*
- int \* [EtaPosition\\_](#)

- *position of Eta vector*
- int \* [EtaStarts\\_](#)  
*Starts of eta vectors.*
- int \* [EtaLengths\\_](#)  
*Lengths of eta vectors.*
- int \* [EtaInd\\_](#)  
*columns of eta vectors*
- double \* [Eta\\_](#)  
*elements of eta vectors*
- int [EtaSize\\_](#)  
*number of elements in Eta\_*
- int [lastEtaRow\\_](#)  
*last eta row*
- int [maxEtaRows\\_](#)  
*maximum number of eta vectors*
- int [EtaMaxCap\\_](#)  
*Capacity of Eta\_.*
- int [minIncrease\\_](#)  
*minimum storage increase*
- double [updateTol\\_](#)  
*maximum size for the diagonal of U after update*
- bool [doSuhlHeuristic\\_](#)  
*do Shul heuristic*
- double [maxU\\_](#)  
*maximum of U*
- double [maxGrowth\\_](#)  
*bound on the growth rate*
- double [maxA\\_](#)  
*maximum of A*
- int [pivotCandLimit\\_](#)  
*maximum number of candidates for pivot*
- int [numberSlacks\\_](#)  
*number of slacks in basis*
- int [firstNumberSlacks\\_](#)  
*number of slacks in irst basis*

### 8.73.1 Detailed Description

Definition at line 38 of file CoinSimpFactorization.hpp.

### 8.73.2 Member Function Documentation

#### 8.73.2.1 virtual int CoinSimpFactorization::factor ( ) [virtual]

Does most of factorization returning status 0 - OK.

-99 - needs more memory -1 - singular - use numberGoodColumns and redo

Implements [CoinOtherFactorization](#).

8.73.2.2 `virtual int CoinSimpFactorization::replaceColumn ( CoinIndexedVector * regionSparse, int pivotRow, double pivotCheck, bool checkBeforeModifying = false, double acceptablePivot = 1.0e-8 ) [virtual]`

Replaces one Column to basis, returns 0=OK, 1=Probably OK, 2=singular, 3=no room If checkBeforeModifying is true will do all accuracy checks before modifying factorization.

Whether to set this depends on speed considerations. You could just do this on first iteration after factorization and thereafter re-factorize partial update already in U

Implements [CoinOtherFactorization](#).

8.73.2.3 `virtual int CoinSimpFactorization::updateColumnFT ( CoinIndexedVector * regionSparse, CoinIndexedVector * regionSparse2, bool noPermute = false ) [virtual]`

Updates one column (FTRAN) from regionSparse2 Tries to do FT update number returned is negative if no room regionSparse starts as zero and is zero at end.

Note - if regionSparse2 packed on input - will be packed on output

Implements [CoinOtherFactorization](#).

8.73.2.4 `int CoinSimpFactorization::checkPivot ( double saveFromU, double oldPivot ) const [protected]`

Returns accuracy status of replaceColumn returns 0=OK, 1=Probably OK, 2=singular.

-----  
The documentation for this class was generated from the following file:

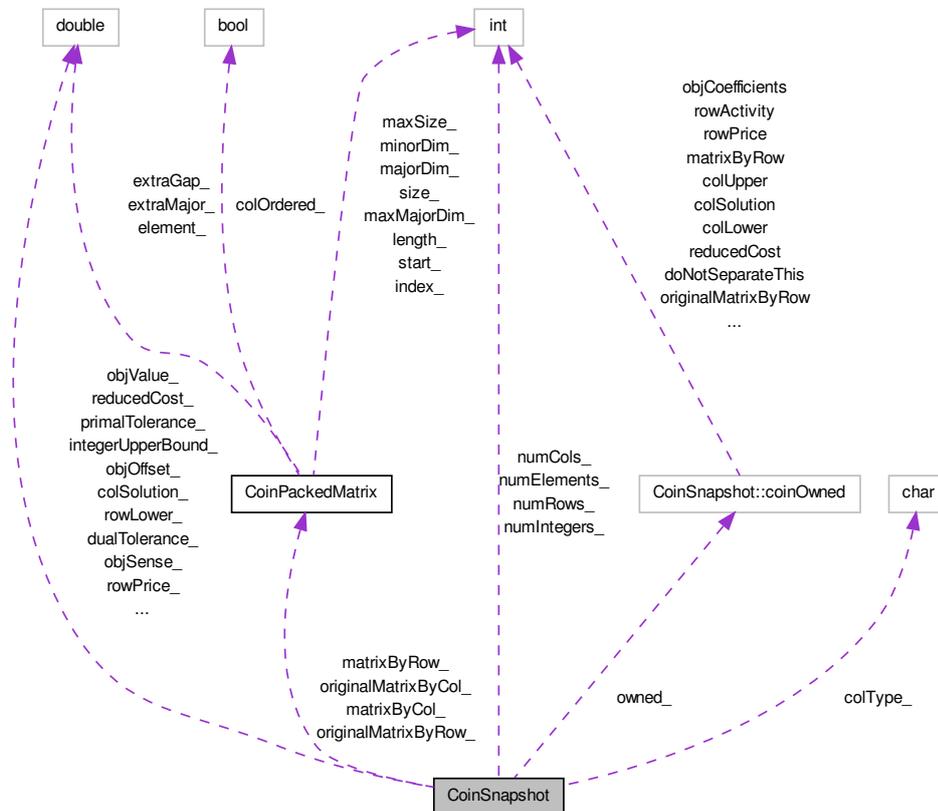
- CoinSimpFactorization.hpp

## 8.74 CoinSnapshot Class Reference

NON Abstract Base Class for interfacing with cut generators or branching code or .

```
#include <CoinSnapshot.hpp>
```

Collaboration diagram for CoinSnapshot:



## Classes

- struct **coinOwned**

To say whether arrays etc are owned by [CoinSnapshot](#).

## Public Member Functions

### Problem query methods

The Matrix pointers may be NULL

- int [getNumCols](#) () const  
Get number of columns.
- int [getNumRows](#) () const  
Get number of rows.

- int [getNumElements](#) () const  
*Get number of nonzero elements.*
- int [getNumIntegers](#) () const  
*Get number of integer variables.*
- const double \* [getColLower](#) () const  
*Get pointer to array[getNumCols()] of column lower bounds.*
- const double \* [getColUpper](#) () const  
*Get pointer to array[getNumCols()] of column upper bounds.*
- const double \* [getRowLower](#) () const  
*Get pointer to array[getNumRows()] of row lower bounds.*
- const double \* [getRowUpper](#) () const  
*Get pointer to array[getNumRows()] of row upper bounds.*
- const double \* [getRightHandSide](#) () const  
*Get pointer to array[getNumRows()] of row right-hand sides This gives same results as OsiSolverInterface for useful cases If [getRowUpper\(\)\[i\]](#) != infinity then [getRightHandSide\(\)\[i\]](#) == [getRowUpper\(\)\[i\]](#) else [getRightHandSide\(\)\[i\]](#) == [getRowLower\(\)\[i\]](#).*
- const double \* [getObjCoefficients](#) () const  
*Get pointer to array[getNumCols()] of objective function coefficients.*
- double [getObjSense](#) () const  
*Get objective function sense (1 for min (default), -1 for max)*
- bool [isContinuous](#) (int colIndex) const  
*Return true if variable is continuous.*
- bool [isBinary](#) (int colIndex) const  
*Return true if variable is binary.*
- bool [isInteger](#) (int colIndex) const  
*Return true if column is integer.*
- bool [isIntegerNonBinary](#) (int colIndex) const  
*Return true if variable is general integer.*
- bool [isFreeBinary](#) (int colIndex) const  
*Return true if variable is binary and not fixed at either bound.*
- const char \* [getColType](#) () const  
*Get colType array ('B', 'I', or 'C' for Binary, Integer and Continuous)*
- const [CoinPackedMatrix](#) \* [getMatrixByRow](#) () const  
*Get pointer to row-wise copy of current matrix.*
- const [CoinPackedMatrix](#) \* [getMatrixByCol](#) () const  
*Get pointer to column-wise copy of current matrix.*
- const [CoinPackedMatrix](#) \* [getOriginalMatrixByRow](#) () const  
*Get pointer to row-wise copy of "original" matrix.*
- const [CoinPackedMatrix](#) \* [getOriginalMatrixByCol](#) () const  
*Get pointer to column-wise copy of "original" matrix.*

#### Solution query methods

- const double \* [getColSolution](#) () const  
*Get pointer to array[getNumCols()] of primal variable values.*
- const double \* [getRowPrice](#) () const  
*Get pointer to array[getNumRows()] of dual variable values.*
- const double \* [getReducedCost](#) () const

Get a pointer to array[getNumCols()] of reduced costs.

- const double \* [getRowActivity](#) () const

Get pointer to array[getNumRows()] of row activity levels (constraint matrix times the solution vector).

- const double \* [getDoNotSeparateThis](#) () const

Get pointer to array[getNumCols()] of primal variable values which should not be separated (for debug)

#### Other scalar get methods

- double [getInfinity](#) () const

Get solver's value for infinity.

- double [getObjValue](#) () const

Get objective function value - including any offset i.e.

- double [getObjOffset](#) () const

Get objective offset i.e.  $\sum c_{sub j} * x_{sub j} - objValue = objOffset$ .

- double [getDualTolerance](#) () const

Get dual tolerance.

- double [getPrimalTolerance](#) () const

Get primal tolerance.

- double [getIntegerTolerance](#) () const

Get integer tolerance.

- double [getIntegerUpperBound](#) () const

Get integer upper bound i.e. best solution \* getObjSense.

- double [getIntegerLowerBound](#) () const

Get integer lower bound i.e. best possible solution \* getObjSense.

#### Method to input a problem

- void [loadProblem](#) (const [CoinPackedMatrix](#) &matrix, const double \*collb, const double \*colub, const double \*obj, const double \*rowlb, const double \*rowub, bool makeRowCopy=false)

Load in an problem by copying the arguments (the constraints on the rows are given by lower and upper bounds).

#### Methods to set data

- void [setNumCols](#) (int value)

Set number of columns.

- void [setNumRows](#) (int value)

Set number of rows.

- void [setNumElements](#) (int value)

Set number of nonzero elements.

- void [setNumIntegers](#) (int value)

Set number of integer variables.

- void [setColLower](#) (const double \*array, bool copyIn=true)

Set pointer to array[getNumCols()] of column lower bounds.

- void [setColUpper](#) (const double \*array, bool copyIn=true)

Set pointer to array[getNumCols()] of column upper bounds.

- void [setRowLower](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumRows()] of row lower bounds.*
- void [setRowUpper](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumRows()] of row upper bounds.*
- void [setRightHandSide](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumRows()] of row right-hand sides This gives same results as OsiSolverInterface for useful cases If [getRowUpper\(\)\[i\]](#) != infinity then [getRightHandSide\(\)\[i\]](#) == [getRowUpper\(\)\[i\]](#) else [getRightHandSide\(\)\[i\]](#) == [getRowLower\(\)\[i\]](#).*
- void [createRightHandSide](#) ()  
*Create array[getNumRows()] of row right-hand sides using existing information This gives same results as OsiSolverInterface for useful cases If [getRowUpper\(\)\[i\]](#) != infinity then [getRightHandSide\(\)\[i\]](#) == [getRowUpper\(\)\[i\]](#) else [getRightHandSide\(\)\[i\]](#) == [getRowLower\(\)\[i\]](#).*
- void [setObjCoefficients](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumCols()] of objective function coefficients.*
- void [setObjSense](#) (double value)  
*Set objective function sense (1 for min (default), -1 for max)*
- void [setColType](#) (const char \*array, bool copyIn=true)  
*Set colType array ('B', 'I', or 'C' for Binary, Integer and Continuous)*
- void [setMatrixByRow](#) (const [CoinPackedMatrix](#) \*matrix, bool copyIn=true)  
*Set pointer to row-wise copy of current matrix.*
- void [createMatrixByRow](#) ()  
*Create row-wise copy from MatrixByCol.*
- void [setMatrixByCol](#) (const [CoinPackedMatrix](#) \*matrix, bool copyIn=true)  
*Set pointer to column-wise copy of current matrix.*
- void [setOriginalMatrixByRow](#) (const [CoinPackedMatrix](#) \*matrix, bool copyIn=true)  
  
*Set pointer to row-wise copy of "original" matrix.*
- void [setOriginalMatrixByCol](#) (const [CoinPackedMatrix](#) \*matrix, bool copyIn=true)  
  
*Set pointer to column-wise copy of "original" matrix.*
- void [setColSolution](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumCols()] of primal variable values.*
- void [setRowPrice](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumRows()] of dual variable values.*
- void [setReducedCost](#) (const double \*array, bool copyIn=true)  
*Set a pointer to array[getNumCols()] of reduced costs.*
- void [setRowActivity](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumRows()] of row activity levels (constraint matrix times the solution vector).*
- void [setDoNotSeparateThis](#) (const double \*array, bool copyIn=true)  
*Set pointer to array[getNumCols()] of primal variable values which should not be separated (for debug)*
- void [setInfinity](#) (double value)  
*Set solver's value for infinity.*
- void [setObjValue](#) (double value)  
*Set objective function value (including any rhs offset)*
- void [setObjOffset](#) (double value)

- *Set objective offset i.e.  $\sum c_{sub\ j} * x_{sub\ j} - objValue = objOffset$ .*
- void [setDualTolerance](#) (double value)  
*Set dual tolerance.*
- void [setPrimalTolerance](#) (double value)  
*Set primal tolerance.*
- void [setIntegerTolerance](#) (double value)  
*Set integer tolerance.*
- void [setIntegerUpperBound](#) (double value)  
*Set integer upper bound i.e. best solution \* getObjSense.*
- void [setIntegerLowerBound](#) (double value)  
*Set integer lower bound i.e. best possible solution \* getObjSense.*

#### Constructors and destructors

- [CoinSnapshot](#) ()  
*Default Constructor.*
- [CoinSnapshot](#) (const [CoinSnapshot](#) &)  
*Copy constructor.*
- [CoinSnapshot](#) & [operator=](#) (const [CoinSnapshot](#) &rhs)  
*Assignment operator.*
- virtual [~CoinSnapshot](#) ()  
*Destructor.*

#### 8.74.1 Detailed Description

NON Abstract Base Class for interfacing with cut generators or branching code or .

It is designed to be snapshot of a problem at a node in tree

The class may or may not own the arrays - see owned\_

Querying a problem that has no data associated with it will result in zeros for the number of rows and columns, and NULL pointers from the methods that return arrays.

Definition at line 25 of file CoinSnapshot.hpp.

#### 8.74.2 Member Function Documentation

##### 8.74.2.1 double CoinSnapshot::getObjValue ( ) const [inline]

Get objective function value - including any offset i.e.

$\sum c_{sub\ j} * x_{sub\ j} - objValue = objOffset$

Definition at line 157 of file CoinSnapshot.hpp.

##### 8.74.2.2 void CoinSnapshot::loadProblem ( const [CoinPackedMatrix](#) & *matrix*, const double \* *collb*, const double \* *colub*, const double \* *obj*, const double \* *rowlb*, const double \* *rowub*, bool *makeRowCopy* = false )

Load in an problem by copying the arguments (the constraints on the rows are given by lower and upper bounds).

If a pointer is NULL then the following values are the default:

- `colub`: all columns have upper bound infinity
- `collb`: all columns have lower bound 0
- `rowub`: all rows have upper bound infinity
- `rowlb`: all rows have lower bound -infinity
- `obj`: all variables have 0 objective coefficient

All solution type arrays will be deleted

The documentation for this class was generated from the following file:

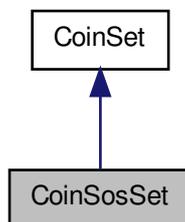
- `CoinSnapshot.hpp`

## 8.75 CoinSosSet Class Reference

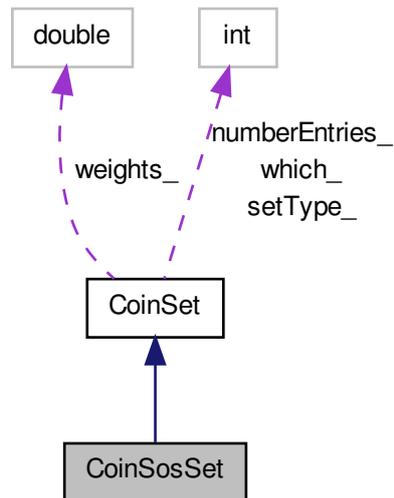
Very simple class for containing SOS set.

```
#include <CoinMpsIO.hpp>
```

Inheritance diagram for `CoinSosSet`:



Collaboration diagram for CoinSosSet:



### Public Member Functions

#### Constructor and destructor

- [CoinSosSet](#) (int numberEntries, const int \*which, const double \*weights, int type)  
*Constructor.*
- virtual [~CoinSosSet](#) ()  
*Destructor.*

#### 8.75.1 Detailed Description

Very simple class for containing SOS set.

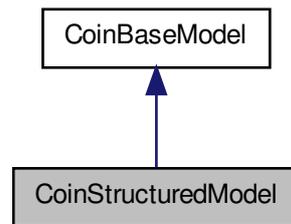
Definition at line 285 of file CoinMpsIO.hpp.

The documentation for this class was generated from the following file:

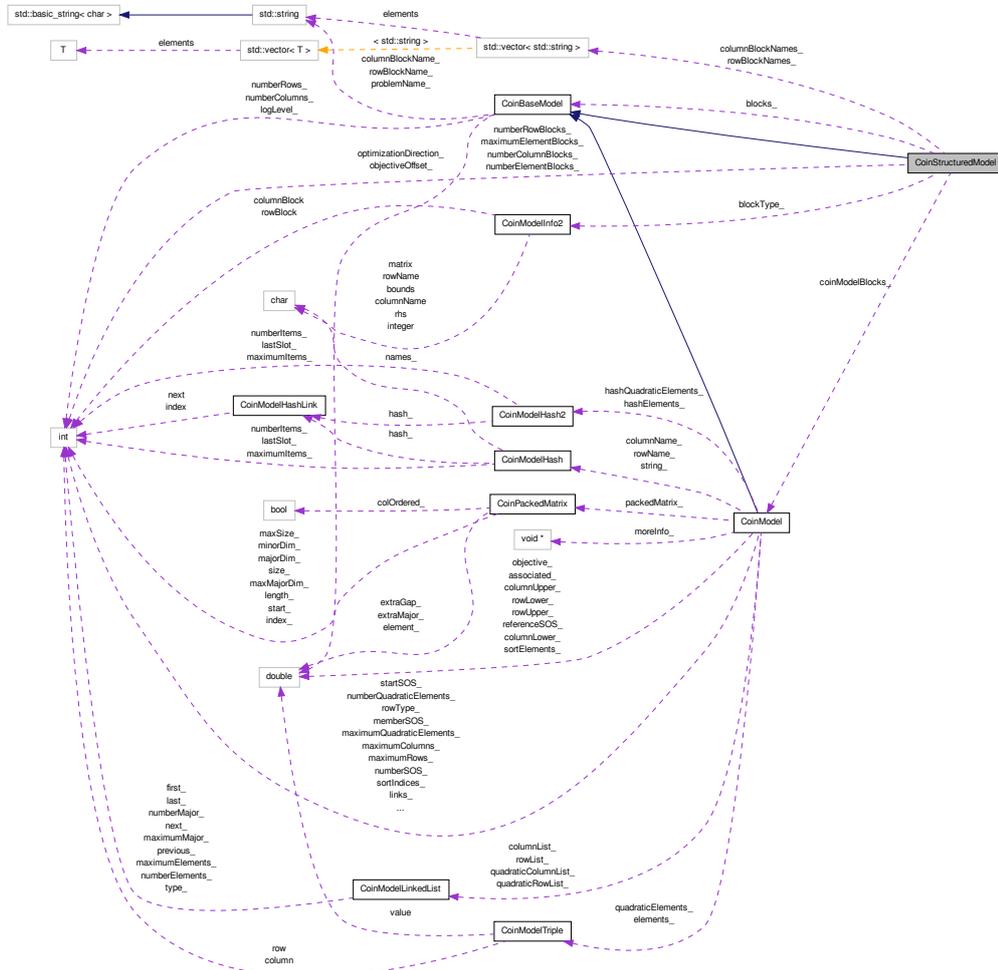
- CoinMpsIO.hpp

### 8.76 CoinStructuredModel Class Reference

Inheritance diagram for CoinStructuredModel:



Collaboration diagram for CoinStructuredModel:



Public Member Functions

Useful methods for building model

- int `addBlock` (const std::string &rowBlock, const std::string &columnBlock, const `CoinBaseModel` &block)  
*add a block from a `CoinModel` using names given as parameters returns number of errors (e.g.*
- int `addBlock` (const `CoinBaseModel` &block)  
*add a block from a `CoinModel` with names in model returns number of errors (e.g.*
- int `addBlock` (const std::string &rowBlock, const std::string &columnBlock, `CoinBaseModel` \*block)

*add a block from a [CoinModel](#) using names given as parameters returns number of errors (e.g.*

- int [addBlock](#) (const std::string &rowBlock, const std::string &columnBlock, const [CoinPackedMatrix](#) &matrix, const double \*rowLower, const double \*rowUpper, const double \*columnLower, const double \*columnUpper, const double \*objective)

*add a block using names*

- int [writeMps](#) (const char \*filename, int compression=0, int formatType=0, int numberAcross=2, bool keepStrings=false)

*Write the problem in MPS format to a file with the given filename.*

- int [decompose](#) (const [CoinModel](#) &model, int type, int maxBlocks=50)

*Decompose a [CoinModel](#) 1 - try D-W 2 - try Benders 3 - try Staircase Returns number of blocks or zero if no structure.*

- int [decompose](#) (const [CoinPackedMatrix](#) &matrix, const double \*rowLower, const double \*rowUpper, const double \*columnLower, const double \*columnUpper, const double \*objective, int type, int maxBlocks=50, double objectiveOffset=0.0)

*Decompose a model specified as arrays + [CoinPackedMatrix](#) 1 - try D-W 2 - try Benders 3 - try Staircase Returns number of blocks or zero if no structure.*

#### For getting information

- int [numberRowBlocks](#) () const  
*Return number of row blocks.*
- int [numberColumnBlocks](#) () const  
*Return number of column blocks.*
- CoinBigIndex [numberElementBlocks](#) () const  
*Return number of elementBlocks.*
- CoinBigIndex [numberElements](#) () const  
*Return number of elements.*
- const std::string & [getRowBlock](#) (int i) const  
*Return the i'th row block name.*
- void [setRowBlock](#) (int i, const std::string &name)  
*Set i'th row block name.*
- int [addRowBlock](#) (int numberRows, const std::string &name)  
*Add or check a row block name and number of rows.*
- int [rowBlock](#) (const std::string &name) const  
*Return a row block index given a row block name.*
- const std::string & [getColumnBlock](#) (int i) const  
*Return i'th the column block name.*
- void [setColumnBlock](#) (int i, const std::string &name)  
*Set i'th column block name.*
- int [addColumnBlock](#) (int numberColumns, const std::string &name)  
*Add or check a column block name and number of columns.*
- int [columnBlock](#) (const std::string &name) const  
*Return a column block index given a column block name.*
- const [CoinModelBlockInfo](#) & [blockType](#) (int i) const  
*Return i'th block type.*

- [CoinBaseModel \\* block](#) (int i) const  
*Return i'th block.*
- const [CoinBaseModel \\* block](#) (int row, int column) const  
*Return block corresponding to row and column.*
- [CoinModel \\* coinBlock](#) (int i) const  
*Return i'th block as CoinModel (or NULL)*
- const [CoinBaseModel \\* coinBlock](#) (int row, int column) const  
*Return block corresponding to row and column as CoinModel.*
- int [blockIndex](#) (int row, int column) const  
*Return block number corresponding to row and column.*
- [CoinModel \\* coinModelBlock](#) ([CoinModelBlockInfo](#) &info)  
*Return model as a CoinModel block and fill in info structure and update counts.*
- void [setCoinModel](#) ([CoinModel](#) \*block, int iBlock)  
*Sets given block into coinModelBlocks\_.*
- void [refresh](#) (int iBlock)  
*Refresh info in blockType\_.*
- [CoinModelBlockInfo block](#) (int row, int column, const double \*&rowLower, const double \*&rowUpper, const double \*&columnLower, const double \*&columnUpper, const double \*&objective) const  
*Fill pointers corresponding to row and column.*
- double [optimizationDirection](#) () const  
*Direction of optimization (1 - minimize, -1 - maximize, 0 - ignore).*
- void [setOptimizationDirection](#) (double value)  
*Set direction of optimization (1 - minimize, -1 - maximize, 0 - ignore).*

#### Constructors, destructor

- [CoinStructuredModel](#) ()  
*Default constructor.*
- [CoinStructuredModel](#) (const char \*fileName, int decompose=0, int maxBlocks=50)  
  
*Read a problem in MPS format from the given filename.*
- virtual [~CoinStructuredModel](#) ()  
*Destructor.*

#### Copy method

- [CoinStructuredModel](#) (const [CoinStructuredModel](#) &)  
*The copy constructor.*
- [CoinStructuredModel](#) & operator= (const [CoinStructuredModel](#) &)  
=
- virtual [CoinBaseModel \\* clone](#) () const  
*Clone.*

#### 8.76.1 Detailed Description

Definition at line 36 of file [CoinStructuredModel.hpp](#).

### 8.76.2 Constructor & Destructor Documentation

#### 8.76.2.1 CoinStructuredModel::CoinStructuredModel ( )

Default constructor.

#### 8.76.2.2 CoinStructuredModel::CoinStructuredModel ( const char \* *fileName*, int *decompose* = 0, int *maxBlocks* = 50 )

Read a problem in MPS format from the given filename.

May try and decompose

#### 8.76.2.3 CoinStructuredModel::CoinStructuredModel ( const CoinStructuredModel & )

The copy constructor.

### 8.76.3 Member Function Documentation

#### 8.76.3.1 int CoinStructuredModel::addBlock ( const std::string & *rowBlock*, const std::string & *columnBlock*, const CoinBaseModel & *block* )

add a block from a [CoinModel](#) using names given as parameters returns number of errors (e.g.

both have objectives but not same)

#### 8.76.3.2 int CoinStructuredModel::addBlock ( const CoinBaseModel & *block* )

add a block from a [CoinModel](#) with names in model returns number of errors (e.g.

both have objectives but not same)

#### 8.76.3.3 int CoinStructuredModel::addBlock ( const std::string & *rowBlock*, const std::string & *columnBlock*, CoinBaseModel \* *block* )

add a block from a [CoinModel](#) using names given as parameters returns number of errors (e.g.

both have objectives but not same) This passes in block - structured model takes ownership

#### 8.76.3.4 int CoinStructuredModel::writeMps ( const char \* *filename*, int *compression* = 0, int *formatType* = 0, int *numberAcross* = 2, bool *keepStrings* = false )

Write the problem in MPS format to a file with the given filename.

### Parameters

---

<i>compression</i>	can be set to three values to indicate what kind of file should be written <ul style="list-style-type: none"> <li>• 0: plain text (default)</li> <li>• 1: gzip compressed (.gz is appended to <code>filename</code>)</li> <li>• 2: bzip2 compressed (.bz2 is appended to <code>filename</code>) (TODO)</li> </ul> If the library was not compiled with the requested compression then <code>writeMps</code> falls back to writing a plain text file.
<i>formatType</i>	specifies the precision to used for values in the MPS file <ul style="list-style-type: none"> <li>• 0: normal precision (default)</li> <li>• 1: extra accuracy</li> <li>• 2: IEEE hex</li> </ul>
<i>number-Across</i>	specifies whether 1 or 2 (default) values should be specified on every data line in the MPS file.

not const as may change model e.g. fill in default bounds

The documentation for this class was generated from the following file:

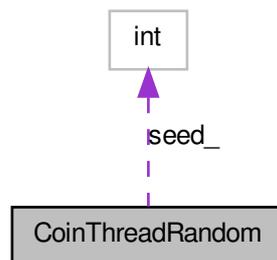
- `CoinStructuredModel.hpp`

## 8.77 CoinThreadRandom Class Reference

Class for thread specific random numbers.

```
#include <CoinHelperFunctions.hpp>
```

Collaboration diagram for `CoinThreadRandom`:



### Public Member Functions

### Constructors, destructor

- [CoinThreadRandom](#) ()  
*Default constructor.*
- [CoinThreadRandom](#) (int seed)  
*Constructor with seed.*
- [~CoinThreadRandom](#) ()  
*Destructor.*
- **CoinThreadRandom** (const [CoinThreadRandom](#) &rhs)
- [CoinThreadRandom](#) & **operator=** (const [CoinThreadRandom](#) &rhs)

### Sets/gets

- void [setSeed](#) (int seed)  
*Set seed.*
- unsigned int [getSeed](#) () const  
*Get seed.*
- double [randomDouble](#) () const  
*return a random number*

### Protected Attributes

#### Data members

*The data members are protected to allow access for derived classes.*

- unsigned int [seed\\_](#)  
*Current seed.*

#### 8.77.1 Detailed Description

Class for thread specific random numbers.

Definition at line 951 of file CoinHelperFunctions.hpp.

#### 8.77.2 Constructor & Destructor Documentation

##### 8.77.2.1 [CoinThreadRandom::CoinThreadRandom \( \)](#) [inline]

Default constructor.

Definition at line 957 of file CoinHelperFunctions.hpp.

##### 8.77.2.2 [CoinThreadRandom::CoinThreadRandom \( int seed \)](#) [inline]

Constructor with seed.

Definition at line 960 of file CoinHelperFunctions.hpp.

### 8.77.3 Member Function Documentation

#### 8.77.3.1 void CoinThreadRandom::setSeed ( int *seed* ) [inline]

Set seed.

Definition at line 984 of file CoinHelperFunctions.hpp.

#### 8.77.3.2 unsigned int CoinThreadRandom::getSeed ( ) const [inline]

Get seed.

Definition at line 989 of file CoinHelperFunctions.hpp.

The documentation for this class was generated from the following file:

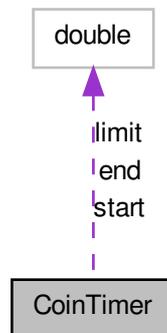
- CoinHelperFunctions.hpp

## 8.78 CoinTimer Class Reference

This class implements a timer that also implements a tracing functionality.

```
#include <CoinTime.hpp>
```

Collaboration diagram for CoinTimer:



### Public Member Functions

- [CoinTimer](#) ()  
*Default constructor creates a timer with no time limit and no tracing.*
- [CoinTimer](#) (double lim)

Create a timer with the given time limit and with no tracing.

- void `restart ()`  
*Restart the timer (keeping the same time limit)*
- void `reset ()`  
*An alternate name for `restart ()`*
- void `reset (double lim)`  
*Reset (and restart) the timer and change its time limit.*
- bool `isPastPercent (double pct) const`  
*Return whether the given percentage of the time limit has elapsed since the timer was started.*
- bool `isPast (double lim) const`  
*Return whether the given amount of time has elapsed since the timer was started.*
- bool `isExpired () const`  
*Return whether the originally specified time limit has passed since the timer was started.*
- double `timeLeft () const`  
*Return how much time is left on the timer.*
- double `timeElapsed () const`  
*Return how much time has elapsed.*

### 8.78.1 Detailed Description

This class implements a timer that also implements a tracing functionality.

The timer stores the start time of the timer, for how much time it was set to and when does it expire ( $\text{start} + \text{limit} = \text{end}$ ). Queries can be made that tell whether the timer is expired, is past an absolute time, is past a percentage of the length of the timer. All times are given in seconds, but as double numbers, so there can be fractional values.

The timer can also be initialized with a stream and a specification whether to write to or read from the stream. In the former case the result of every query is written into the stream, in the latter case timing is not tested at all, rather the supposed result is read out from the stream. This makes it possible to exactly retrace time sensitive program execution.

Definition at line 197 of file `CoinTime.hpp`.

The documentation for this class was generated from the following file:

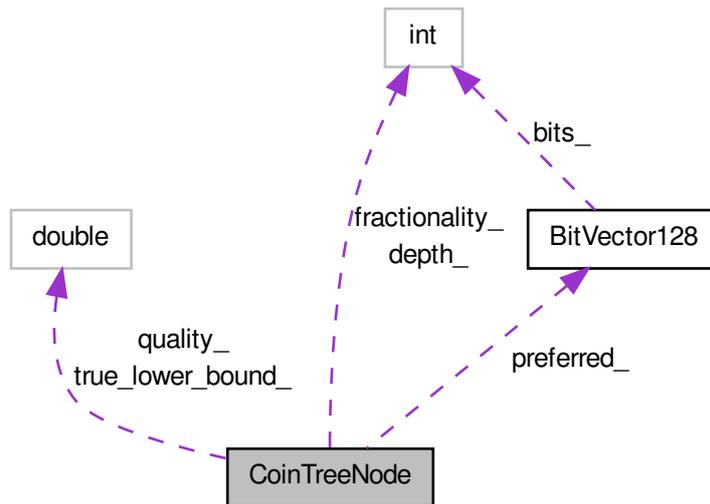
- `CoinTime.hpp`

## 8.79 CoinTreeNode Class Reference

A class from which the real tree nodes should be derived from.

```
#include <CoinSearchTree.hpp>
```

Collaboration diagram for CoinTreeNode:



### 8.79.1 Detailed Description

A class from which the real tree nodes should be derived from.

Some of the data that undoubtedly exist in the real tree node is replicated here for fast access. This class is used in the various comparison functions.

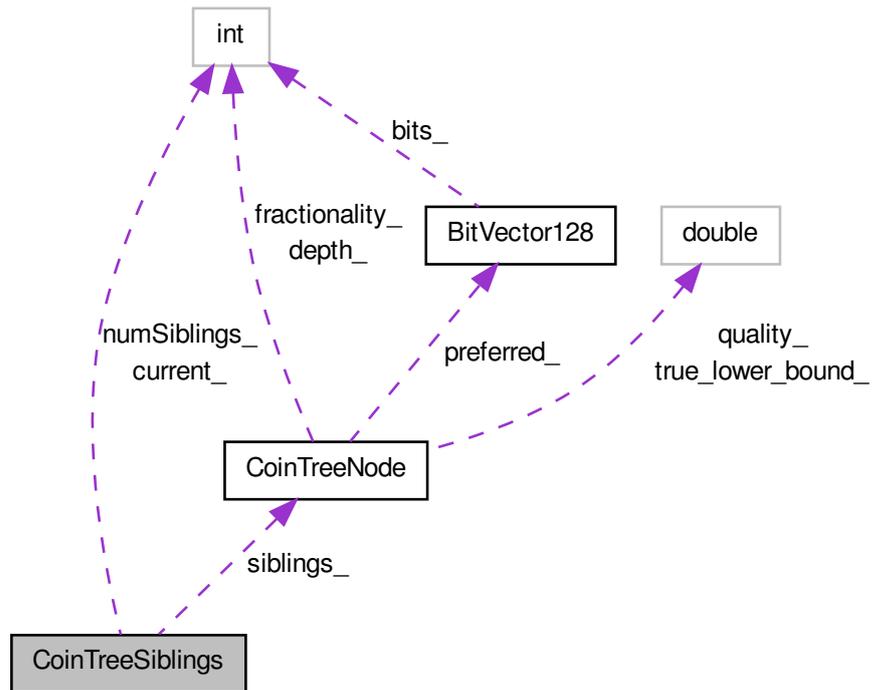
Definition at line 40 of file `CoinSearchTree.hpp`.

The documentation for this class was generated from the following file:

- `CoinSearchTree.hpp`

## 8.80 CoinTreeSiblings Class Reference

Collaboration diagram for CoinTreeSiblings:



## Public Member Functions

- bool [advanceNode](#) ()  
*returns false if cannot be advanced*

## 8.80.1 Detailed Description

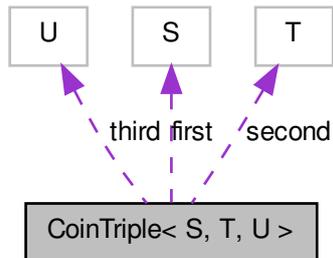
Definition at line 108 of file `CoinSearchTree.hpp`.

The documentation for this class was generated from the following file:

- `CoinSearchTree.hpp`

## 8.81 CoinTriple&lt; S, T, U &gt; Class Template Reference

Collaboration diagram for CoinTriple< S, T, U >:

**Public Member Functions**

- `CoinTriple` (const S &s, const T &t, const U &u)  
*Construct from ordered triple.*

**Public Attributes**

- S `first`  
*First member of triple.*
- T `second`  
*Second member of triple.*
- U `third`  
*Third member of triple.*

**8.81.1 Detailed Description**

```
template<class S, class T, class U>class CoinTriple< S, T, U >
```

Definition at line 360 of file CoinSort.hpp.

The documentation for this class was generated from the following file:

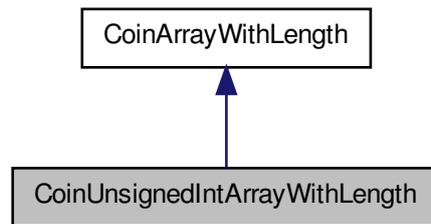
- CoinSort.hpp

## 8.82 CoinUnsignedIntArrayWithLength Class Reference

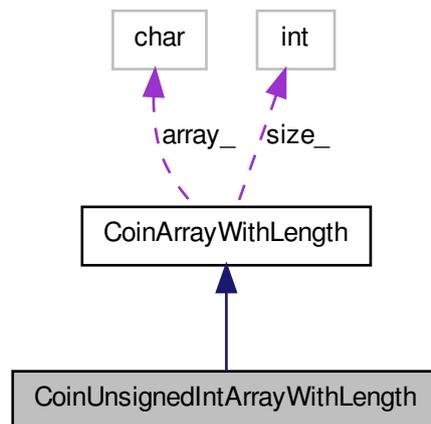
unsigned int \* version

```
#include <CoinIndexedVector.hpp>
```

Inheritance diagram for CoinUnsignedIntArrayWithLength:



Collaboration diagram for CoinUnsignedIntArrayWithLength:



### Public Member Functions

**Get methods.**

- int [getSize](#) () const  
*Get the size.*
- unsigned int \* [array](#) () const  
*Get Array.*

**Set methods**

- void [setSize](#) (int value)  
*Set the size.*

**Condition methods**

- unsigned int \* [conditionalNew](#) (int sizeWanted)  
*Conditionally gets new array.*

**Constructors and destructors**

- [CoinUnsignedIntArrayWithLength](#) ()  
*Default constructor - NULL.*
- [CoinUnsignedIntArrayWithLength](#) (int size)  
*Alternate Constructor - length in bytes - size\_ -1.*
- [CoinUnsignedIntArrayWithLength](#) (int size, int mode)  
*Alternate Constructor - length in bytes mode - 0 size\_ set to size 1 size\_ set to size and zeroed.*
- [CoinUnsignedIntArrayWithLength](#) (const [CoinUnsignedIntArrayWithLength](#) &rhs)  
  
*Copy constructor.*
- [CoinUnsignedIntArrayWithLength](#) (const [CoinUnsignedIntArrayWithLength](#) \*rhs)  
  
*Copy constructor.2.*
- [CoinUnsignedIntArrayWithLength](#) & [operator=](#) (const [CoinUnsignedIntArrayWithLength](#) &rhs)  
*Assignment operator.*

**8.82.1 Detailed Description**

unsigned int \* version

Definition at line 804 of file CoinIndexedVector.hpp.

**8.82.2 Constructor & Destructor Documentation****8.82.2.1 CoinUnsignedIntArrayWithLength::CoinUnsignedIntArrayWithLength ( const CoinUnsignedIntArrayWithLength & rhs ) [inline]**

Copy constructor.

Definition at line 846 of file CoinIndexedVector.hpp.

## 8.82.3 Member Function Documentation

8.82.3.1 CoinUnsignedIntArrayWithLength& CoinUnsignedIntArrayWithLength::operator= ( const CoinUnsignedIntArrayWithLength & rhs )  
[inline]

Assignment operator.

Definition at line 852 of file CoinIndexedVector.hpp.

The documentation for this class was generated from the following file:

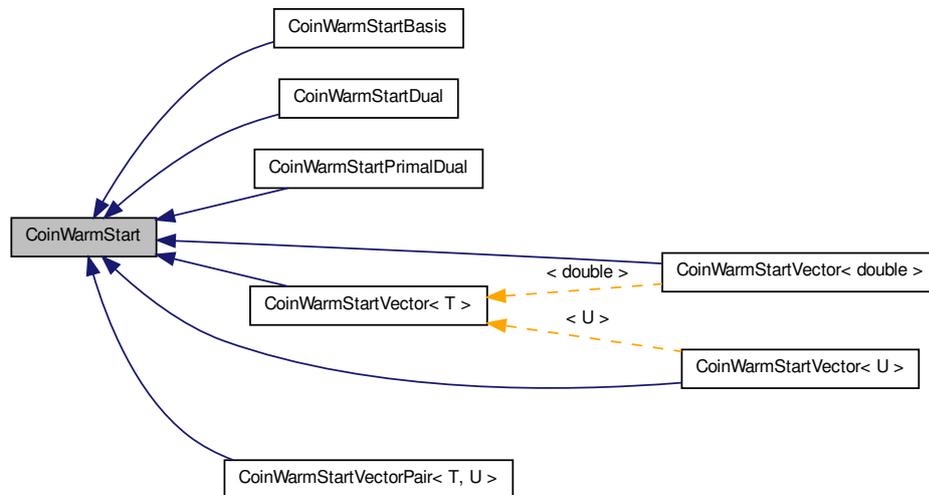
- CoinIndexedVector.hpp

## 8.83 CoinWarmStart Class Reference

Abstract base class for warm start information.

```
#include <CoinWarmStart.hpp>
```

Inheritance diagram for CoinWarmStart:



## Public Member Functions

- virtual `~CoinWarmStart ()`  
*Abstract destructor.*
- virtual `CoinWarmStart * clone () const =0`  
*'Virtual constructor'*

### 8.83.1 Detailed Description

Abstract base class for warm start information.

Really nothing can be generalized for warm start information --- all we know is that it exists. Hence the abstract base class contains only a virtual destructor and a virtual clone function (a virtual constructor), so that derived classes can provide these functions.

Definition at line 21 of file CoinWarmStart.hpp.

The documentation for this class was generated from the following file:

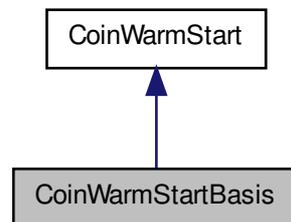
- [CoinWarmStart.hpp](#)

## 8.84 CoinWarmStartBasis Class Reference

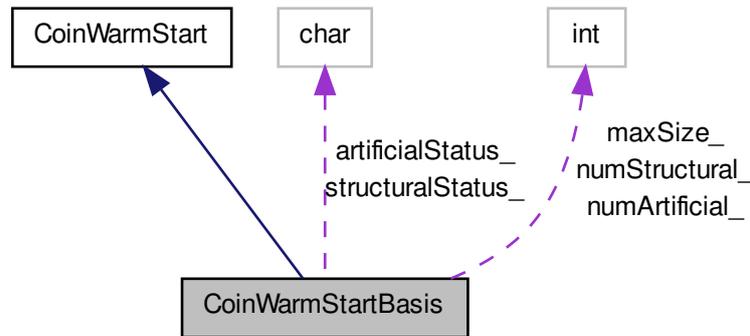
The default COIN simplex (basis-oriented) warm start class.

```
#include <CoinWarmStartBasis.hpp>
```

Inheritance diagram for CoinWarmStartBasis:



Collaboration diagram for CoinWarmStartBasis:



### Public Types

- enum [Status](#) { `isFree` = 0x00, `basic` = 0x01, `atUpperBound` = 0x02, `atLowerBound` = 0x03 }
- *Enum for status of variables.*
- typedef [CoinTriple](#)< int, int, int > [XferEntry](#)
- *Transfer vector entry for `mergeBasis(const CoinWarmStartBasis*, const XferVec*, const XferVec*)`*
- typedef `std::vector`< [XferEntry](#) > [XferVec](#)
- *Transfer vector for `mergeBasis(const CoinWarmStartBasis*, const XferVec*, const XferVec*)`*

### Public Member Functions

Methods to get and set basis information.

*The status of variables is kept in a pair of arrays, one for structural variables, and one for artificials (aka logicals and slacks). The status is coded using the values of the [Status](#) enum.*

#### See also

[CoinWarmStartBasis::Status](#) for a description of the packing used in the status arrays.

- int [getNumStructural](#) () const
- *Return the number of structural variables.*
- int [getNumArtificial](#) () const
- *Return the number of artificial variables.*

- int `numberBasicStructurals` () const  
*Return the number of basic structurals.*
- Status `getStructStatus` (int i) const  
*Return the status of the specified structural variable.*
- void `setStructStatus` (int i, Status st)  
*Set the status of the specified structural variable.*
- char \* `getStructuralStatus` ()  
*Return the status array for the structural variables.*
- const char \* `getStructuralStatus` () const  
*const overload for `getStructuralStatus()`*
- char \* `getArtificialStatus` ()  
*As for `getStructuralStatus`, but returns the status array for the artificial variables.*
- Status `getArtifStatus` (int i) const  
*Return the status of the specified artificial variable.*
- void `setArtifStatus` (int i, Status st)  
*Set the status of the specified artificial variable.*
- const char \* `getArtificialStatus` () const  
*const overload for `getArtificialStatus()`*

#### Basis 'diff' methods

- virtual `CoinWarmStartDiff` \* `generateDiff` (const `CoinWarmStart` \*const old-CWS) const  
*Generate a 'diff' that can convert the warm start basis passed as a parameter to the warm start basis specified by `this`.*
- virtual void `applyDiff` (const `CoinWarmStartDiff` \*const cwsdDiff)  
*Apply `diff` to this basis.*

#### Methods to modify the warm start object

- virtual void `setSize` (int ns, int na)  
*Set basis capacity; existing basis is discarded.*
- virtual void `resize` (int newNumberRows, int newNumberColumns)  
*Set basis capacity; existing basis is maintained.*
- virtual void `compressRows` (int tgtCnt, const int \*tgts)  
*Delete a set of rows from the basis.*
- virtual void `deleteRows` (int rawTgtCnt, const int \*rawTgts)  
*Delete a set of rows from the basis.*
- virtual void `deleteColumns` (int number, const int \*which)  
*Delete a set of columns from the basis.*
- virtual void `mergeBasis` (const `CoinWarmStartBasis` \*src, const `XferVec` \*xferRows, const `XferVec` \*xferCols)  
*Merge entries from a source basis into this basis.*

#### Constructors, destructors, and related functions

- `CoinWarmStartBasis` ()  
*Default constructor.*
- `CoinWarmStartBasis` (int ns, int na, const char \*sStat, const char \*aStat)  
*Constructs a warm start object with the specified status vectors.*

- [CoinWarmStartBasis](#) (const [CoinWarmStartBasis](#) &ws)  
*Copy constructor.*
- virtual [CoinWarmStart](#) \* [clone](#) () const  
*'Virtual constructor'*
- virtual [~CoinWarmStartBasis](#) ()  
*Destructor.*
- virtual [CoinWarmStartBasis](#) & [operator=](#) (const [CoinWarmStartBasis](#) &rhs)  
*Assignment.*
- virtual void [assignBasisStatus](#) (int ns, int na, char \*&sStat, char \*&aStat)  
*Assign the status vectors to be the warm start information.*

#### Miscellaneous methods

- virtual void [print](#) () const  
*Prints in readable format (for debug)*
- bool [fullBasis](#) () const  
*Returns true if full basis (for debug)*
- bool [fixFullBasis](#) ()  
*Returns true if full basis and fixes up (for debug)*

#### Protected Attributes

##### Protected data members

##### See also

[CoinWarmStartBasis::Status](#) for a description of the packing used in the status arrays.

- int [numStructural\\_](#)  
*The number of structural variables.*
- int [numArtificial\\_](#)  
*The number of artificial variables.*
- int [maxSize\\_](#)  
*The maximum size (in ints - actually 4\*char) (so resize does not need to do new)*
- char \* [structuralStatus\\_](#)  
*The status of the structural variables.*
- char \* [artificialStatus\\_](#)  
*The status of the artificial variables.*

#### Related Functions

(Note that these are not member functions.)

- [CoinWarmStartBasis::Status](#) [getStatus](#) (const char \*array, int i)  
*Get the status of the specified variable in the given status array.*
- void [setStatus](#) (char \*array, int i, [CoinWarmStartBasis::Status](#) st)  
*Set the status of the specified variable in the given status array.*

### 8.84.1 Detailed Description

The default COIN simplex (basis-oriented) warm start class.

[CoinWarmStartBasis](#) provides for a warm start object which contains the status of each variable (structural and artificial).

Definition at line 40 of file `CoinWarmStartBasis.hpp`.

### 8.84.2 Member Enumeration Documentation

#### 8.84.2.1 enum `CoinWarmStartBasis::Status`

Enum for status of variables.

Matches [CoinPrePostsolveMatrix::Status](#), without `superBasic`. Most code that converts between [CoinPrePostsolveMatrix::Status](#) and [CoinWarmStartBasis::Status](#) will break if this correspondence is broken.

The status vectors are currently packed using two bits per status code, four codes per byte. The location of the status information for variable `i` is in byte `i >> 2` and occupies bits 0:1 if `i % 4 == 0`, bits 2:3 if `i % 4 == 1`, etc. The non-member functions [getStatus\(const char\\*,int\)](#) and [setStatus\(char\\*,int,CoinWarmStartBasis::Status\)](#) are provided to hide details of the packing.

#### Enumerator:

- isFree*** Nonbasic free variable.
- basic*** Basic variable.
- atUpperBound*** Nonbasic at upper bound.
- atLowerBound*** Nonbasic at lower bound.

Definition at line 57 of file `CoinWarmStartBasis.hpp`.

### 8.84.3 Constructor & Destructor Documentation

#### 8.84.3.1 `CoinWarmStartBasis::CoinWarmStartBasis ( )`

Default constructor.

Creates a warm start object representing an empty basis (0 rows, 0 columns).

#### 8.84.3.2 `CoinWarmStartBasis::CoinWarmStartBasis ( int ns, int na, const char * sStat, const char * aStat )`

Constructs a warm start object with the specified status vectors.

The parameters are copied. Consider [assignBasisStatus\(int,int,char\\*&,char\\*&\)](#) if the object should assume ownership.

**See also**

[CoinWarmStartBasis::Status](#) for a description of the packing used in the status arrays.

**8.84.4 Member Function Documentation****8.84.4.1** `int CoinWarmStartBasis::numberBasicStructurals ( ) const`

Return the number of basic structurals.

A fast test for an all-slack basis.

**8.84.4.2** `char* CoinWarmStartBasis::getStructuralStatus ( ) [inline]`

Return the status array for the structural variables.

The status information is stored using the codes defined in the Status enum, 2 bits per variable, packed 4 variables per byte.

Definition at line 116 of file CoinWarmStartBasis.hpp.

**8.84.4.3** `virtual CoinWarmStartDiff* CoinWarmStartBasis::generateDiff ( const CoinWarmStart *const oldCWS ) const [virtual]`

Generate a 'diff' that can convert the warm start basis passed as a parameter to the warm start basis specified by `this`.

The capabilities are limited: the basis passed as a parameter can be no larger than the basis pointed to by `this`.

Reimplemented from [CoinWarmStart](#).

**8.84.4.4** `virtual void CoinWarmStartBasis::applyDiff ( const CoinWarmStartDiff *const cwsdDiff ) [virtual]`

Apply `diff` to this basis.

Update this basis by applying `diff`. It's assumed that the allocated capacity of the basis is sufficiently large.

Reimplemented from [CoinWarmStart](#).

**8.84.4.5** `virtual void CoinWarmStartBasis::setSize ( int ns, int na ) [virtual]`

Set basis capacity; existing basis is discarded.

After execution of this routine, the warm start object does not describe a valid basis: all structural and artificial variables have status `isFree`.

**8.84.4.6** `virtual void CoinWarmStartBasis::resize ( int newNumberRows, int newNumberColumns ) [virtual]`

Set basis capacity; existing basis is maintained.

After execution of this routine, the warm start object describes a valid basis: the status

of new structural variables (added columns) is set to nonbasic at lower bound, and the status of new artificial variables (added rows) is set to basic. (The basis can be invalid if new structural variables do not have a finite lower bound.)

**8.84.4.7** `virtual void CoinWarmStartBasis::compressRows ( int tgtCnt, const int * tgts )`  
[virtual]

Delete a set of rows from the basis.

#### Warning

This routine assumes that the set of indices to be deleted is sorted in ascending order and contains no duplicates. Use `deleteRows()` if this is not the case. The resulting basis is guaranteed valid only if all deleted constraints are slack (hence the associated logicals are basic).

Removal of a tight constraint with a nonbasic logical implies that some basic variable must be made nonbasic. This correction is left to the client.

**8.84.4.8** `virtual void CoinWarmStartBasis::deleteRows ( int rawTgtCnt, const int * rawTgts )`  
[virtual]

Delete a set of rows from the basis.

#### Warning

The resulting basis is guaranteed valid only if all deleted constraints are slack (hence the associated logicals are basic).

Removal of a tight constraint with a nonbasic logical implies that some basic variable must be made nonbasic. This correction is left to the client.

**8.84.4.9** `virtual void CoinWarmStartBasis::deleteColumns ( int number, const int * which )`  
[virtual]

Delete a set of columns from the basis.

#### Warning

The resulting basis is guaranteed valid only if all deleted variables are nonbasic.

Removal of a basic variable implies that some nonbasic variable must be made basic. This correction is left to the client.

**8.84.4.10** `virtual void CoinWarmStartBasis::mergeBasis ( const CoinWarmStartBasis * src, const XferVec * xferRows, const XferVec * xferCols )` [virtual]

Merge entries from a source basis into this basis.

#### Warning

It's the client's responsibility to ensure validity of the merged basis, if that's important to the application.

The vector `xferCols` (`xferRows`) specifies runs of entries to be taken from the source basis and placed in this basis. Each entry is a [CoinTriple](#), with first specifying the starting source index of a run, second specifying the starting destination index, and third specifying the run length.

```
8.84.4.11 virtual void CoinWarmStartBasis::assignBasisStatus ( int ns, int na, char *& sStat,  
char *& aStat ) [virtual]
```

Assign the status vectors to be the warm start information.

In this method the [CoinWarmStartBasis](#) object assumes ownership of the pointers and upon return the argument pointers will be NULL. If copying is desirable, use the [array constructor](#) or the [assignment operator](#) .

#### Note

The pointers passed to this method will be freed using `delete[]`, so they must be created using `new[]`.

#### 8.84.5 Member Data Documentation

```
8.84.5.1 char* CoinWarmStartBasis::structuralStatus_ [protected]
```

The status of the structural variables.

Definition at line 340 of file `CoinWarmStartBasis.hpp`.

```
8.84.5.2 char* CoinWarmStartBasis::artificialStatus_ [protected]
```

The status of the artificial variables.

Definition at line 342 of file `CoinWarmStartBasis.hpp`.

The documentation for this class was generated from the following file:

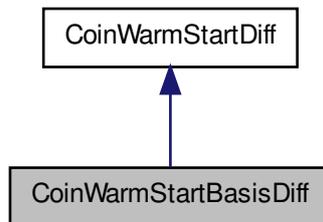
- `CoinWarmStartBasis.hpp`

## 8.85 CoinWarmStartBasisDiff Class Reference

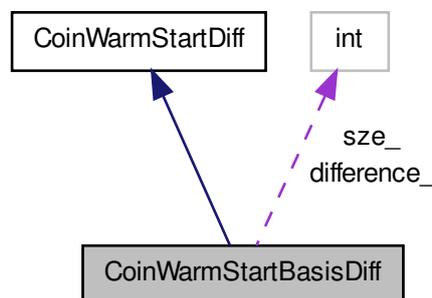
A 'diff' between two [CoinWarmStartBasis](#) objects.

```
#include <CoinWarmStartBasis.hpp>
```

Inheritance diagram for CoinWarmStartBasisDiff:



Collaboration diagram for CoinWarmStartBasisDiff:



#### Public Member Functions

- virtual `CoinWarmStartDiff * clone () const`  
*'Virtual constructor'*
- virtual `CoinWarmStartBasisDiff & operator= (const CoinWarmStartBasisDiff &rhs)`  
*Assignment.*
- virtual `~CoinWarmStartBasisDiff ()`  
*Destructor.*

## Protected Member Functions

- [CoinWarmStartBasisDiff](#) ()  
*Default constructor.*
- [CoinWarmStartBasisDiff](#) (const [CoinWarmStartBasisDiff](#) &cwsbd)  
*Copy constructor.*
- [CoinWarmStartBasisDiff](#) (int size, const unsigned int \*const diffNdxs, const unsigned int \*const diffVals)  
*Standard constructor.*
- [CoinWarmStartBasisDiff](#) (const [CoinWarmStartBasis](#) \*rhs)  
*Constructor when full is smaller than diff!*

## 8.85.1 Detailed Description

A 'diff' between two [CoinWarmStartBasis](#) objects.

This class exists in order to hide from the world the details of calculating and representing a 'diff' between two [CoinWarmStartBasis](#) objects. For convenience, assignment, cloning, and deletion are visible to the world, and default and copy constructors are made available to derived classes. Knowledge of the rest of this structure, and of generating and applying diffs, is restricted to the friend functions [CoinWarmStartBasis::generateDiff\(\)](#) and [CoinWarmStartBasis::applyDiff\(\)](#).

The actual data structure is an unsigned int vector, #difference\_ which starts with indices of changed and then has values starting after #size\_

Definition at line 391 of file [CoinWarmStartBasis.hpp](#).

## 8.85.2 Constructor &amp; Destructor Documentation

8.85.2.1 [CoinWarmStartBasisDiff::CoinWarmStartBasisDiff](#) ( ) [`inline`, `protected`]

Default constructor.

This is protected (rather than private) so that derived classes can see it when they make *their* default constructor protected or private.

Definition at line 414 of file [CoinWarmStartBasis.hpp](#).

8.85.2.2 [CoinWarmStartBasisDiff::CoinWarmStartBasisDiff](#) ( const [CoinWarmStartBasisDiff](#) & cwsbd ) [`protected`]

Copy constructor.

For convenience when copying objects containing [CoinWarmStartBasisDiff](#) objects. But consider whether you should be using [clone\(\)](#) to retain polymorphism.

This is protected (rather than private) so that derived classes can see it when they make *their* copy constructor protected or private.

The documentation for this class was generated from the following file:

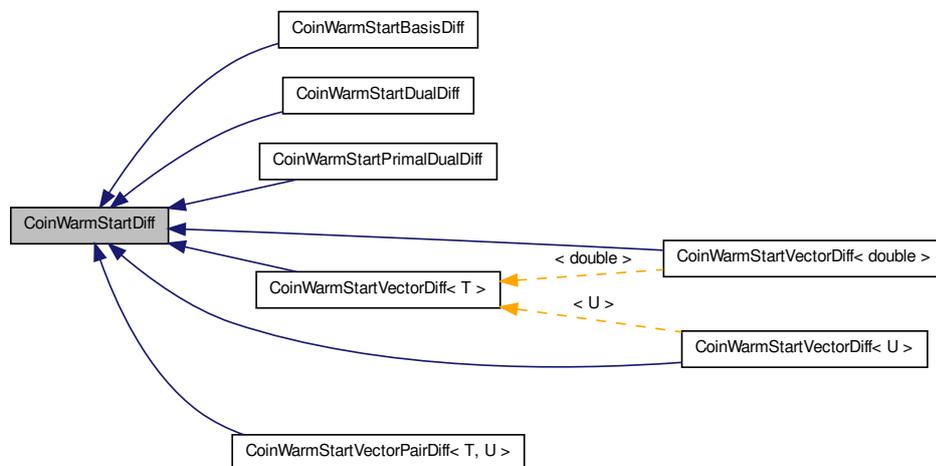
- CoinWarmStartBasis.hpp

## 8.86 CoinWarmStartDiff Class Reference

Abstract base class for warm start 'diff' objects.

```
#include <CoinWarmStart.hpp>
```

Inheritance diagram for CoinWarmStartDiff:



### Public Member Functions

- virtual `~CoinWarmStartDiff ()`  
*Abstract destructor.*
- virtual `CoinWarmStartDiff * clone () const =0`  
*'Virtual constructor'*

### 8.86.1 Detailed Description

Abstract base class for warm start 'diff' objects.

For those types of warm start objects where the notion of a 'diff' makes sense, this virtual base class is provided. As with [CoinWarmStart](#), its sole reason for existence is to make it possible to write solver-independent code.

Definition at line 48 of file CoinWarmStart.hpp.

The documentation for this class was generated from the following file:

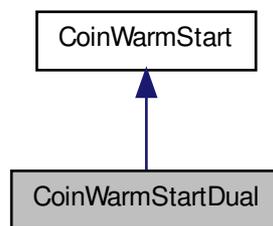
- [CoinWarmStart.hpp](#)

### 8.87 CoinWarmStartDual Class Reference

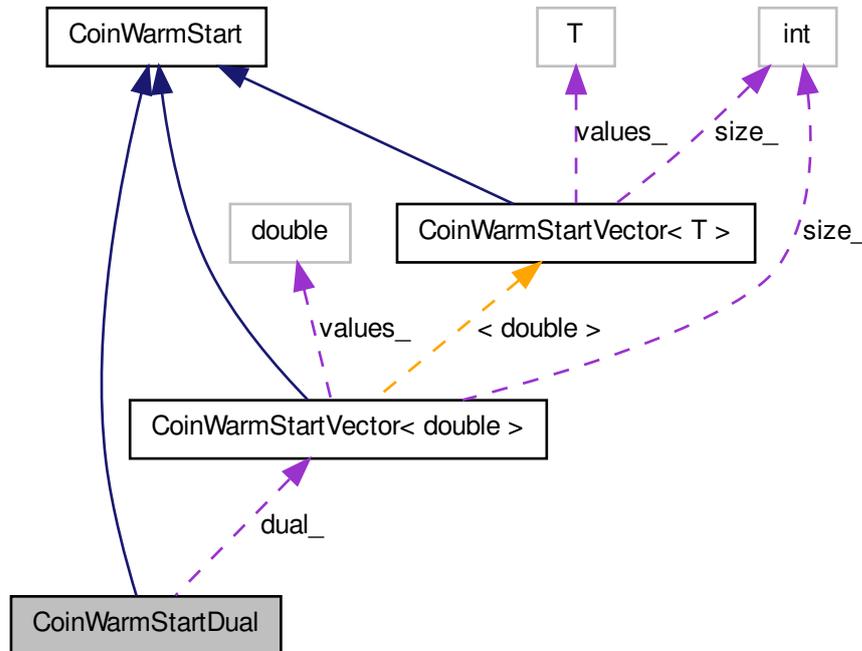
WarmStart information that is only a dual vector.

```
#include <CoinWarmStartDual.hpp>
```

Inheritance diagram for CoinWarmStartDual:



Collaboration diagram for CoinWarmStartDual:



#### Public Member Functions

- `int size () const`  
*return the size of the dual vector*
- `const double * dual () const`  
*return a pointer to the array of duals*
- `void assignDual (int size, double *&dual)`  
*Assign the dual vector to be the warmstart information.*
- `virtual CoinWarmStart * clone () const`  
*'Virtual constructor'*

#### Dual warm start 'diff' methods

- `virtual CoinWarmStartDiff * generateDiff (const CoinWarmStart *const old-CWS) const`  
*Generate a 'diff' that can convert the warm start passed as a parameter to the warm start specified by `this`.*

- virtual void [applyDiff](#) (const [CoinWarmStartDiff](#) \*const *cwsdDiff*)  
*Apply diff to this warm start.*

### 8.87.1 Detailed Description

WarmStart information that is only a dual vector.

Definition at line 18 of file [CoinWarmStartDual.hpp](#).

### 8.87.2 Member Function Documentation

#### 8.87.2.1 void [CoinWarmStartDual::assignDual](#) ( int *size*, double \*& *dual* ) [[inline](#)]

Assign the dual vector to be the warmstart information.

In this method the object assumes ownership of the pointer and upon return "dual" will be a NULL pointer. If copying is desirable use the constructor.

Definition at line 28 of file [CoinWarmStartDual.hpp](#).

#### 8.87.2.2 virtual [CoinWarmStartDiff](#)\* [CoinWarmStartDual::generateDiff](#) ( const [CoinWarmStart](#) \*const *oldCWS* ) const [[virtual](#)]

Generate a 'diff' that can convert the warm start passed as a parameter to the warm start specified by *this*.

The capabilities are limited: the basis passed as a parameter can be no larger than the basis pointed to by *this*.

Reimplemented from [CoinWarmStart](#).

#### 8.87.2.3 virtual void [CoinWarmStartDual::applyDiff](#) ( const [CoinWarmStartDiff](#) \*const *cwsdDiff* ) [[virtual](#)]

Apply *diff* to this warm start.

Update this warm start by applying *diff*. It's assumed that the allocated capacity of the warm start is sufficiently large.

Reimplemented from [CoinWarmStart](#).

The documentation for this class was generated from the following file:

- [CoinWarmStartDual.hpp](#)

## 8.88 CoinWarmStartDualDiff Class Reference

A 'diff' between two [CoinWarmStartDual](#) objects.

```
#include <CoinWarmStartDual.hpp>
```



**Public Member Functions**

- virtual [CoinWarmStartDiff](#) \* [clone](#) () const  
*Virtual constructor*
- virtual [CoinWarmStartDualDiff](#) & [operator=](#) (const [CoinWarmStartDualDiff](#) &rhs)  
*Assignment.*
- virtual [~CoinWarmStartDualDiff](#) ()  
*Destructor.*

**Protected Member Functions**

- [CoinWarmStartDualDiff](#) ()  
*Default constructor.*
- [CoinWarmStartDualDiff](#) (const [CoinWarmStartDualDiff](#) &rhs)  
*Copy constructor.*

**8.88.1 Detailed Description**

A 'diff' between two [CoinWarmStartDual](#) objects.

This class exists in order to hide from the world the details of calculating and representing a 'diff' between two [CoinWarmStartDual](#) objects. For convenience, assignment, cloning, and deletion are visible to the world, and default and copy constructors are made available to derived classes. Knowledge of the rest of this structure, and of generating and applying diffs, is restricted to the friend functions [CoinWarmStartDual::generateDiff\(\)](#) and [CoinWarmStartDual::applyDiff\(\)](#).

The actual data structure is a pair of vectors, `#diffNdxs_` and `#diffVals_`.

Definition at line 101 of file `CoinWarmStartDual.hpp`.

**8.88.2 Constructor & Destructor Documentation****8.88.2.1 [CoinWarmStartDualDiff::CoinWarmStartDualDiff](#) ( ) [inline, protected]**

Default constructor.

This is protected (rather than private) so that derived classes can see it when they make *their* default constructor protected or private.

Definition at line 130 of file `CoinWarmStartDual.hpp`.

**8.88.2.2 [CoinWarmStartDualDiff::CoinWarmStartDualDiff](#) ( const [CoinWarmStartDualDiff](#) & rhs ) [inline, protected]**

Copy constructor.

For convenience when copying objects containing [CoinWarmStartDualDiff](#) objects. But consider whether you should be using [clone\(\)](#) to retain polymorphism.

This is protected (rather than private) so that derived classes can see it when they make *their* copy constructor protected or private.

Definition at line 142 of file CoinWarmStartDual.hpp.

The documentation for this class was generated from the following file:

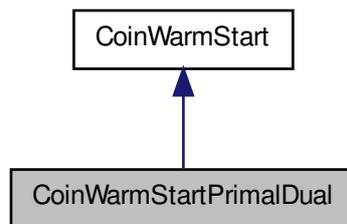
- CoinWarmStartDual.hpp

## 8.89 CoinWarmStartPrimalDual Class Reference

WarmStart information that is only a dual vector.

```
#include <CoinWarmStartPrimalDual.hpp>
```

Inheritance diagram for CoinWarmStartPrimalDual:





## PrimalDual warm start 'diff' methods

- virtual [CoinWarmStartDiff](#) \* [generateDiff](#) (const [CoinWarmStart](#) \*const oldCWS) const  
Generate a 'diff' that can convert the warm start passed as a parameter to the warm start specified by *this*.
- virtual void [applyDiff](#) (const [CoinWarmStartDiff](#) \*const cwsdDiff)  
Apply *diff* to this warm start.

## 8.89.1 Detailed Description

WarmStart information that is only a dual vector.

Definition at line 18 of file [CoinWarmStartPrimalDual.hpp](#).

## 8.89.2 Member Function Documentation

**8.89.2.1** void [CoinWarmStartPrimalDual::assign](#) ( int *primalSize*, int *dualSize*, double \*&*primal*, double \*&*dual* ) [[inline](#)]

Assign the primal/dual vectors to be the warmstart information.

In this method the object assumes ownership of the pointers and upon return *primal* and *dual* will be a NULL pointers. If copying is desirable use the constructor.

NOTE: *primal* and *dual* must have been allocated by `new double[]`, because they will be freed by `delete[]` upon the destruction of this object...

Definition at line 39 of file [CoinWarmStartPrimalDual.hpp](#).

**8.89.2.2** void [CoinWarmStartPrimalDual::clear](#) ( ) [[inline](#)]

Clear the data.

Make it appear as if the warmstart was just created using the default constructor.

Definition at line 66 of file [CoinWarmStartPrimalDual.hpp](#).

**8.89.2.3** virtual [CoinWarmStartDiff](#)\* [CoinWarmStartPrimalDual::generateDiff](#) ( const [CoinWarmStart](#) \*const *oldCWS* ) const [[virtual](#)]

Generate a 'diff' that can convert the warm start passed as a parameter to the warm start specified by *this*.

The capabilities are limited: the basis passed as a parameter can be no larger than the basis pointed to by *this*.

Reimplemented from [CoinWarmStart](#).

**8.89.2.4** virtual void [CoinWarmStartPrimalDual::applyDiff](#) ( const [CoinWarmStartDiff](#) \*const *cwsdDiff* ) [[virtual](#)]

Apply *diff* to this warm start.

Update this warm start by applying `diff`. It's assumed that the allocated capacity of the warm start is sufficiently large.

Reimplemented from [CoinWarmStart](#).

The documentation for this class was generated from the following file:

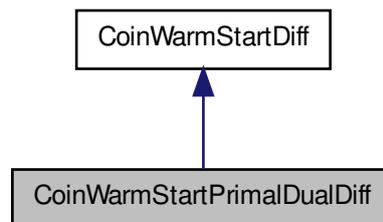
- `CoinWarmStartPrimalDual.hpp`

## 8.90 CoinWarmStartPrimalDualDiff Class Reference

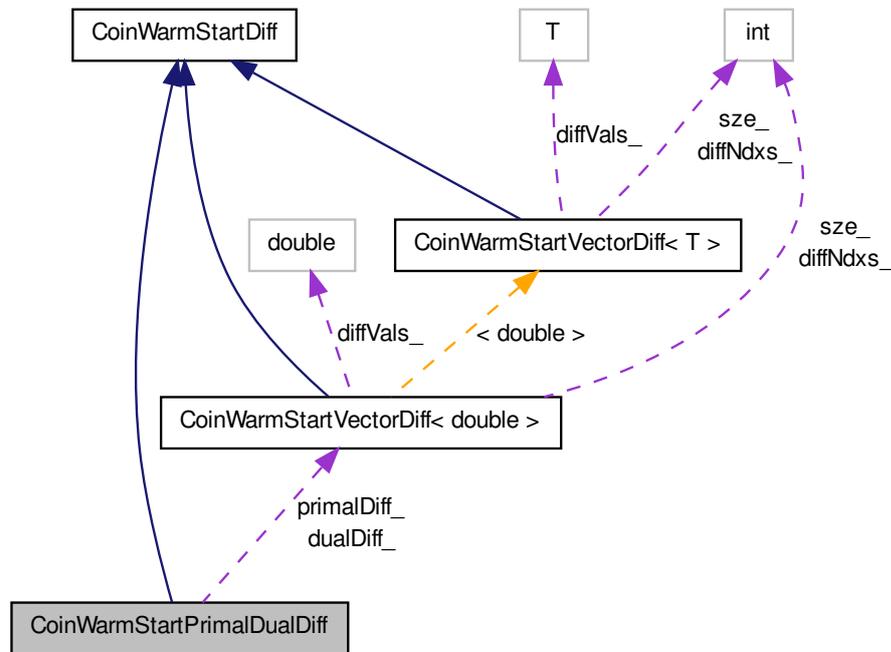
A 'diff' between two [CoinWarmStartPrimalDual](#) objects.

```
#include <CoinWarmStartPrimalDual.hpp>
```

Inheritance diagram for `CoinWarmStartPrimalDualDiff`:



Collaboration diagram for CoinWarmStartPrimalDualDiff:



#### Public Member Functions

- virtual [CoinWarmStartDiff](#) \* [clone](#) () const  
*'Virtual constructor'.*
- virtual [~CoinWarmStartPrimalDualDiff](#) ()  
*Destructor.*

#### Protected Member Functions

- [CoinWarmStartPrimalDualDiff](#) ()  
*Default constructor.*
- [CoinWarmStartPrimalDualDiff](#) (const [CoinWarmStartPrimalDualDiff](#) &rhs)  
*Copy constructor.*
- void [clear](#) ()  
*Clear the data.*

### 8.90.1 Detailed Description

A 'diff' between two [CoinWarmStartPrimalDual](#) objects.

This class exists in order to hide from the world the details of calculating and representing a 'diff' between two [CoinWarmStartPrimalDual](#) objects. For convenience, assignment, cloning, and deletion are visible to the world, and default and copy constructors are made available to derived classes. Knowledge of the rest of this structure, and of generating and applying diffs, is restricted to the friend functions [CoinWarmStartPrimalDual::generateDiff\(\)](#) and [CoinWarmStartPrimalDual::applyDiff\(\)](#).

The actual data structure is a pair of vectors, `#diffNdxs_` and `#diffVals_`.

Definition at line 142 of file `CoinWarmStartPrimalDual.hpp`.

### 8.90.2 Constructor & Destructor Documentation

**8.90.2.1** `CoinWarmStartPrimalDualDiff::CoinWarmStartPrimalDualDiff ( )` [`inline`, `protected`]

Default constructor.

This is protected (rather than private) so that derived classes can see it when they make *their* default constructor protected or private.

Definition at line 169 of file `CoinWarmStartPrimalDual.hpp`.

**8.90.2.2** `CoinWarmStartPrimalDualDiff::CoinWarmStartPrimalDualDiff ( const CoinWarmStartPrimalDualDiff & rhs )` [`inline`, `protected`]

Copy constructor.

For convenience when copying objects containing [CoinWarmStartPrimalDualDiff](#) objects. But consider whether you should be using `clone()` to retain polymorphism.

This is protected (rather than private) so that derived classes can see it when they make *their* copy constructor protected or private.

Definition at line 181 of file `CoinWarmStartPrimalDual.hpp`.

### 8.90.3 Member Function Documentation

**8.90.3.1** `virtual CoinWarmStartDiff* CoinWarmStartPrimalDualDiff::clone ( )` `const` [`inline`, `virtual`]

'Virtual constructor'.

To be used when retaining polymorphism is important

Implements [CoinWarmStartDiff](#).

Definition at line 153 of file `CoinWarmStartPrimalDual.hpp`.

8.90.3.2 `void CoinWarmStartPrimalDualDiff::clear( ) [inline, protected]`

Clear the data.

Make it appear as if the diff was just created using the default constructor.

Definition at line 189 of file CoinWarmStartPrimalDual.hpp.

The documentation for this class was generated from the following file:

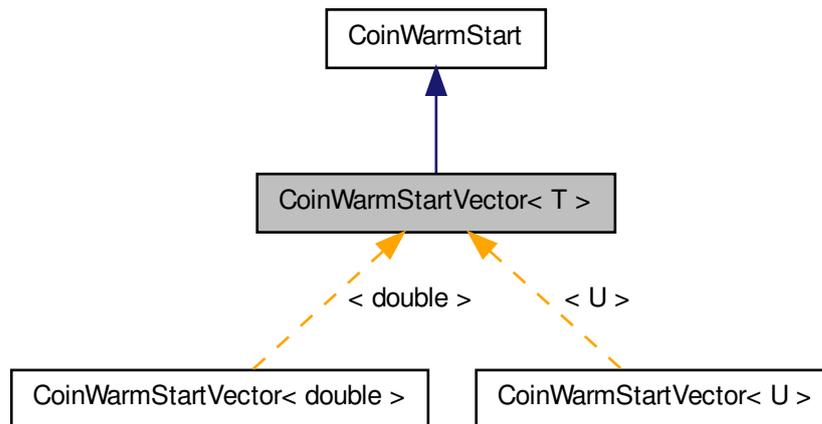
- CoinWarmStartPrimalDual.hpp

## 8.91 CoinWarmStartVector< T > Class Template Reference

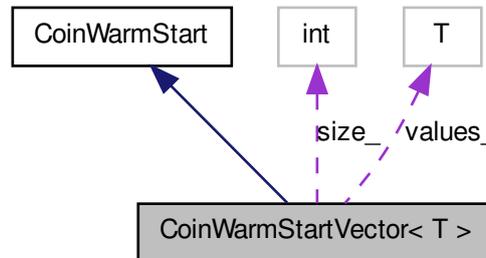
WarmStart information that is only a vector.

```
#include <CoinWarmStartVector.hpp>
```

Inheritance diagram for CoinWarmStartVector< T >:



Collaboration diagram for CoinWarmStartVector< T >:



#### Public Member Functions

- int `size` () const  
*return the size of the vector*
- const T \* `values` () const  
*return a pointer to the array of vectors*
- void `assignVector` (int size, T \*&vec)  
*Assign the vector to be the warmstart information.*
- virtual `CoinWarmStart` \* `clone` () const  
*'Virtual constructor'*
- void `clear` ()  
*Clear the data.*

#### Vector warm start 'diff' methods

- virtual `CoinWarmStartDiff` \* `generateDiff` (const `CoinWarmStart` \*const old-CWS) const  
*Generate a 'diff' that can convert the warm start passed as a parameter to the warm start specified by `this`.*
- virtual void `applyDiff` (const `CoinWarmStartDiff` \*const cwsdDiff)  
*Apply `diff` to this warm start.*

#### 8.91.1 Detailed Description

```
template<typename T>class CoinWarmStartVector< T >
```

WarmStart information that is only a vector.

Definition at line 26 of file CoinWarmStartVector.hpp.

## 8.91.2 Member Function Documentation

8.91.2.1 `template<typename T> void CoinWarmStartVector< T >::assignVector ( int size, T *& vec ) [inline]`

Assign the vector to be the warmstart information.

In this method the object assumes ownership of the pointer and upon return #vector will be a NULL pointer. If copying is desirable use the constructor.

Definition at line 47 of file CoinWarmStartVector.hpp.

8.91.2.2 `template<typename T> void CoinWarmStartVector< T >::clear ( ) [inline]`

Clear the data.

Make it appear as if the warmstart was just created using the default constructor.

Definition at line 94 of file CoinWarmStartVector.hpp.

8.91.2.3 `template<typename T > CoinWarmStartDiff * CoinWarmStartVector< T >::generateDiff ( const CoinWarmStart *const oldCWS ) const [virtual]`

Generate a 'diff' that can convert the warm start passed as a parameter to the warm start specified by `this`.

The capabilities are limited: the basis passed as a parameter can be no larger than the basis pointed to by `this`.

Reimplemented from [CoinWarmStart](#).

Definition at line 332 of file CoinWarmStartVector.hpp.

8.91.2.4 `template<typename T > void CoinWarmStartVector< T >::applyDiff ( const CoinWarmStartDiff *const cwsdDiff ) [virtual]`

Apply `diff` to this warm start.

Update this warm start by applying `diff`. It's assumed that the allocated capacity of the warm start is sufficiently large.

Reimplemented from [CoinWarmStart](#).

Definition at line 396 of file CoinWarmStartVector.hpp.

The documentation for this class was generated from the following file:

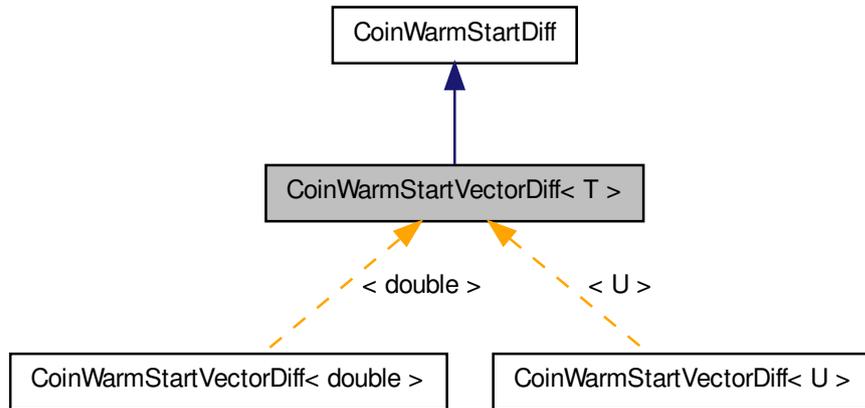
- CoinWarmStartVector.hpp

## 8.92 CoinWarmStartVectorDiff&lt; T &gt; Class Template Reference

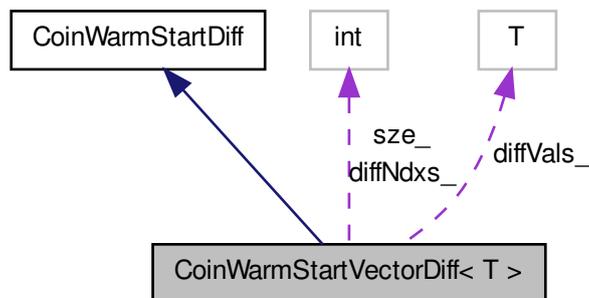
A 'diff' between two [CoinWarmStartVector](#) objects.

```
#include <CoinWarmStartVector.hpp>
```

Inheritance diagram for CoinWarmStartVectorDiff< T >:



Collaboration diagram for CoinWarmStartVectorDiff< T >:



#### Public Member Functions

- virtual `CoinWarmStartDiff * clone () const`  
'Virtual constructor'

- virtual [CoinWarmStartVectorDiff](#) & `operator=` (const [CoinWarmStartVectorDiff](#)< T > &rhs)  
*Assignment.*
- virtual `~CoinWarmStartVectorDiff` ()  
*Destructor.*
- [CoinWarmStartVectorDiff](#) ()  
*Default constructor.*
- [CoinWarmStartVectorDiff](#) (const [CoinWarmStartVectorDiff](#)< T > &rhs)  
*Copy constructor.*
- [CoinWarmStartVectorDiff](#) (int size, const unsigned int \*const diffNdxs, const T \*const diffVals)  
*Standard constructor.*
- void `clear` ()  
*Clear the data.*

### 8.92.1 Detailed Description

```
template<typename T>class CoinWarmStartVectorDiff< T >
```

A 'diff' between two [CoinWarmStartVector](#) objects.

This class exists in order to hide from the world the details of calculating and representing a 'diff' between two [CoinWarmStartVector](#) objects. For convenience, assignment, cloning, and deletion are visible to the world, and default and copy constructors are made available to derived classes. Knowledge of the rest of this structure, and of generating and applying diffs, is restricted to the friend functions [CoinWarmStartVector::generateDiff\(\)](#) and [CoinWarmStartVector::applyDiff\(\)](#).

The actual data structure is a pair of vectors, #diffNdxs\_ and #diffVals\_.

Definition at line 151 of file [CoinWarmStartVector.hpp](#).

### 8.92.2 Constructor & Destructor Documentation

```
8.92.2.1 template<typename T> CoinWarmStartVectorDiff< T  
>::CoinWarmStartVectorDiff ( const CoinWarmStartVectorDiff< T > & rhs )
```

Copy constructor.

For convenience when copying objects containing [CoinWarmStartVectorDiff](#) objects. But consider whether you should be using [clone\(\)](#) to retain polymorphism.

Definition at line 454 of file [CoinWarmStartVector.hpp](#).

### 8.92.3 Member Function Documentation

8.92.3.1 `template<typename T> void CoinWarmStartVectorDiff< T >::clear ( )`  
`[inline]`

Clear the data.

Make it appear as if the diff was just created using the default constructor.

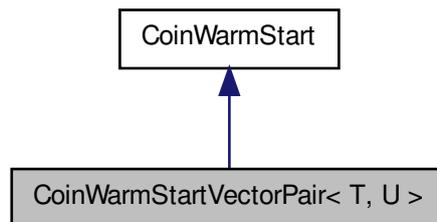
Definition at line 204 of file CoinWarmStartVector.hpp.

The documentation for this class was generated from the following file:

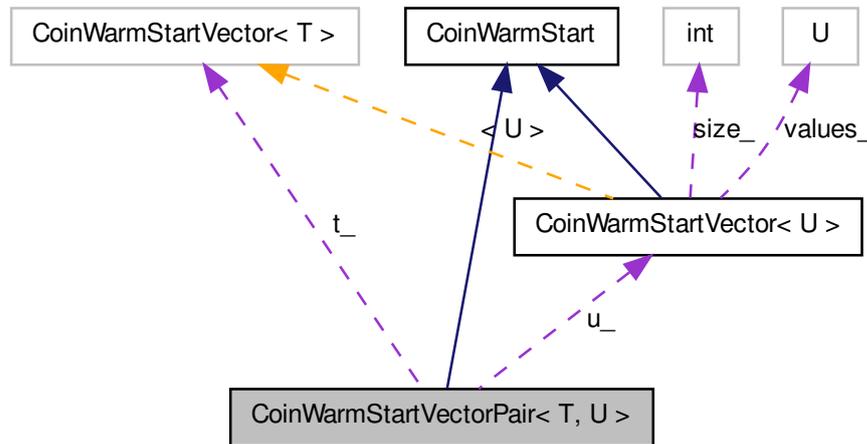
- CoinWarmStartVector.hpp

### 8.93 CoinWarmStartVectorPair< T, U > Class Template Reference

Inheritance diagram for CoinWarmStartVectorPair< T, U >:



Collaboration diagram for CoinWarmStartVectorPair< T, U >:



#### Public Member Functions

- virtual [CoinWarmStart](#) \* `clone` () const  
*'Virtual constructor'*

#### 8.93.1 Detailed Description

```
template<typename T, typename U>class CoinWarmStartVectorPair< T, U >
```

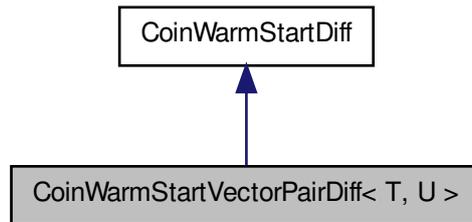
Definition at line 229 of file CoinWarmStartVector.hpp.

The documentation for this class was generated from the following file:

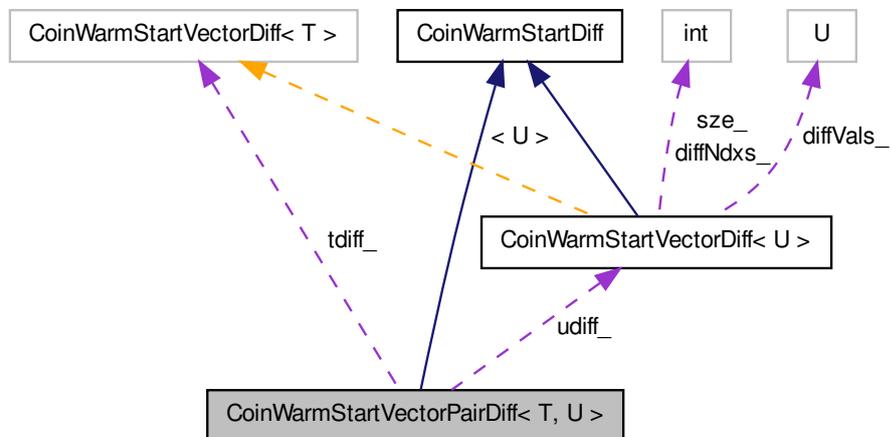
- CoinWarmStartVector.hpp

## 8.94 CoinWarmStartVectorPairDiff&lt; T, U &gt; Class Template Reference

Inheritance diagram for CoinWarmStartVectorPairDiff< T, U >:



Collaboration diagram for CoinWarmStartVectorPairDiff< T, U >:



## Public Member Functions

- virtual `CoinWarmStartDiff * clone () const`  
*'Virtual constructor'*

## 8.94.1 Detailed Description

```
template<typename T, typename U>class CoinWarmStartVectorPairDiff< T, U >
```

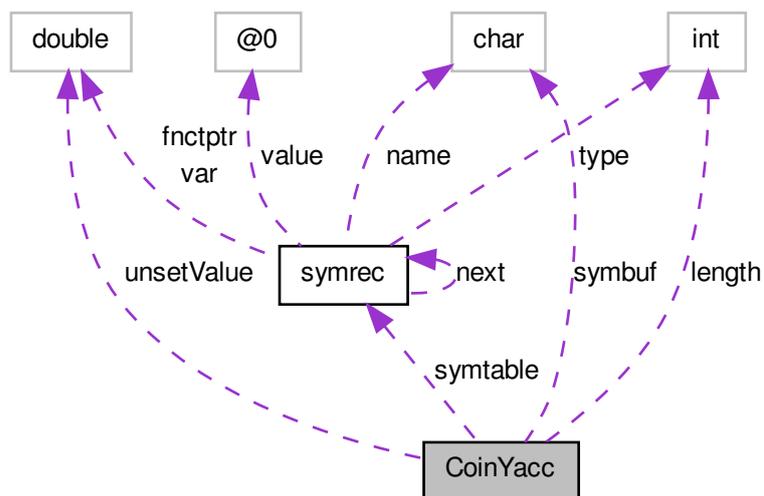
Definition at line 282 of file CoinWarmStartVector.hpp.

The documentation for this class was generated from the following file:

- CoinWarmStartVector.hpp

## 8.95 CoinYacc Class Reference

Collaboration diagram for CoinYacc:



## 8.95.1 Detailed Description

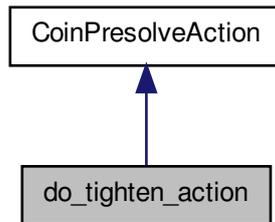
Definition at line 151 of file CoinModelUseful.hpp.

The documentation for this class was generated from the following file:

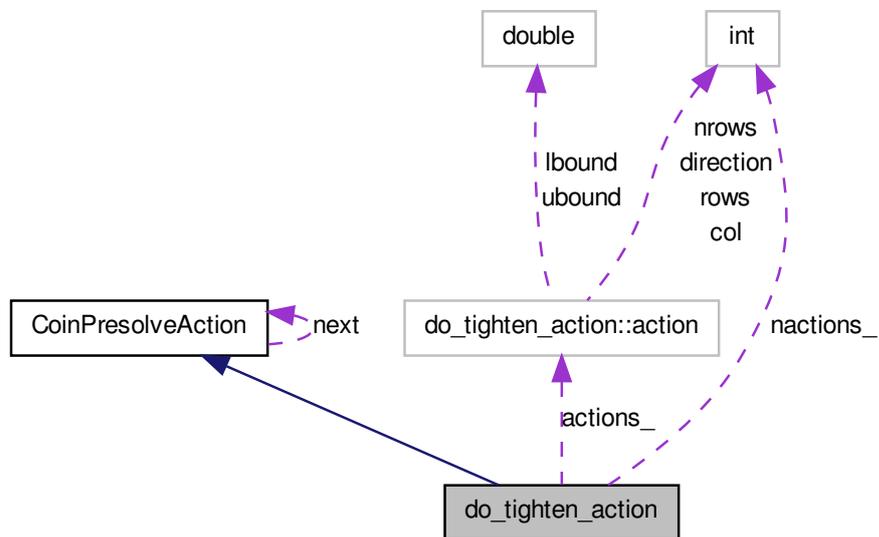
- CoinModelUseful.hpp

## 8.96 do\_tighten\_action Class Reference

Inheritance diagram for do\_tighten\_action:



Collaboration diagram for do\_tighten\_action:



## Classes

- struct **action**

## Public Member Functions

- const char \* [name](#) () const  
*A name for debug printing.*
- void [postsolve](#) ([CoinPostsolveMatrix](#) \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

### 8.96.1 Detailed Description

Definition at line 19 of file `CoinPresolveTighten.hpp`.

### 8.96.2 Member Function Documentation

#### 8.96.2.1 const char\* do\_tighten\_action::name ( ) const [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

The documentation for this class was generated from the following file:

- `CoinPresolveTighten.hpp`

## 8.97 doubleton\_action Class Reference

Solve  $ax+by=c$  for  $y$  and substitute  $y$  out of the problem.

```
#include <CoinPresolveDoubleton.hpp>
```



**Classes**

- struct [action](#)

**Public Member Functions**

- const char \* [name](#) () const  
*A name for debug printing.*
- void [postsolve](#) ([CoinPostsolveMatrix](#) \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

**8.97.1 Detailed Description**

Solve  $ax+by=c$  for  $y$  and substitute  $y$  out of the problem.

This moves the bounds information for  $y$  onto  $x$ , making  $y$  free and allowing us to substitute it away.

```

a x + b y = c
l1 <= x <= u1
l2 <= y <= u2 ==>

l2 <= (c - a x) / b <= u2
b/-a > 0 ==> (b l2 - c) / -a <= x <= (b u2 - c) / -a
b/-a < 0 ==> (b u2 - c) / -a <= x <= (b l2 - c) / -a

```

Definition at line 26 of file `CoinPresolveDoubleton.hpp`.

**8.97.2 Member Function Documentation****8.97.2.1** `const char* doubleton_action::name ( ) const` `[inline, virtual]`

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

Definition at line 62 of file `CoinPresolveDoubleton.hpp`.

The documentation for this class was generated from the following file:

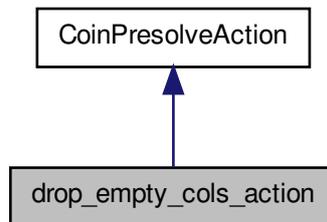
- `CoinPresolveDoubleton.hpp`

**8.98 drop\_empty\_cols\_action Class Reference**

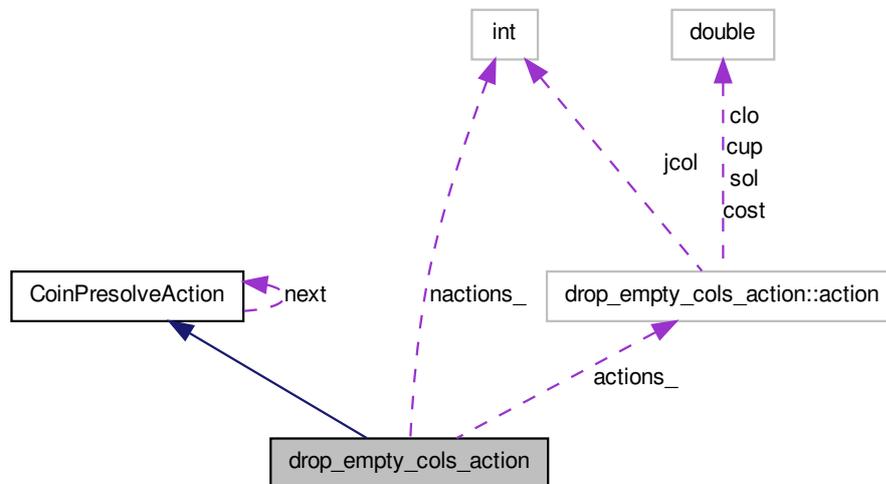
Physically removes empty columns in presolve, and reinserts empty columns in postsolve.

```
#include <CoinPresolveEmpty.hpp>
```

Inheritance diagram for drop\_empty\_cols\_action:



Collaboration diagram for drop\_empty\_cols\_action:



#### Classes

- struct **action**

### Public Member Functions

- `const char * name () const`  
*A name for debug printing.*
- `void postsolve (CoinPostsolveMatrix *prob) const`  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.98.1 Detailed Description

Physically removes empty columns in presolve, and reinserts empty columns in postsolve.

Physical removal of rows and columns should be the last activities performed during presolve. Do them exactly once. The row-major matrix is **not** maintained by this transform.

To physically drop the columns, `CoinPrePostsolveMatrix::mcstrt_` and `CoinPrePostsolveMatrix::hincol_` are compressed, along with column bounds, objective, and (if present) the column portions of the solution. This renumbers the columns. `drop_empty_cols_action::presolve` will reconstruct `CoinPresolveMatrix::clink_`.

Definition at line 34 of file `CoinPresolveEmpty.hpp`.

#### 8.98.2 Member Function Documentation

##### 8.98.2.1 `const char* drop_empty_cols_action::name ( ) const` `[inline, virtual]`

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements `CoinPresolveAction`.

Definition at line 56 of file `CoinPresolveEmpty.hpp`.

The documentation for this class was generated from the following file:

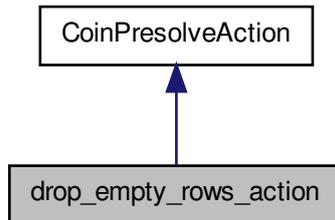
- `CoinPresolveEmpty.hpp`

### 8.99 drop\_empty\_rows\_action Class Reference

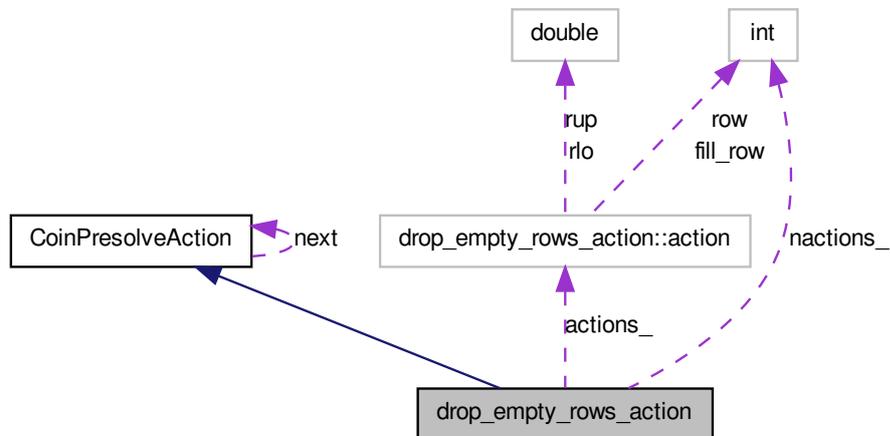
Physically removes empty rows in presolve, and reinserts empty rows in postsolve.

```
#include <CoinPresolveEmpty.hpp>
```

Inheritance diagram for drop\_empty\_rows\_action:



Collaboration diagram for drop\_empty\_rows\_action:



#### Classes

- struct **action**

#### Public Member Functions

- const char \* [name](#) () const

*A name for debug printing.*

- void `postsolve` (`CoinPostsolveMatrix` \*prob) const

*Apply the postsolve transformation for this particular presolve action.*

### 8.99.1 Detailed Description

Physically removes empty rows in presolve, and reinserts empty rows in postsolve.

Physical removal of rows and columns should be the last activities performed during presolve. Do them exactly once. The row-major matrix is **not** maintained by this transform.

To physically drop the rows, the rows are renumbered, excluding empty rows. This involves rewriting `CoinPrePostsolveMatrix::hrow_` and compressing the row bounds and (if present) the row portions of the solution.

Definition at line 86 of file `CoinPresolveEmpty.hpp`.

### 8.99.2 Member Function Documentation

#### 8.99.2.1 `const char* drop_empty_rows_action::name( )const` [`inline`, `virtual`]

*A name for debug printing.*

It is expected that the name is not stored in the transform itself.

Implements `CoinPresolveAction`.

Definition at line 106 of file `CoinPresolveEmpty.hpp`.

The documentation for this class was generated from the following file:

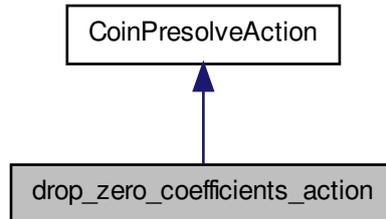
- `CoinPresolveEmpty.hpp`

## 8.100 `drop_zero_coefficients_action` Class Reference

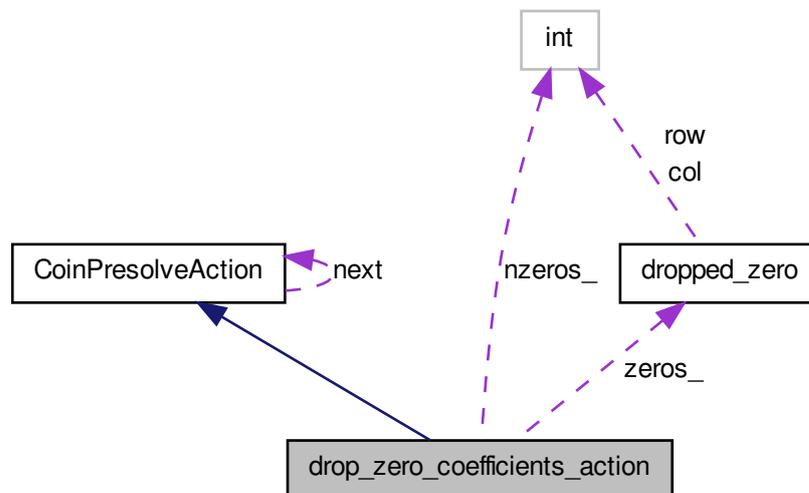
Removal of explicit zeros.

```
#include <CoinPresolveZeros.hpp>
```

Inheritance diagram for drop\_zero\_coefficients\_action:



Collaboration diagram for drop\_zero\_coefficients\_action:



#### Public Member Functions

- const char \* [name](#) () const  
*A name for debug printing.*

- void `postsolve` (`CoinPostsolveMatrix` \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.100.1 Detailed Description

Removal of explicit zeros.

The presolve action for this class removes explicit zeros from the constraint matrix. The postsolve action puts them back.

Definition at line 32 of file `CoinPresolveZeros.hpp`.

#### 8.100.2 Member Function Documentation

8.100.2.1 `const char* drop_zero_coefficients_action::name ( ) const` [`inline`, `virtual`]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements `CoinPresolveAction`.

Definition at line 45 of file `CoinPresolveZeros.hpp`.

The documentation for this class was generated from the following file:

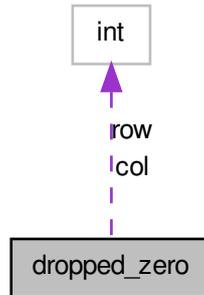
- `CoinPresolveZeros.hpp`

#### 8.101 `dropped_zero` Struct Reference

Tracking information for an explicit zero coefficient.

```
#include <CoinPresolveZeros.hpp>
```

Collaboration diagram for dropped\_zero:



#### 8.101.1 Detailed Description

Tracking information for an explicit zero coefficient.

Definition at line 22 of file `CoinPresolveZeros.hpp`.

The documentation for this struct was generated from the following file:

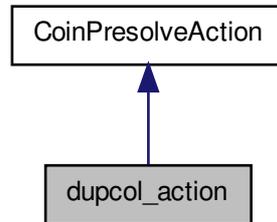
- [CoinPresolveZeros.hpp](#)

#### 8.102 dupcol\_action Class Reference

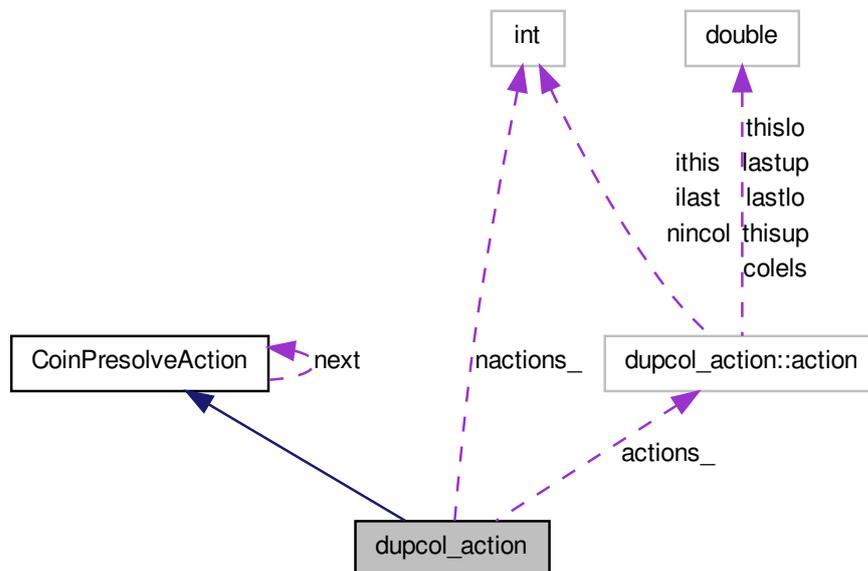
Detect and remove duplicate columns.

```
#include <CoinPresolveDupcol.hpp>
```

Inheritance diagram for dupcol\_action:



Collaboration diagram for dupcol\_action:



#### Classes

- struct **action**

### Public Member Functions

- `const char * name () const`  
*A name for debug printing.*
- `void postsolve (CoinPostsolveMatrix *prob) const`  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.102.1 Detailed Description

Detect and remove duplicate columns.

The general technique is to sum the coefficients  $a_{(*,j)}$  of each column. Columns with identical sums are duplicates. The obvious problem is that, *e.g.*,  $[1\ 0\ 1\ 0]$  and  $[0\ 1\ 0\ 1]$  both add to 2. To minimize the chances of false positives, the coefficients of each row are multiplied by a random number  $r_i$ , so that we sum  $r_i * a_{ij}$ .

Candidate columns are checked to confirm they are identical. Where the columns have the same objective coefficient, the two are combined. If the columns have different objective coefficients, complications ensue. In order to remove the duplicate, it must be possible to fix the variable at a bound.

Definition at line 32 of file `CoinPresolveDupcol.hpp`.

#### 8.102.2 Member Function Documentation

##### 8.102.2.1 `const char* dupcol_action::name ( ) const` [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

The documentation for this class was generated from the following file:

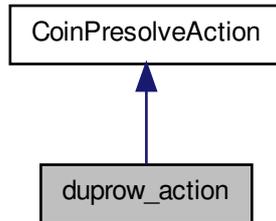
- [CoinPresolveDupcol.hpp](#)

### 8.103 duprow\_action Class Reference

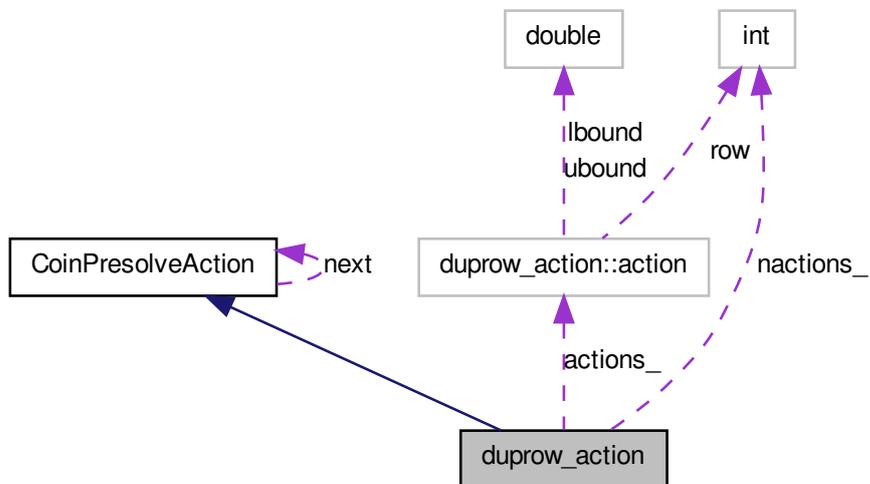
Detect and remove duplicate rows.

```
#include <CoinPresolveDupcol.hpp>
```

Inheritance diagram for duprow\_action:



Collaboration diagram for duprow\_action:



#### Classes

- struct **action**

### Public Member Functions

- `const char * name () const`  
*A name for debug printing.*
- `void postsolve (CoinPostsolveMatrix *prob) const`  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.103.1 Detailed Description

Detect and remove duplicate rows.

The algorithm to detect duplicate rows is as outlined for [dupcol\\_action](#).

If the feasible interval for one constraint is strictly contained in the other, the tighter (contained) constraint is kept. If the feasible intervals are disjoint, the problem is infeasible. If the feasible intervals overlap, both constraints are kept.

[duprow\\_action](#) is definitely a work in progress; [postsolve](#) is unimplemented. This doesn't matter as it uses `useless_constraint`.

Definition at line 87 of file `CoinPresolveDupcol.hpp`.

#### 8.103.2 Member Function Documentation

##### 8.103.2.1 `const char* duprow_action::name ( ) const` [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

The documentation for this class was generated from the following file:

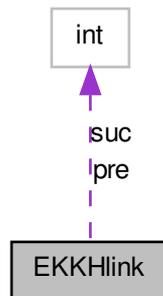
- [CoinPresolveDupcol.hpp](#)

## 8.104 EKKHlink Struct Reference

This deals with Factorization and Updates This is ripped off from OSL!!!!!!!!!!

```
#include <CoinOslFactorization.hpp>
```

Collaboration diagram for EKKHlink:



#### 8.104.1 Detailed Description

This deals with Factorization and Updates This is ripped off from OSL!!!!!!!!!!

I am assuming that 32 bits is enough for number of rows or columns, but CoinBigIndex may be redefined to get 64 bits.

Definition at line 28 of file CoinOslFactorization.hpp.

The documentation for this struct was generated from the following file:

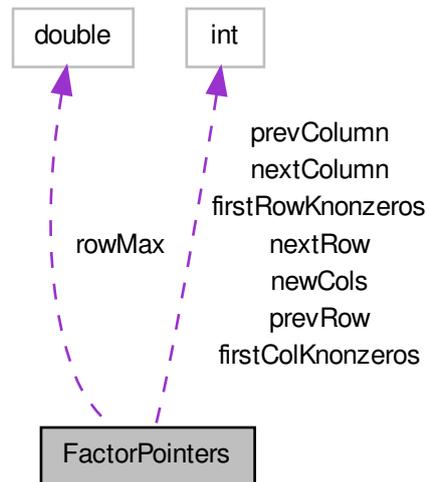
- CoinOslFactorization.hpp

#### 8.105 FactorPointers Class Reference

pointers used during factorization

```
#include <CoinSimpFactorization.hpp>
```

Collaboration diagram for FactorPointers:



#### 8.105.1 Detailed Description

pointers used during factorization

Definition at line 22 of file `CoinSimpFactorization.hpp`.

The documentation for this class was generated from the following file:

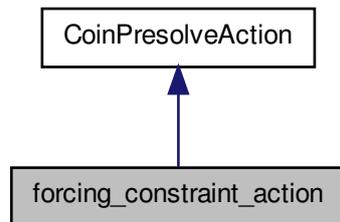
- `CoinSimpFactorization.hpp`

#### 8.106 forcing\_constraint\_action Class Reference

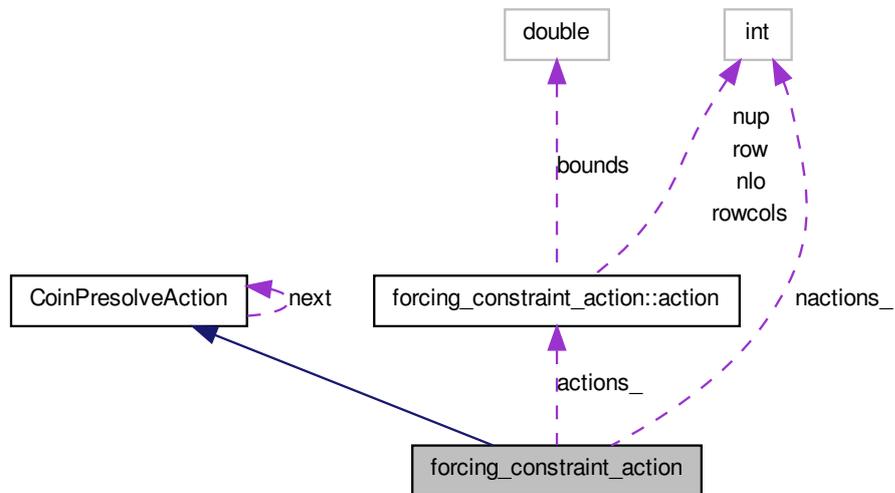
Detect and process forcing constraints and useless constraints.

```
#include <CoinPresolveForcing.hpp>
```

Inheritance diagram for forcing\_constraint\_action:



Collaboration diagram for forcing\_constraint\_action:



#### Classes

- struct [action](#)

### Public Member Functions

- `const char * name () const`  
*A name for debug printing.*
- `void postsolve (CoinPostsolveMatrix *prob) const`  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.106.1 Detailed Description

Detect and process forcing constraints and useless constraints.

A constraint is useless if the bounds on the variables prevent the constraint from ever being violated.

A constraint is a forcing constraint if the bounds on the constraint force the value of an involved variable to one of its bounds. A constraint can force more than one variable.

Definition at line 27 of file `CoinPresolveForcing.hpp`.

#### 8.106.2 Member Function Documentation

##### 8.106.2.1 `const char* forcing_constraint_action::name ( ) const` [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements `CoinPresolveAction`.

The documentation for this class was generated from the following file:

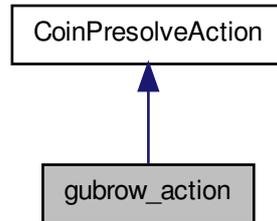
- `CoinPresolveForcing.hpp`

### 8.107 gubrow\_action Class Reference

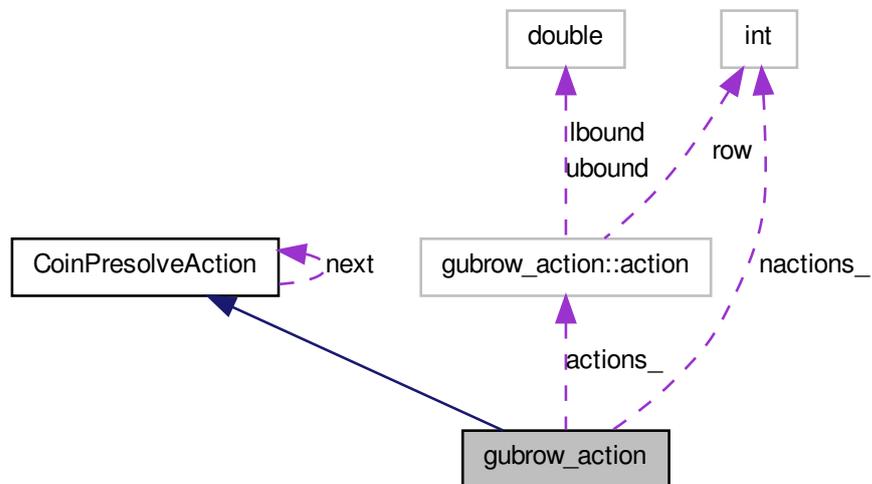
Detect and remove entries whose sum is known.

```
#include <CoinPresolveDupcol.hpp>
```

Inheritance diagram for gubrow\_action:



Collaboration diagram for gubrow\_action:



#### Classes

- struct **action**

### Public Member Functions

- `const char * name () const`  
*A name for debug printing.*
- `void postsolve (CoinPostsolveMatrix *prob) const`  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.107.1 Detailed Description

Detect and remove entries whose sum is known.

If we have an equality row where all entries same then For other rows where all entries for that equality row are same then we can delete entries and modify rhs `gubrow_action` is definitely a work in progress; `postsolve` is unimplemented.

Definition at line 125 of file `CoinPresolveDupcol.hpp`.

#### 8.107.2 Member Function Documentation

##### 8.107.2.1 `const char* gubrow_action::name ( ) const` [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements `CoinPresolveAction`.

The documentation for this class was generated from the following file:

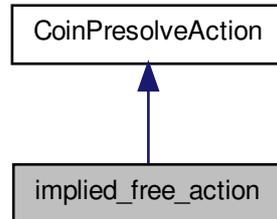
- `CoinPresolveDupcol.hpp`

### 8.108 implied\_free\_action Class Reference

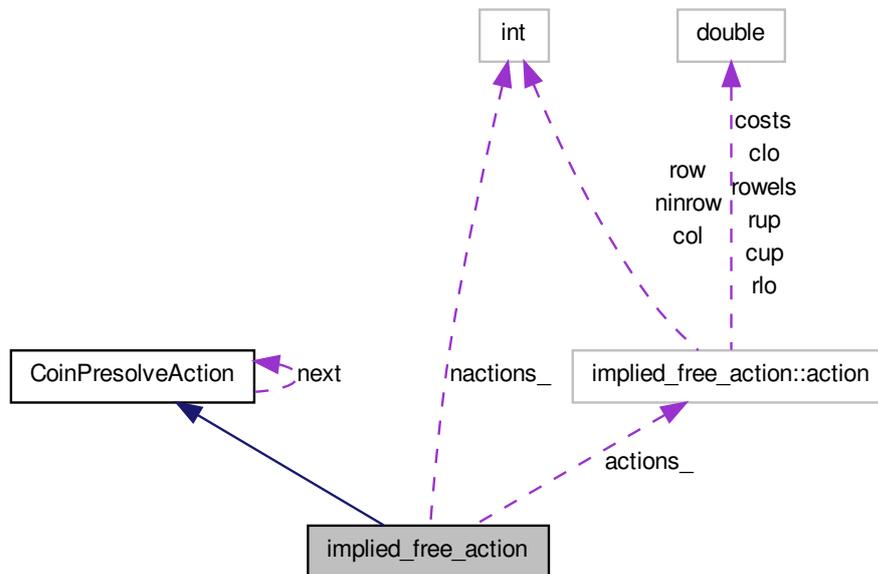
Detect and process implied free variables.

```
#include <CoinPresolveImpliedFree.hpp>
```

Inheritance diagram for implied\_free\_action:



Collaboration diagram for implied\_free\_action:



#### Classes

- struct **action**

### Public Member Functions

- `const char * name () const`  
*A name for debug printing.*
- `void postsolve (CoinPostsolveMatrix *prob) const`  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.108.1 Detailed Description

Detect and process implied free variables.

Consider a singleton variable  $x$  (*i.e.*, a variable involved in only one constraint). Suppose that the bounds on that constraint, combined with the bounds on the other variables involved in the constraint, are such that even the worst case values of the other variables still imply bounds for  $x$  which are tighter than the variable's original bounds. Since  $x$  can never reach its upper or lower bounds, it is an implied free variable. Both  $x$  and the constraint can be deleted from the problem.

The transform also handles more complicated variations, where  $x$  is not a singleton.

Definition at line 29 of file `CoinPresolveImpliedFree.hpp`.

#### 8.108.2 Member Function Documentation

##### 8.108.2.1 `const char* implied_free_action::name ( ) const` [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

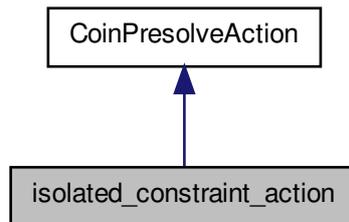
Implements [CoinPresolveAction](#).

The documentation for this class was generated from the following file:

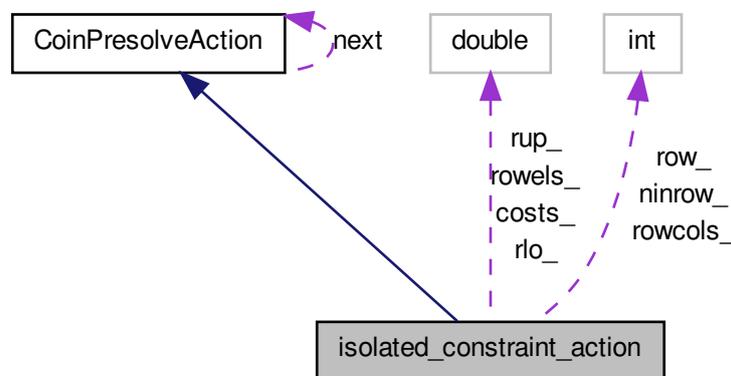
- [CoinPresolveImpliedFree.hpp](#)

## 8.109 isolated\_constraint\_action Class Reference

Inheritance diagram for isolated\_constraint\_action:



Collaboration diagram for isolated\_constraint\_action:



## Public Member Functions

- const char \* [name](#) () const  
*A name for debug printing.*
- void [postsolve](#) (CoinPostsolveMatrix \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

### 8.109.1 Detailed Description

Definition at line 11 of file `CoinPresolveIsolated.hpp`.

### 8.109.2 Member Function Documentation

#### 8.109.2.1 `const char* isolated_constraint_action::name ( ) const` [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

The documentation for this class was generated from the following file:

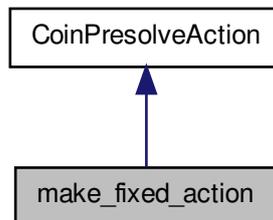
- `CoinPresolveIsolated.hpp`

## 8.110 `make_fixed_action` Class Reference

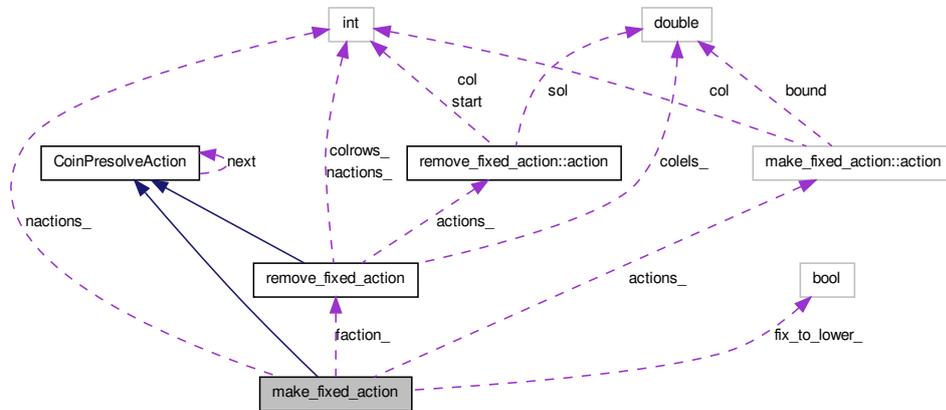
Fix a variable at a specified bound.

```
#include <CoinPresolveFixed.hpp>
```

Inheritance diagram for `make_fixed_action`:



Collaboration diagram for make\_fixed\_action:



## Classes

- struct **action**

*Structure to preserve the bound overwritten when fixing a variable.*

## Public Member Functions

- const char \* [name](#) () const  
*Returns string "make\_fixed\_action".*
- void [postsolve](#) (CoinPostsolveMatrix \*prob) const  
*Postsolve (unfix variables)*
- ~[make\\_fixed\\_action](#) ()  
*Destructor.*

## Static Public Member Functions

- static const [CoinPresolveAction](#) \* [presolve](#) (CoinPresolveMatrix \*prob, int \*fcols, int nfcols, bool fix\_to\_lower, const [CoinPresolveAction](#) \*next)  
*Perform actions to fix variables and return postsolve object.*

## Related Functions

(Note that these are not member functions.)

- `const CoinPresolveAction * make_fixed (CoinPresolveMatrix *prob, const CoinPresolveAction *next)`

*Scan variables and fix any with equal bounds.*

### 8.110.1 Detailed Description

Fix a variable at a specified bound.

Implements the action of fixing a variable by forcing both bounds to the same value and forcing the value of the variable to match.

If the bounds are already equal, and the value of the variable is already correct, consider [remove\\_fixed\\_action](#).

Definition at line 95 of file `CoinPresolveFixed.hpp`.

### 8.110.2 Member Function Documentation

- 8.110.2.1 `static const CoinPresolveAction* make_fixed_action::presolve (CoinPresolveMatrix * prob, int * fcols, int nfcols, bool fix_to_lower, const CoinPresolveAction * next ) [static]`

Perform actions to fix variables and return postsolve object.

For each specified variable (`nfcols`, `fcols`), fix the variable to the specified bound (`fix_to_lower`) by setting the variable's bounds to be equal in `prob`. Create a postsolve object, link it at the head of the list of postsolve objects (`next`), and return the object.

- 8.110.2.2 `void make_fixed_action::postsolve ( CoinPostsolveMatrix * prob ) const [virtual]`

Postsolve (unfix variables)

Back out the variables fixed by the presolve side of this object.

Implements [CoinPresolveAction](#).

### 8.110.3 Friends And Related Function Documentation

- 8.110.3.1 `const CoinPresolveAction * make_fixed ( CoinPresolveMatrix * prob, const CoinPresolveAction * next ) [related]`

Scan variables and fix any with equal bounds.

A front end to collect a list of columns with equal bounds and hand them to [make\\_fixed\\_action::presolve\(\)](#) for processing.

The documentation for this class was generated from the following file:

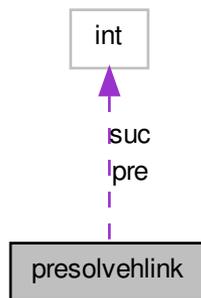
- `CoinPresolveFixed.hpp`

## 8.111 presolvehlink Class Reference

Links to aid in packed matrix modification.

```
#include <CoinPresolveMatrix.hpp>
```

Collaboration diagram for presolvehlink:



### Related Functions

(Note that these are not member functions.)

- void [PRESOLVE\\_REMOVE\\_LINK](#) ([presolvehlink](#) \*link, int i)  
*unlink vector i*
- void [PRESOLVE\\_INSERT\\_LINK](#) ([presolvehlink](#) \*link, int i, int j)  
*insert vector i after vector j*
- void [PRESOLVE\\_MOVE\\_LINK](#) ([presolvehlink](#) \*link, int i, int j)  
*relink vector j in place of vector i*

### 8.111.1 Detailed Description

Links to aid in packed matrix modification.

Currently, the matrices held by the [CoinPrePostsolveMatrix](#) and [CoinPresolveMatrix](#) objects are represented in the same way as a [CoinPackedMatrix](#). In the course of presolve and postsolve transforms, it will happen that a major-dimension vector needs to increase in size. In order to check whether there is enough room to add another coefficient in place, it helps to know the next vector (in memory order) in the bulk storage area. To do that, a linked list of major-dimension vectors is maintained; the "pre" and "suc" fields give the previous and next vector, in memory order (that is, the vector whose mcstrt\_ or mrstrt\_entry is next smaller or larger).

Consider a column-major matrix with `ncols` columns. By definition, `presolvehlink[ncols].pre` points to the column in the last occupied position of the bulk storage arrays. There is no easy way to find the column which occupies the first position (there is no `presolvehlink[-1]` to consult). If the column that initially occupies the first position is moved for expansion, there is no way to reclaim the space until the bulk storage is compacted. The same holds for the last and first rows of a row-major matrix, of course.

Definition at line 700 of file `CoinPresolveMatrix.hpp`.

### 8.111.2 Friends And Related Function Documentation

#### 8.111.2.1 void PRESOLVE\_REMOVE\_LINK ( presolvehlink \* link, int i ) [related]

unlink vector `i`

Remove vector `i` from the ordering.

Definition at line 712 of file `CoinPresolveMatrix.hpp`.

#### 8.111.2.2 void PRESOLVE\_INSERT\_LINK ( presolvehlink \* link, int i, int j ) [related]

insert vector `i` after vector `j`

Insert vector `i` between `j` and `j.suc`.

Definition at line 730 of file `CoinPresolveMatrix.hpp`.

#### 8.111.2.3 void PRESOLVE\_MOVE\_LINK ( presolvehlink \* link, int i, int j ) [related]

relink vector `j` in place of vector `i`

Replace vector `i` in the ordering with vector `j`. This is equivalent to

```
int pre = link[i].pre;
PRESOLVE_REMOVE_LINK(link, i);
PRESOLVE_INSERT_LINK(link, j, pre);
```

But, this routine will work even if `i` happens to be first in the order.

Definition at line 752 of file `CoinPresolveMatrix.hpp`.

The documentation for this class was generated from the following file:

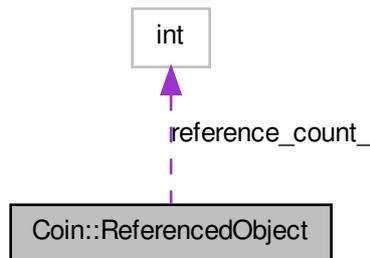
- [CoinPresolveMatrix.hpp](#)

## 8.112 Coin::ReferencedObject Class Reference

[ReferencedObject](#) class.

```
#include <CoinSmartPtr.hpp>
```

Collaboration diagram for Coin::ReferencedObject:



### 8.112.1 Detailed Description

[ReferencedObject](#) class.

This is part of the implementation of an intrusive smart pointer design. This class stores the reference count of all the smart pointers that currently reference it. See the documentation for the [SmartPtr](#) class for more details.

A [SmartPtr](#) behaves much like a raw pointer, but manages the lifetime of an object, deleting the object automatically. This class implements a reference-counting, intrusive smart pointer design, where all objects pointed to must inherit off of [ReferencedObject](#), which stores the reference count. Although this is intrusive (native types and externally authored classes require wrappers to be referenced by smart pointers), it is a safer design. A more detailed discussion of these issues follows after the usage information.

Usage Example: Note: to use the [SmartPtr](#), all objects to which you point MUST inherit off of [ReferencedObject](#).

```

*
* In MyClass.hpp...
*
* #include "CoinSmartPtr.hpp"
*
*
* class MyClass : public Coin::ReferencedObject // must derive from ReferencedObject
* {
*     ...
* }
*
* In my_usage.cpp...
*
* #include "CoinSmartPtr.hpp"
* #include "MyClass.hpp"
*
* void func(AnyObject& obj)
  
```

```

* {
*   Coin::SmartPtr<MyClass> ptr_to_myclass = new MyClass(...);
*   // ptr_to_myclass now points to a new MyClass,
*   // and the reference count is 1
*
*   ...
*
*   obj.SetMyClass(ptr_to_myclass);
*   // Here, let's assume that AnyObject uses a
*   // SmartPtr<MyClass> internally here.
*   // Now, both ptr_to_myclass and the internal
*   // SmartPtr in obj point to the same MyClass object
*   // and its reference count is 2.
*
*   ...
*
*   // No need to delete ptr_to_myclass, this
*   // will be done automatically when the
*   // reference count drops to zero.
*
* }
*
*

```

Other Notes: The [SmartPtr](#) implements both dereference operators `->` & `*`. The [SmartPtr](#) does NOT implement a conversion operator to the raw pointer. Use the `GetRawPtr()` method when this is necessary. Make sure that the raw pointer is NOT deleted. The [SmartPtr](#) implements the comparison operators `==` & `!=` for a variety of types. Use these instead of

```

*   if (GetRawPtr(smrt_ptr) == ptr) // Don't use this
*

```

[SmartPtr](#)'s, as currently implemented, do NOT handle circular references. For example: consider a higher level object using [SmartPtr](#)s to point to A and B, but A and B also point to each other (i.e. A has a [SmartPtr](#) to B and B has a [SmartPtr](#) to A). In this scenario, when the higher level object is finished with A and B, their reference counts will never drop to zero (since they reference each other) and they will not be deleted. This can be detected by memory leak tools like `valgrind`. If the circular reference is necessary, the problem can be overcome by a number of techniques:

1) A and B can have a method that "releases" each other, that is they set their internal [SmartPtr](#)s to NULL.

```

*       void AClass::ReleaseCircularReferences()
*       {
*           smart_ptr_to_B = NULL;
*       }
*

```

Then, the higher level class can call these methods before it is done using A & B.

2) Raw pointers can be used in A and B to reference each other. Here, an implicit assumption is made that the lifetime is controlled by the higher level object and that A and B will both exist in a controlled manner. Although this seems dangerous, in many situations, this type of referencing is very controlled and this is reasonably safe.

3) This [SmartPtr](#) class could be redesigned with the Weak/Strong design concept. Here, the [SmartPtr](#) is identified as being Strong (controls lifetime of the object) or Weak

(merely referencing the object). The Strong [SmartPtr](#) increments (and decrements) the reference count in [ReferencedObject](#) but the Weak [SmartPtr](#) does not. In the example above, the higher level object would have Strong [SmartPtr](#)s to A and B, but A and B would have Weak [SmartPtr](#)s to each other. Then, when the higher level object was done with A and B, they would be deleted. The Weak [SmartPtr](#)s in A and B would not decrement the reference count and would, of course, not delete the object. This idea is very similar to item (2), where it is implied that the sequence of events is controlled such that A and B will not call anything using their pointers following the higher level delete (i.e. in their destructors!). This is somehow safer, however, because code can be written (however expensive) to perform run-time detection of this situation. For example, the [ReferencedObject](#) could store pointers to all Weak [SmartPtr](#)s that are referencing it and, in its destructor, tell these pointers that it is dying. They could then set themselves to NULL, or set an internal flag to detect usage past this point.

Comments on Non-Intrusive Design: In a non-intrusive design, the reference count is stored somewhere other than the object being referenced. This means, unless the reference counting pointer is the first referencer, it must get a pointer to the referenced object from another smart pointer (so it has access to the reference count location). In this non-intrusive design, if we are pointing to an object with a smart pointer (or a number of smart pointers), and we then give another smart pointer the address through a RAW pointer, we will have two independent, AND INCORRECT, reference counts. To avoid this pitfall, we use an intrusive reference counting technique where the reference count is stored in the object being referenced.

Definition at line 156 of file `CoinSmartPtr.hpp`.

The documentation for this class was generated from the following file:

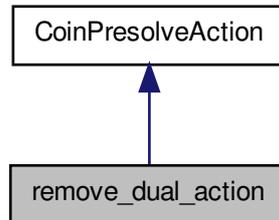
- `CoinSmartPtr.hpp`

### 8.113 remove\_dual\_action Class Reference

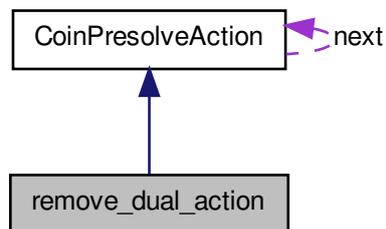
Attempt to fix variables by bounding reduced costs.

```
#include <CoinPresolveDual.hpp>
```

Inheritance diagram for remove\_dual\_action:



Collaboration diagram for remove\_dual\_action:



#### Static Public Member Functions

- static const `CoinPresolveAction` \* `presolve` (`CoinPresolveMatrix` \*`prob`, const `CoinPresolveAction` \*`next`)

*Attempt to fix variables by bounding reduced costs.*

#### 8.113.1 Detailed Description

Attempt to fix variables by bounding reduced costs.

The reduced cost of  $x_j$  is  $d_j = c_j - y \cdot a_j$  (1). Assume minimization, so that at optimality  $d_j \geq 0$  for  $x_j$  nonbasic at lower bound, and  $d_j \leq 0$  for  $x_j$  nonbasic at upper bound.

For a slack variable  $s_i$ ,  $c_{(n+i)} = 0$  and  $a_{(n+i)}$  is a unit vector, hence  $d_{(n+i)} = -y_i$ . If  $s_i$  has a finite lower bound and no upper bound, we must have  $y_i \leq 0$  at optimality. Similarly, if  $s_i$  has no lower bound and a finite upper bound, we must have  $y_i \geq 0$ .

For a singleton variable  $x_j$ ,  $d_j = c_j - y_i a_{ij}$ . Given  $x_j$  with a single finite bound, we can bound  $d_j$  greater or less than 0 at optimality, and that allows us to calculate an upper or lower bound on  $y_i$  (depending on the bound on  $d_j$  and the sign of  $a_{ij}$ ).

Now we have bounds on some subset of the  $y_i$ , and we can use these to calculate upper and lower bounds on the  $d_j$ , using bound propagation on (1). If we can manage to bound some  $d_j$  as strictly positive or strictly negative, then at optimality the corresponding variable must be nonbasic at its lower or upper bound, respectively. If the required bound is lacking, the problem is unbounded.

There is no postsolve object specific to `remove_dual_action`, but execution will queue postsolve actions for any variables that are fixed.

Definition at line 38 of file `CoinPresolveDual.hpp`.

### 8.113.2 Member Function Documentation

8.113.2.1 `static const CoinPresolveAction* remove_dual_action::presolve ( CoinPresolveMatrix * prob, const CoinPresolveAction * next )`  
[static]

Attempt to fix variables by bounding reduced costs.

Always scans all variables. Propagates bounds on reduced costs until there's no change or until some set of variables can be fixed.

The documentation for this class was generated from the following file:

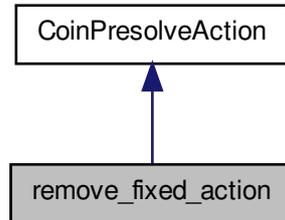
- `CoinPresolveDual.hpp`

### 8.114 `remove_fixed_action` Class Reference

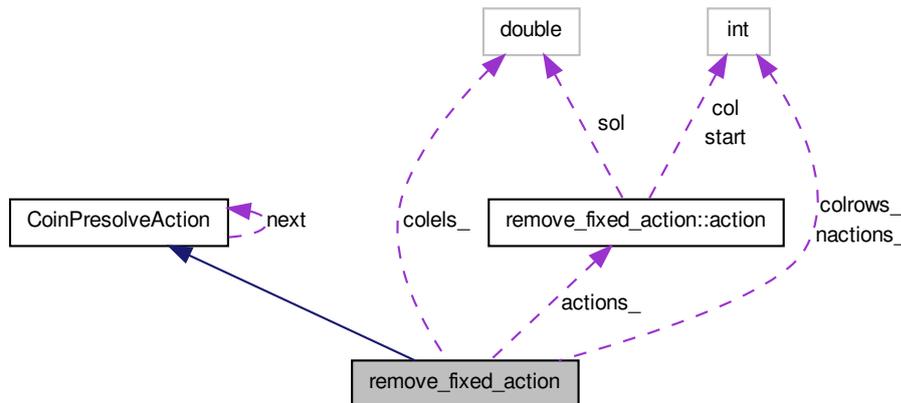
Excise fixed variables from the model.

```
#include <CoinPresolveFixed.hpp>
```

Inheritance diagram for remove\_fixed\_action:



Collaboration diagram for remove\_fixed\_action:



#### Classes

- struct `action`

*Structure to hold information necessary to reintroduce a column into the problem representation.*

#### Public Member Functions

- `const char * name () const`

Returns string "remove\_fixed\_action".

- void `postsolve` (`CoinPostsolveMatrix` \*prob) const  
Apply the postsolve transformation for this particular presolve action.
- `~remove_fixed_action` ()  
Destructor.

#### Static Public Member Functions

- static const `remove_fixed_action` \* `presolve` (`CoinPresolveMatrix` \*prob, int \*fcols, int nfcols, const `CoinPresolveAction` \*next)  
Excise the specified columns.

#### Public Attributes

- int \* `colrows_`  
Array of row indices for coefficients of excised columns.
- double \* `colels_`  
Array of coefficients of excised columns.
- int `nactions_`  
Number of entries in `actions_`.
- `action` \* `actions_`  
Vector specifying variable(s) affected by this object.

#### Related Functions

(Note that these are not member functions.)

- const `CoinPresolveAction` \* `remove_fixed` (`CoinPresolveMatrix` \*prob, const `CoinPresolveAction` \*next)  
Scan the problem for fixed columns and remove them.

##### 8.114.1 Detailed Description

Excise fixed variables from the model.

Implements the action of removing one or more fixed variables  $x_j$  from the model by substituting the value  $sol_j$  in each constraint. Specifically, for each constraint  $i$  where  $a_{ij} \neq 0$ ,  $rlo_i$  and  $rup_i$  are adjusted by  $-a_{ij} * sol_j$  and  $a_{ij}$  is set to 0.

There is an implicit assumption that the variable already has the correct value. If this isn't true, corrections to row activity may be incorrect. If you want to guard against this possibility, consider `make_fixed_action`.

Actual removal of the column from the matrix is handled by `drop_empty_cols_action`. Correction of the objective function is done there.

Definition at line 25 of file `CoinPresolveFixed.hpp`.

## 8.114.2 Member Function Documentation

8.114.2.1 `static const remove_fixed_action* remove_fixed_action::presolve ( CoinPresolveMatrix * prob, int * fcols, int nfcols, const CoinPresolveAction * next ) [static]`

Excise the specified columns.

Remove the specified columns (`nfcols`, `fcols`) from the problem representation (`prob`), leaving the appropriate postsolve object linked as the head of the list of postsolve objects (currently headed by `next`).

## 8.114.3 Friends And Related Function Documentation

8.114.3.1 `const CoinPresolveAction * remove_fixed ( CoinPresolveMatrix * prob, const CoinPresolveAction * next ) [related]`

Scan the problem for fixed columns and remove them.

A front end to collect a list of columns with equal bounds and hand them to `remove_fixed_action::presolve()` for processing.

The documentation for this class was generated from the following file:

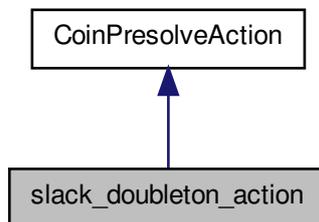
- `CoinPresolveFixed.hpp`

8.115 `slack_doubleton_action` Class Reference

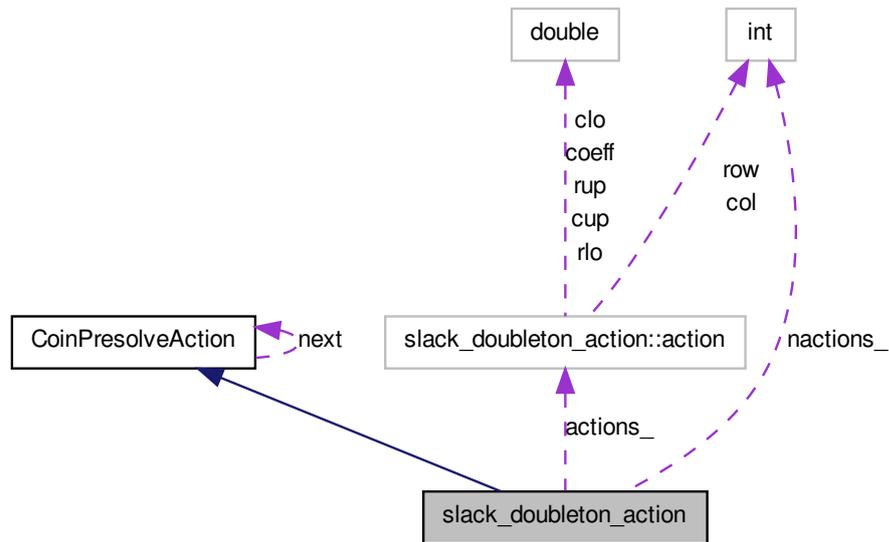
Convert an explicit bound constraint to a column bound.

```
#include <CoinPresolveSingleton.hpp>
```

Inheritance diagram for `slack_doubleton_action`:



Collaboration diagram for slack\_doubleton\_action:



#### Classes

- struct **action**

#### Public Member Functions

- const char \* [name](#) () const  
*A name for debug printing.*
- void [postsolve](#) (CoinPostsolveMatrix \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

#### Static Public Member Functions

- static const [CoinPresolveAction](#) \* [presolve](#) (CoinPresolveMatrix \*prob, const [CoinPresolveAction](#) \*next, bool &notFinished)  
*Convert explicit bound constraints to column bounds.*

### 8.115.1 Detailed Description

Convert an explicit bound constraint to a column bound.

This transform looks for explicit bound constraints for a variable and transfers the bound to the appropriate column bound array. The constraint is removed from the constraint system.

Definition at line 24 of file `CoinPresolveSingleton.hpp`.

### 8.115.2 Member Function Documentation

#### 8.115.2.1 `const char* slack_doubleton_action::name ( ) const` [`inline`, `virtual`]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

Definition at line 50 of file `CoinPresolveSingleton.hpp`.

#### 8.115.2.2 `static const CoinPresolveAction* slack_doubleton_action::presolve ( CoinPresolveMatrix * prob, const CoinPresolveAction * next, bool & notFinished )` [`static`]

Convert explicit bound constraints to column bounds.

Not now There is a hard limit (`#MAX_SLACK_DOUBLETONS`) on the number of constraints processed in a given call. `notFinished` is set to true if candidates remain.

The documentation for this class was generated from the following file:

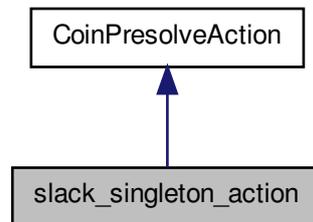
- [CoinPresolveSingleton.hpp](#)

## 8.116 `slack_singleton_action` Class Reference

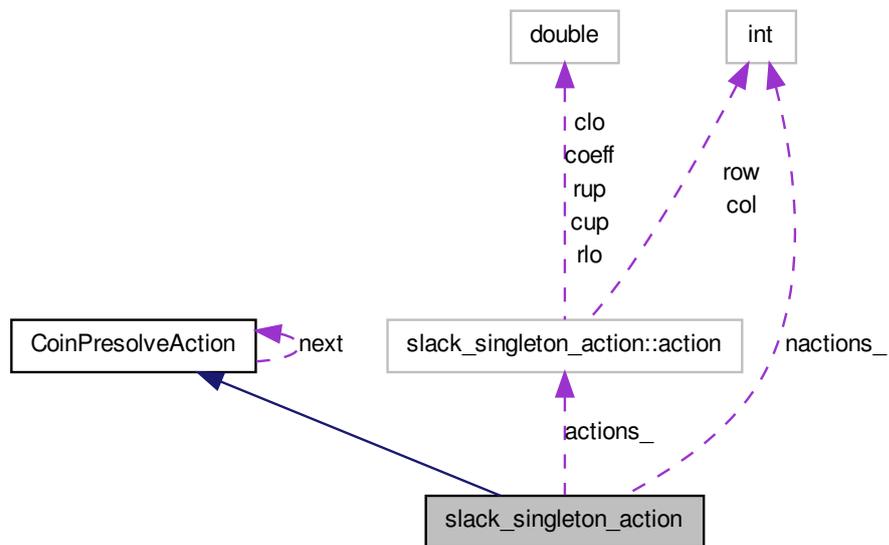
For variables with one entry.

```
#include <CoinPresolveSingleton.hpp>
```

Inheritance diagram for slack\_singleton\_action:



Collaboration diagram for slack\_singleton\_action:



#### Classes

- struct `action`

### Public Member Functions

- `const char * name () const`  
*A name for debug printing.*
- `void postsolve (CoinPostsolveMatrix *prob) const`  
*Apply the postsolve transformation for this particular presolve action.*

#### 8.116.1 Detailed Description

For variables with one entry.

If we have a variable with one entry and no cost then we can transform the row from E to G etc. If there is a row objective region then we may be able to do this even with a cost.

Definition at line 75 of file `CoinPresolveSingleton.hpp`.

#### 8.116.2 Member Function Documentation

##### 8.116.2.1 `const char* slack_singleton_action::name ( ) const` `[inline, virtual]`

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements `CoinPresolveAction`.

Definition at line 101 of file `CoinPresolveSingleton.hpp`.

The documentation for this class was generated from the following file:

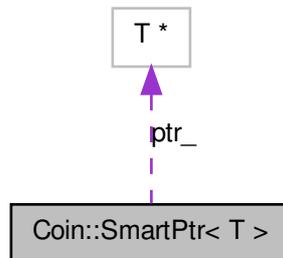
- `CoinPresolveSingleton.hpp`

### 8.117 `Coin::SmartPtr< T >` Class Template Reference

Template class for Smart Pointers.

```
#include <CoinSmartPtr.hpp>
```

Collaboration diagram for Coin::SmartPtr< T >:



#### Public Member Functions

- `T *` `GetRawPtr ()` const  
*Returns the raw pointer contained.*
- `bool` `IsValid ()` const  
*Returns true if the `SmartPtr` is NOT NULL.*
- `bool` `IsNull ()` const  
*Returns true if the `SmartPtr` is NULL.*

#### Constructors/Destructors

- `SmartPtr ()`  
*Default constructor, initialized to NULL.*
- `SmartPtr (const SmartPtr< T > &copy)`  
*Copy constructor, initialized from copy.*
- `SmartPtr (T *ptr)`  
*Constructor, initialized from `T* ptr`.*
- `~SmartPtr ()`  
*Destructor, automatically decrements the reference count, deletes the object if necessary.*

#### Overloaded operators.

- `T *` `operator-> ()` const  
*Overloaded arrow operator, allows the user to call methods using the contained pointer.*
- `T &` `operator* ()` const  
*Overloaded dereference operator, allows the user to dereference the contained pointer.*
- `SmartPtr< T > &` `operator= (T *rhs)`

Overloaded equals operator, allows the user to set the value of the [SmartPtr](#) from a raw pointer.

- `SmartPtr< T > & operator= (const SmartPtr< T > &rhs)`

Overloaded equals operator, allows the user to set the value of the [SmartPtr](#) from another [SmartPtr](#).

- `template<class U1 , class U2 >`

`bool operator== (const SmartPtr< U1 > &lhs, const SmartPtr< U2 > &rhs)`

Overloaded equality comparison operator, allows the user to compare the value of two [SmartPtrs](#).

- `template<class U1 , class U2 >`

`bool operator== (const SmartPtr< U1 > &lhs, U2 *raw_rhs)`

Overloaded equality comparison operator, allows the user to compare the value of a [SmartPtr](#) with a raw pointer.

- `template<class U1 , class U2 >`

`bool operator== (U1 *lhs, const SmartPtr< U2 > &raw_rhs)`

Overloaded equality comparison operator, allows the user to compare the value of a raw pointer with a [SmartPtr](#).

- `template<class U1 , class U2 >`

`bool operator!= (const SmartPtr< U1 > &lhs, const SmartPtr< U2 > &rhs)`

Overloaded in-equality comparison operator, allows the user to compare the value of two [SmartPtrs](#).

- `template<class U1 , class U2 >`

`bool operator!= (const SmartPtr< U1 > &lhs, U2 *raw_rhs)`

Overloaded in-equality comparison operator, allows the user to compare the value of a [SmartPtr](#) with a raw pointer.

- `template<class U1 , class U2 >`

`bool operator!= (U1 *lhs, const SmartPtr< U2 > &raw_rhs)`

Overloaded in-equality comparison operator, allows the user to compare the value of a [SmartPtr](#) with a raw pointer.

### 8.117.1 Detailed Description

```
template<class T>class Coin::SmartPtr< T >
```

Template class for Smart Pointers.

A [SmartPtr](#) behaves much like a raw pointer, but manages the lifetime of an object, deleting the object automatically. This class implements a reference-counting, intrusive smart pointer design, where all objects pointed to must inherit off of [ReferencedObject](#), which stores the reference count. Although this is intrusive (native types and externally authored classes require wrappers to be referenced by smart pointers), it is a safer design. A more detailed discussion of these issues follows after the usage information.

Usage Example: Note: to use the [SmartPtr](#), all objects to which you point MUST inherit off of [ReferencedObject](#).

```
*
* In MyClass.hpp...
*
```

```

* #include "CoinSmartPtr.hpp"
*
* class MyClass : public Coin::ReferencedObject // must derive from ReferencedObject
* {
*     ...
* }
*
* In my_usage.cpp...
*
* #include "CoinSmartPtr.hpp"
* #include "MyClass.hpp"
*
* void func(AnyObject& obj)
* {
*     SmartPtr<MyClass> ptr_to_myclass = new MyClass(...);
*     // ptr_to_myclass now points to a new MyClass,
*     // and the reference count is 1
*
*     ...
*
*     obj.SetMyClass(ptr_to_myclass);
*     // Here, let's assume that AnyObject uses a
*     // SmartPtr<MyClass> internally here.
*     // Now, both ptr_to_myclass and the internal
*     // SmartPtr in obj point to the same MyClass object
*     // and its reference count is 2.
*
*     ...
*
*     // No need to delete ptr_to_myclass, this
*     // will be done automatically when the
*     // reference count drops to zero.
* }
*
*
*

```

It is not necessary to use SmartPtr's in all cases where an object is used that has been allocated "into" a [SmartPtr](#). It is possible to just pass objects by reference or regular pointers, even if lower down in the stack a [SmartPtr](#) is to be held on to. Everything should work fine as long as a pointer created by "new" is immediately passed into a [SmartPtr](#), and if SmartPtr's are used to hold on to objects.

Other Notes: The [SmartPtr](#) implements both dereference operators -> & \*. The [SmartPtr](#) does NOT implement a conversion operator to the raw pointer. Use the [GetRawPtr\(\)](#) method when this is necessary. Make sure that the raw pointer is NOT deleted. The [SmartPtr](#) implements the comparison operators == & != for a variety of types. Use these instead of

```

*     if (GetRawPtr(smrt_ptr) == ptr) // Don't use this
*

```

SmartPtr's, as currently implemented, do NOT handle circular references. For example: consider a higher level object using SmartPtrs to point to A and B, but A and B also point to each other (i.e. A has a [SmartPtr](#) to B and B has a [SmartPtr](#) to A). In this scenario, when the higher level object is finished with A and B, their reference counts will never drop to zero (since they reference each other) and they will not be deleted. This can be detected by memory leak tools like valgrind. If the circular reference is necessary, the problem can be overcome by a number of techniques:

1) A and B can have a method that "releases" each other, that is they set their internal SmartPtrs to NULL.

```
*         void AClass::ReleaseCircularReferences ()
*         {
*             smart_ptr_to_B = NULL;
*         }
*
```

Then, the higher level class can call these methods before it is done using A & B.

2) Raw pointers can be used in A and B to reference each other. Here, an implicit assumption is made that the lifetime is controlled by the higher level object and that A and B will both exist in a controlled manner. Although this seems dangerous, in many situations, this type of referencing is very controlled and this is reasonably safe.

3) This [SmartPtr](#) class could be redesigned with the Weak/Strong design concept. Here, the [SmartPtr](#) is identified as being Strong (controls lifetime of the object) or Weak (merely referencing the object). The Strong [SmartPtr](#) increments (and decrements) the reference count in [ReferencedObject](#) but the Weak [SmartPtr](#) does not. In the example above, the higher level object would have Strong SmartPtrs to A and B, but A and B would have Weak SmartPtrs to each other. Then, when the higher level object was done with A and B, they would be deleted. The Weak SmartPtrs in A and B would not decrement the reference count and would, of course, not delete the object. This idea is very similar to item (2), where it is implied that the sequence of events is controlled such that A and B will not call anything using their pointers following the higher level delete (i.e. in their destructors!). This is somehow safer, however, because code can be written (however expensive) to perform run-time detection of this situation. For example, the [ReferencedObject](#) could store pointers to all Weak SmartPtrs that are referencing it and, in its destructor, tell these pointers that it is dying. They could then set themselves to NULL, or set an internal flag to detect usage past this point.

Comments on Non-Intrusive Design: In a non-intrusive design, the reference count is stored somewhere other than the object being referenced. This means, unless the reference counting pointer is the first referencer, it must get a pointer to the referenced object from another smart pointer (so it has access to the reference count location). In this non-intrusive design, if we are pointing to an object with a smart pointer (or a number of smart pointers), and we then give another smart pointer the address through a RAW pointer, we will have two independent, AND INCORRECT, reference counts. To avoid this pitfall, we use an intrusive reference counting technique where the reference count is stored in the object being referenced.

Definition at line 318 of file CoinSmartPtr.hpp.

## 8.117.2 Constructor & Destructor Documentation

### 8.117.2.1 `template<class T> Coin::SmartPtr< T >::~~SmartPtr ( ) [inline]`

Destructor, automatically decrements the reference count, deletes the object if necessary.

Definition at line 397 of file CoinSmartPtr.hpp.

### 8.117.3 Member Function Documentation

8.117.3.1 `template<class T> T* Coin::SmartPtr< T >::GetRawPtr ( ) const`  
[inline]

Returns the raw pointer contained.

Use to get the value of the raw ptr (i.e. to pass to other methods/functions, etc.) Note: This method does NOT copy, therefore, modifications using this value modify the underlying object contained by the [SmartPtr](#), NEVER delete this returned value.

Definition at line 326 of file CoinSmartPtr.hpp.

8.117.3.2 `template<class T> bool Coin::SmartPtr< T >::IsValid ( ) const` [inline]

Returns true if the [SmartPtr](#) is NOT NULL.

Use this to check if the [SmartPtr](#) is not null This is preferred to `if(GetRawPtr(sp) != NULL)`

Definition at line 332 of file CoinSmartPtr.hpp.

8.117.3.3 `template<class T> bool Coin::SmartPtr< T >::IsNull ( ) const` [inline]

Returns true if the [SmartPtr](#) is NULL.

Use this to check if the [SmartPtr](#) IsNull. This is preferred to `if(GetRawPtr(sp) == NULL)`

Definition at line 338 of file CoinSmartPtr.hpp.

8.117.3.4 `template<class T> T* Coin::SmartPtr< T >::operator-> ( ) const`  
[inline]

Overloaded arrow operator, allows the user to call methods using the contained pointer.

Definition at line 406 of file CoinSmartPtr.hpp.

8.117.3.5 `template<class T> T& Coin::SmartPtr< T >::operator*( ) const` [inline]

Overloaded dereference operator, allows the user to dereference the contained pointer.

Definition at line 415 of file CoinSmartPtr.hpp.

### 8.117.4 Friends And Related Function Documentation

8.117.4.1 `template<class T> template<class U1 , class U2 > bool operator==( const`  
`SmartPtr< U1 > & lhs, U2 * raw_rhs )` [friend]

Overloaded equality comparison operator, allows the user to compare the value of a [SmartPtr](#) with a raw pointer.

Definition at line 498 of file CoinSmartPtr.hpp.

8.117.4.2 `template<class T> template<class U1 , class U2 > bool operator==( U1 * lhs, const SmartPtr< U2 > & raw_rhs ) [friend]`

Overloaded equality comparison operator, allows the user to compare the value of a raw pointer with a [SmartPtr](#).

Definition at line 503 of file CoinSmartPtr.hpp.

8.117.4.3 `template<class T> template<class U1 , class U2 > bool operator!=( const SmartPtr< U1 > & lhs, U2 * raw_rhs ) [friend]`

Overloaded in-equality comparison operator, allows the user to compare the value of a [SmartPtr](#) with a raw pointer.

Definition at line 513 of file CoinSmartPtr.hpp.

8.117.4.4 `template<class T> template<class U1 , class U2 > bool operator!=( U1 * lhs, const SmartPtr< U2 > & raw_rhs ) [friend]`

Overloaded in-equality comparison operator, allows the user to compare the value of a [SmartPtr](#) with a raw pointer.

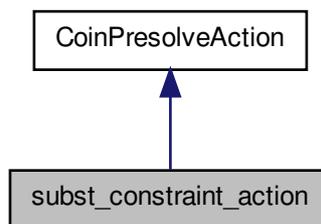
Definition at line 518 of file CoinSmartPtr.hpp.

The documentation for this class was generated from the following file:

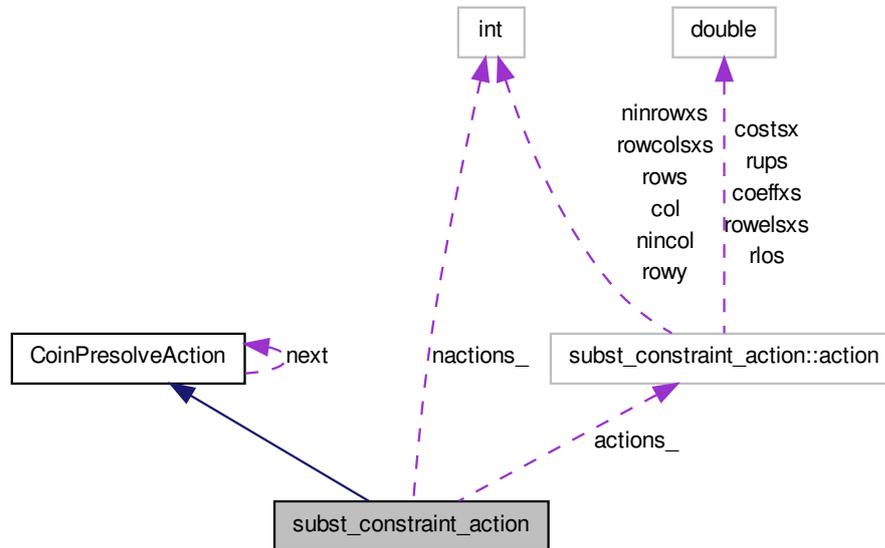
- CoinSmartPtr.hpp

## 8.118 subst\_constraint\_action Class Reference

Inheritance diagram for subst\_constraint\_action:



Collaboration diagram for subst\_constraint\_action:



## Classes

- struct **action**

## Public Member Functions

- const char \* [name](#) () const  
*A name for debug printing.*
- void [postsolve](#) (CoinPostsolveMatrix \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

### 8.118.1 Detailed Description

Definition at line 12 of file CoinPresolveSubst.hpp.

### 8.118.2 Member Function Documentation

#### 8.118.2.1 const char\* subst\_constraint\_action::name ( ) const [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

The documentation for this class was generated from the following file:

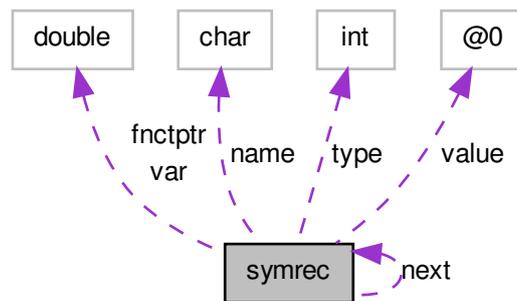
- [CoinPresolveSubst.hpp](#)

## 8.119 symrec Struct Reference

For string evaluation.

```
#include <CoinModelUseful.hpp>
```

Collaboration diagram for symrec:



### 8.119.1 Detailed Description

For string evaluation.

Definition at line 137 of file [CoinModelUseful.hpp](#).

The documentation for this struct was generated from the following file:

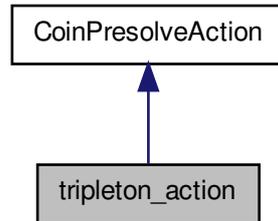
- [CoinModelUseful.hpp](#)

## 8.120 tripton\_action Class Reference

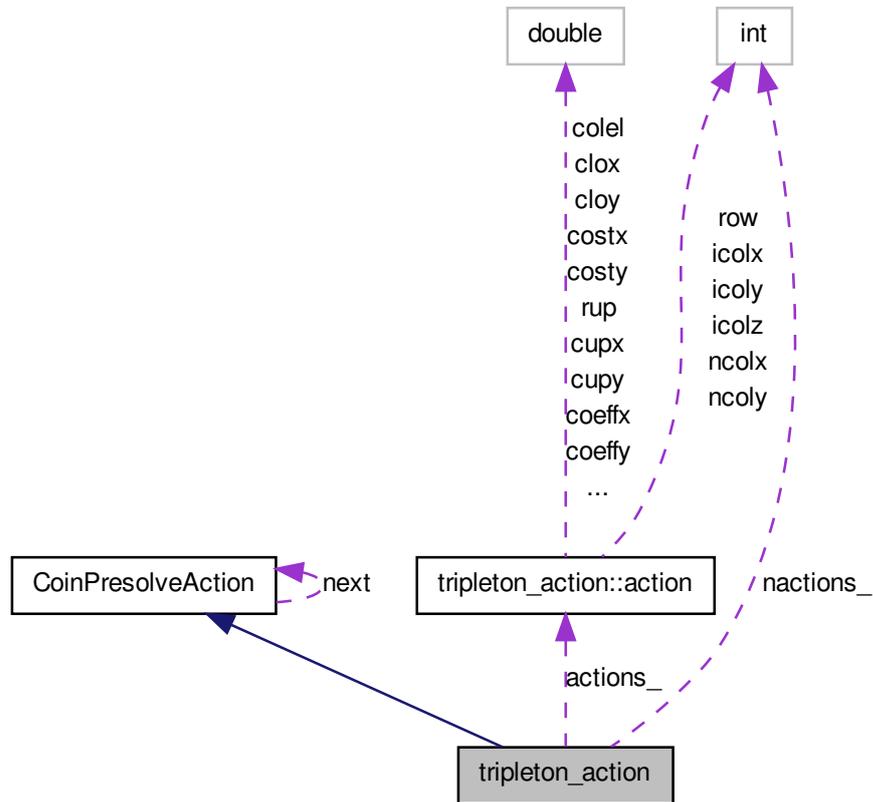
We are only going to do this if it does not increase number of elements?.

```
#include <CoinPresolveTripton.hpp>
```

Inheritance diagram for tripleton\_action:



Collaboration diagram for tripleton\_action:



### Classes

- struct [action](#)

### Public Member Functions

- const char \* [name](#) () const  
*A name for debug printing.*
- void [postsolve](#) (CoinPostsolveMatrix \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

### 8.120.1 Detailed Description

We are only going to do this if it does not increase number of elements?.

It could be generalized to more than three but it seems unlikely it would help.

As it is adapted from doubleton icoly is one dropped.

Definition at line 15 of file `CoinPresolveTripletion.hpp`.

### 8.120.2 Member Function Documentation

#### 8.120.2.1 `const char* tripletion_action::name( )const` [inline, virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

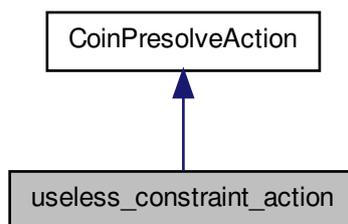
Definition at line 55 of file `CoinPresolveTripletion.hpp`.

The documentation for this class was generated from the following file:

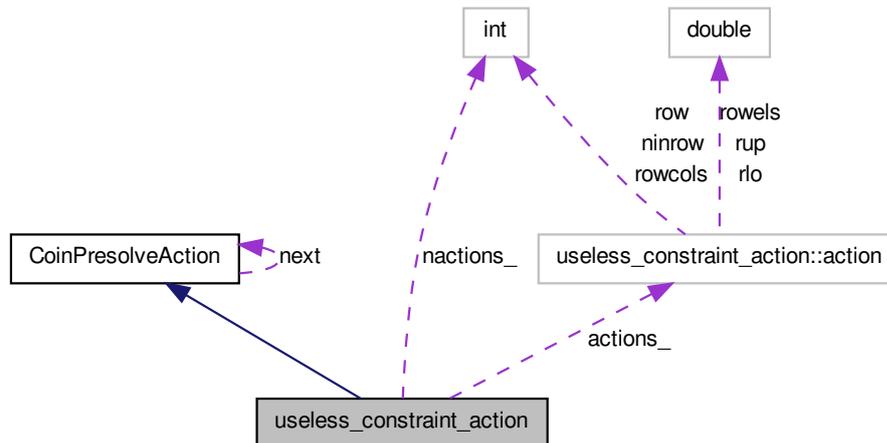
- `CoinPresolveTripletion.hpp`

## 8.121 `useless_constraint_action` Class Reference

Inheritance diagram for `useless_constraint_action`:



Collaboration diagram for useless\_constraint\_action:



## Classes

- struct **action**

## Public Member Functions

- const char \* [name](#) () const  
*A name for debug printing.*
- void [postsolve](#) (CoinPostsolveMatrix \*prob) const  
*Apply the postsolve transformation for this particular presolve action.*

### 8.121.1 Detailed Description

Definition at line 10 of file CoinPresolveUseless.hpp.

### 8.121.2 Member Function Documentation

#### 8.121.2.1 const char\* useless\_constraint\_action::name ( ) const [virtual]

A name for debug printing.

It is expected that the name is not stored in the transform itself.

Implements [CoinPresolveAction](#).

The documentation for this class was generated from the following file:

- CoinPresolveUseless.hpp

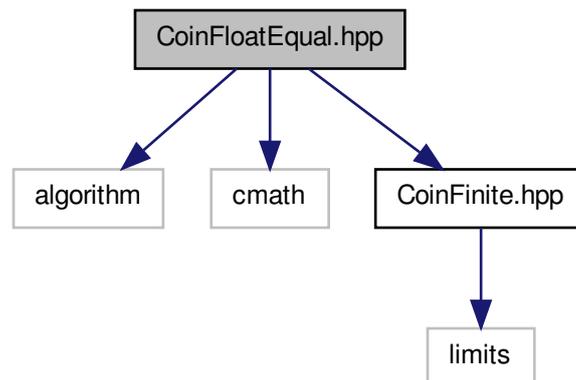
## 9 File Documentation

### 9.1 CoinFloatEqual.hpp File Reference

Function objects for testing equality of real numbers.

```
#include <algorithm>
#include <cmath>
#include "CoinFinite.hpp"
```

Include dependency graph for CoinFloatEqual.hpp:



#### Classes

- class [CoinAbsFltEq](#)  
*Equality to an absolute tolerance.*
- class [CoinRelFltEq](#)  
*Equality to a scaled tolerance.*

### 9.1.1 Detailed Description

Function objects for testing equality of real numbers. Two objects are provided; one tests for equality to an absolute tolerance, one to a scaled tolerance. The tests will handle IEEE floating point, but note that `infinity == infinity`. Mathematicians are rolling in their graves, but this matches the behaviour for the common practice of using `DBL_MAX` (`numeric_limits<double>::max()`), or similar large finite number) as infinity.

Example usage:

```
double d1 = 3.14159 ;
double d2 = d1 ;
double d3 = d1+.0001 ;

CoinAbsFltEq eq1 ;
CoinAbsFltEq eq2(.001) ;

assert( eq1(d1,d2) ) ;
assert( !eq1(d1,d3) ) ;
assert( eq2(d1,d3) ) ;
```

[CoinRelFltEq](#) follows the same pattern.

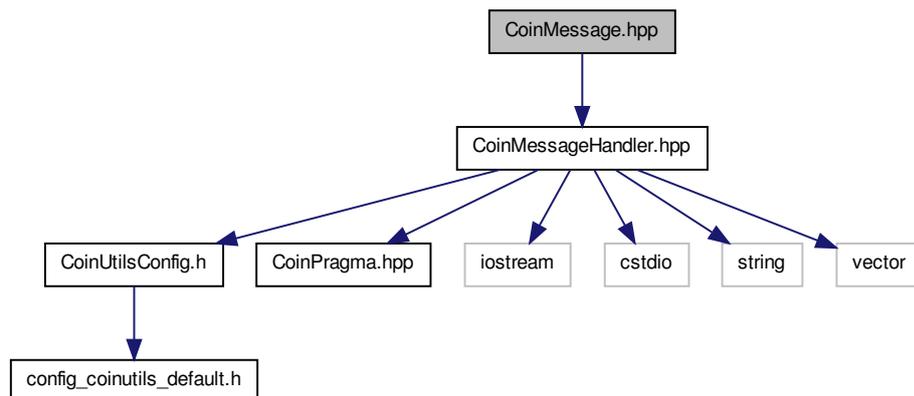
Definition in file [CoinFloatEqual.hpp](#).

## 9.2 CoinMessage.hpp File Reference

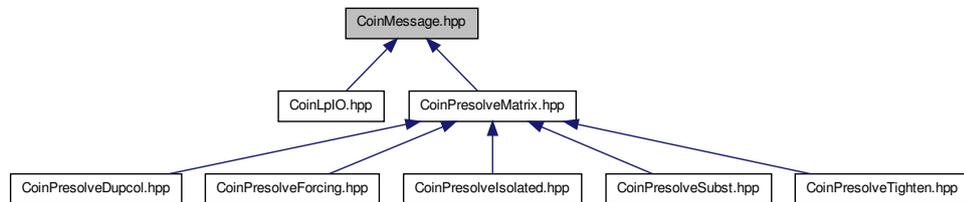
This file contains the enum for the standard set of Coin messages and a class definition whose sole purpose is to supply a constructor.

```
#include "CoinMessageHandler.hpp"
```

Include dependency graph for CoinMessage.hpp:



This graph shows which files directly or indirectly include this file:



### Classes

- class [CoinMessage](#)  
*The standard set of Coin messages.*

### Enumerations

- enum [COIN\\_Message](#)  
*Symbolic names for the standard set of COIN messages.*

#### 9.2.1 Detailed Description

This file contains the enum for the standard set of Coin messages and a class definition whose sole purpose is to supply a constructor. The text of the messages is defined in `CoinMessage.cpp`,

[CoinMessageHandler.hpp](#) contains the generic facilities for message handling.

Definition in file [CoinMessage.hpp](#).

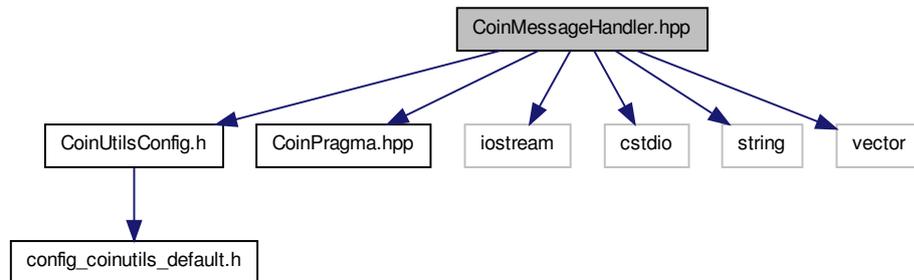
### 9.3 CoinMessageHandler.hpp File Reference

This is a first attempt at a message handler.

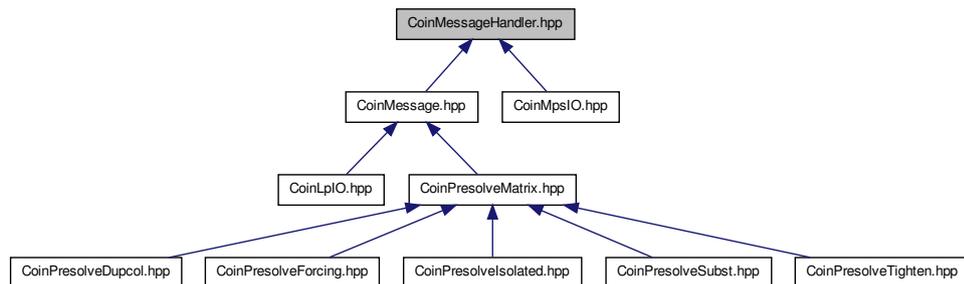
```

#include "CoinUtilsConfig.h"
#include "CoinPragma.hpp"
#include <iostream>
#include <cstdio>
#include <string>
#include <vector>
  
```

Include dependency graph for CoinMessageHandler.hpp:



This graph shows which files directly or indirectly include this file:



### Classes

- class [CoinOneMessage](#)  
*Class for one massaged message.*
- class [CoinMessages](#)  
*Class to hold and manipulate an array of massaged messages.*
- class [CoinMessageHandler](#)  
*Base class for message handling.*

### Defines

- `#define` [COIN\\_NUM\\_LOG](#) 4  
*Log levels will be by type and will then use type given in [CoinMessage::class\\_](#).*

- `#define COIN_MESSAGE_HANDLER_MAX_BUFFER_SIZE 1000`  
*Maximum length of constructed message (characters)*

#### Functions

- `bool CoinMessageHandlerUnitTest ()`  
*A function that tests the methods in the [CoinMessageHandler](#) class.*

#### 9.3.1 Detailed Description

This is a first attempt at a message handler. The COIN Project is in favor of multi-language support. This implementation of a message handler tries to make it as lightweight as possible in the sense that only a subset of messages need to be defined --- the rest default to US English.

The default handler at present just prints to stdout or to a FILE pointer

Definition in file [CoinMessageHandler.hpp](#).

#### 9.3.2 Define Documentation

##### 9.3.2.1 `#define COIN_NUM_LOG 4`

Log levels will be by type and will then use type given in [CoinMessage::class\\_](#).

- 0 - Branch and bound code or similar
- 1 - Solver
- 2 - Stuff in Coin directory
- 3 - Cut generators

Definition at line 570 of file [CoinMessageHandler.hpp](#).

#### 9.3.3 Function Documentation

##### 9.3.3.1 `bool CoinMessageHandlerUnitTest ( )`

A function that tests the methods in the [CoinMessageHandler](#) class.

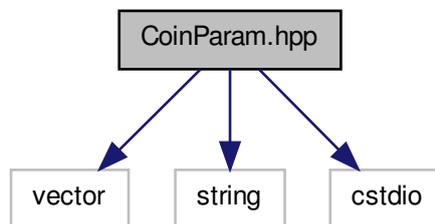
The only reason for it not to be a member method is that this way it doesn't have to be compiled into the library. And that's a gain, because the library should be compiled with optimization on, but this method should be compiled with debugging.

## 9.4 CoinParam.hpp File Reference

Declaration of a class for command line parameters.

```
#include <vector>
#include <string>
#include <cstdio>
```

Include dependency graph for CoinParam.hpp:



### Classes

- class [CoinParam](#)  
*A base class for 'keyword value' command line parameters.*

### Namespaces

- namespace [CoinParamUtils](#)  
*Utility functions for processing [CoinParam](#) parameters.*

### Functions

- `std::ostream & operator<< (std::ostream &s, const CoinParam &param)`  
*A stream output function for a [CoinParam](#) object.*
- `void CoinParamUtils::setInputSrc (FILE *src)`  
*Take command input from the file specified by src.*
- `bool CoinParamUtils::isCommandLine ()`  
*Returns true if command line parameters are being processed.*
- `bool CoinParamUtils::isInteractive ()`  
*Returns true if parameters are being obtained from stdin.*

- `std::string CoinParamUtils::getStringField` (int argc, const char \*argv[], int \*valid)
  - Attempt to read a string from the input.*
- `int CoinParamUtils::getIntField` (int argc, const char \*argv[], int \*valid)
  - Attempt to read an integer from the input.*
- `double CoinParamUtils::getDoubleField` (int argc, const char \*argv[], int \*valid)
  - Attempt to read a real (double) from the input.*
- `int CoinParamUtils::matchParam` (const `CoinParamVec` &paramVec, std::string name, int &matchNdx, int &shortCnt)
  - Scan a parameter vector for parameters whose keyword (name) string matches name using minimal match rules.*
- `std::string CoinParamUtils::getCommand` (int argc, const char \*argv[], const std::string prompt, std::string \*pfx=0)
  - Get the next command keyword (name)*
- `int CoinParamUtils::lookupParam` (std::string name, `CoinParamVec` &paramVec, int \*matchCnt=0, int \*shortCnt=0, int \*queryCnt=0)
  - Look up the command keyword (name) in the parameter vector. Print help if requested.*
- `void CoinParamUtils::printIt` (const char \*msg)
  - Utility to print a long message as filled lines of text.*
- `void CoinParamUtils::shortOrHelpOne` (`CoinParamVec` &paramVec, int matchNdx, std::string name, int numQuery)
  - Utility routine to print help given a short match or explicit request for help.*
- `void CoinParamUtils::shortOrHelpMany` (`CoinParamVec` &paramVec, std::string name, int numQuery)
  - Utility routine to print help given multiple matches.*
- `void CoinParamUtils::printGenericHelp` ()
  - Print a generic 'how to use the command interface' help message.*
- `void CoinParamUtils::printHelp` (`CoinParamVec` &paramVec, int firstParam, int lastParam, std::string prefix, bool shortHelp, bool longHelp, bool hidden)
  - Utility routine to print help messages for one or more parameters.*

#### 9.4.1 Detailed Description

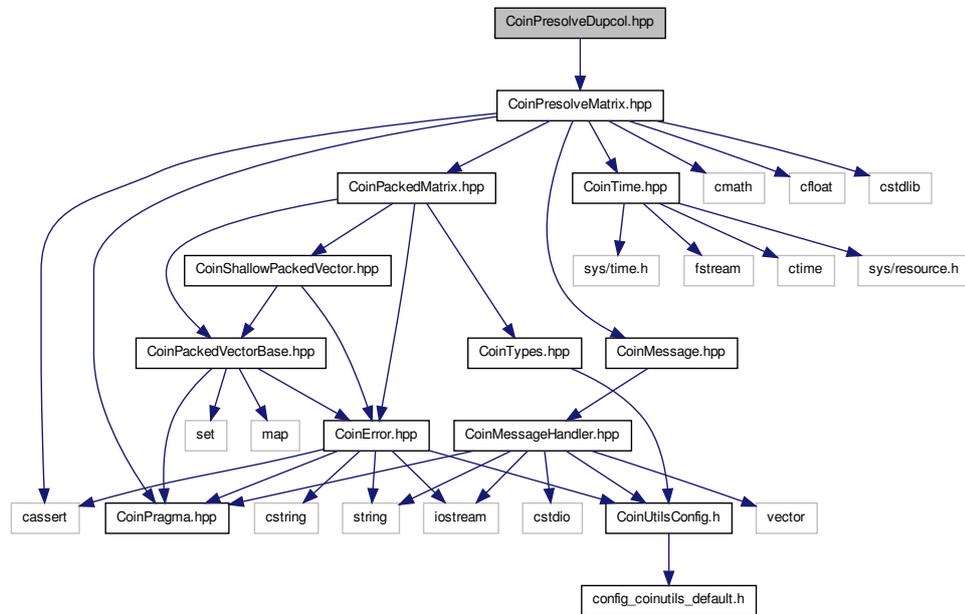
Declaration of a class for command line parameters.

Definition in file `CoinParam.hpp`.

## 9.5 CoinPresolveDupcol.hpp File Reference

```
#include "CoinPresolveMatrix.hpp"
```

Include dependency graph for CoinPresolveDupcol.hpp:



## Classes

- class [dupcol\\_action](#)  
*Detect and remove duplicate columns.*
- struct **dupcol\_action::action**
- class [duprow\\_action](#)  
*Detect and remove duplicate rows.*
- struct **duprow\_action::action**
- class [gubrow\\_action](#)  
*Detect and remove entries whose sum is known.*
- struct **gubrow\_action::action**

### 9.5.1 Detailed Description

Definition in file [CoinPresolveDupcol.hpp](#).

## 9.6 CoinPresolveEmpty.hpp File Reference

Drop/reinsert empty rows/columns.

## Classes

- class [drop\\_empty\\_cols\\_action](#)  
*Physically removes empty columns in presolve, and reinserts empty columns in post-solve.*
- struct **drop\_empty\_cols\_action::action**
- class [drop\\_empty\\_rows\\_action](#)  
*Physically removes empty rows in presolve, and reinserts empty rows in postsolve.*
- struct **drop\_empty\_rows\_action::action**

## 9.6.1 Detailed Description

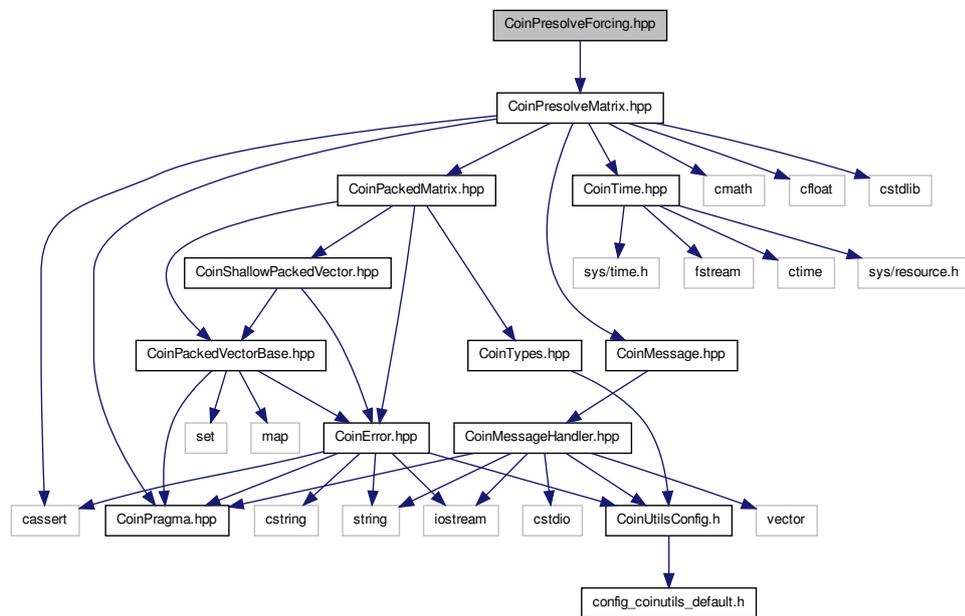
Drop/reinsert empty rows/columns.

Definition in file [CoinPresolveEmpty.hpp](#).

## 9.7 CoinPresolveForcing.hpp File Reference

```
#include "CoinPresolveMatrix.hpp"
```

Include dependency graph for CoinPresolveForcing.hpp:



### Classes

- class [forcing\\_constraint\\_action](#)  
*Detect and process forcing constraints and useless constraints.*
- struct [forcing\\_constraint\\_action::action](#)

#### 9.7.1 Detailed Description

Definition in file [CoinPresolveForcing.hpp](#).

## 9.8 CoinPresolveImpliedFree.hpp File Reference

### Classes

- class [implied\\_free\\_action](#)  
*Detect and process implied free variables.*
- struct [implied\\_free\\_action::action](#)

#### 9.8.1 Detailed Description

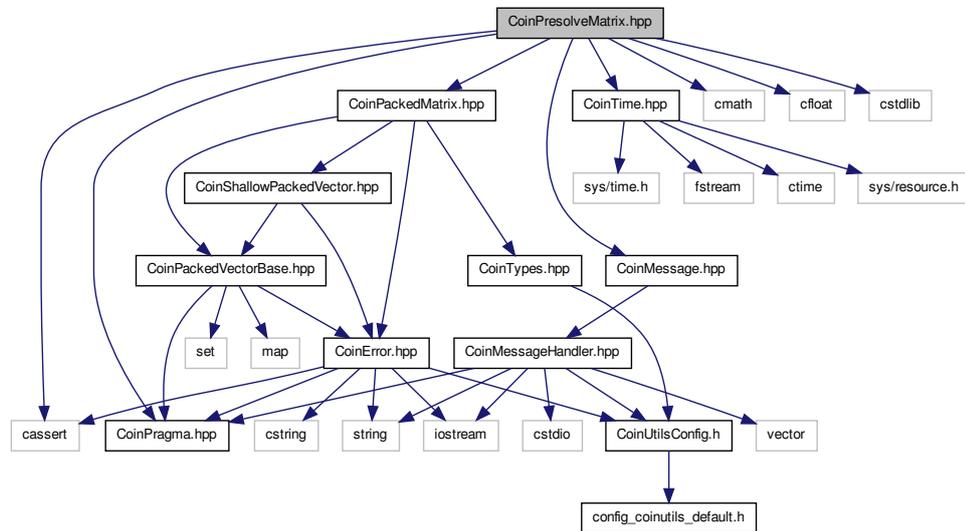
Definition in file [CoinPresolveImpliedFree.hpp](#).

## 9.9 CoinPresolveMatrix.hpp File Reference

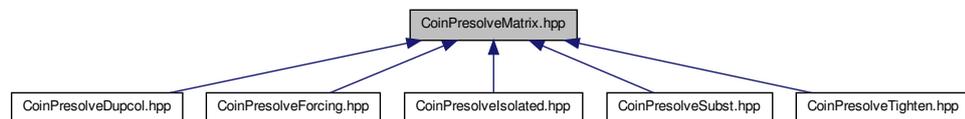
Declarations for [CoinPresolveMatrix](#) and [CoinPostsolveMatrix](#) and their common base class [CoinPrePostsolveMatrix](#).

```
#include "CoinPragma.hpp"
#include "CoinPackedMatrix.hpp"
#include "CoinMessage.hpp"
#include "CoinTime.hpp"
#include <cmath>
#include <cassert>
#include <cfloat>
#include <cstdlib>
```

Include dependency graph for CoinPresolveMatrix.hpp:



This graph shows which files directly or indirectly include this file:



## Classes

- class [CoinPresolveAction](#)  
*Abstract base class of all presolve routines.*
- class [CoinPrePostsolveMatrix](#)  
*Collects all the information about the problem that is needed in both presolve and postsolve.*
- class [presolvehlink](#)  
*Links to aid in packed matrix modification.*
- class [CoinPresolveMatrix](#)  
*Augments [CoinPrePostsolveMatrix](#) with information about the problem that is only needed during presolve.*

- class [CoinPostsolveMatrix](#)

*Augments [CoinPrePostsolveMatrix](#) with information about the problem that is only needed during postsolve.*

#### Functions

- double \* [presolve\\_dupmajor](#) (const double \*elems, const int \*indices, int length, CoinBigIndex offset, int tgt=-1)  
*Duplicate a major-dimension vector; optionally omit the entry with minor index `tgt`.*
- void [coin\\_init\\_random\\_vec](#) (double \*work, int n)  
*Initialize an array with random numbers.*

#### Variables

- const double [ZTOLDP](#) = 1e-12  
*Zero tolerance.*

#### 9.9.1 Detailed Description

Declarations for [CoinPresolveMatrix](#) and [CoinPostsolveMatrix](#) and their common base class [CoinPrePostsolveMatrix](#). Also declarations for [CoinPresolveAction](#) and a number of non-member utility functions.

Definition in file [CoinPresolveMatrix.hpp](#).

#### 9.9.2 Variable Documentation

##### 9.9.2.1 const double ZTOLDP = 1e-12

Zero tolerance.

OSL had a fixed zero tolerance; we still use that here.

Definition at line 40 of file [CoinPresolveMatrix.hpp](#).

## 9.10 CoinPresolveSingleton.hpp File Reference

#### Classes

- class [slack\\_doubleton\\_action](#)  
*Convert an explicit bound constraint to a column bound.*
- struct [slack\\_doubleton\\_action::action](#)
- class [slack\\_singleton\\_action](#)  
*For variables with one entry.*
- struct [slack\\_singleton\\_action::action](#)

## 9.10.1 Detailed Description

Definition in file [CoinPresolveSingleton.hpp](#).

## 9.11 CoinPresolveZeros.hpp File Reference

Drop/reintroduce explicit zeros.

## Classes

- struct [dropped\\_zero](#)  
*Tracking information for an explicit zero coefficient.*
- class [drop\\_zero\\_coefficients\\_action](#)  
*Removal of explicit zeros.*

## 9.11.1 Detailed Description

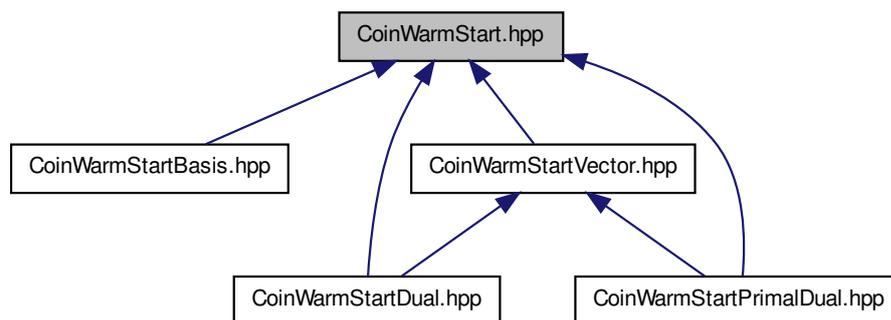
Drop/reintroduce explicit zeros.

Definition in file [CoinPresolveZeros.hpp](#).

## 9.12 CoinWarmStart.hpp File Reference

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This graph shows which files directly or indirectly include this file:



### Classes

- class [CoinWarmStart](#)  
*Abstract base class for warm start information.*
- class [CoinWarmStartDiff](#)  
*Abstract base class for warm start 'diff' objects.*

#### 9.12.1 Detailed Description

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Declaration of the generic simplex (basis-oriented) warm start class. Also contains a basis diff class.

Definition in file [CoinWarmStart.hpp](#).