IMPACT Solver for Optimization Services

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Outline

• Brief Introduction
• Impact solver
• Optimization Services And Impact
• Demo of Impact Solver Service
• Conclusion
IMPACT -- Integrated Mathematical Programming
Advanced Computational Tools

• Research code for testing optimization algorithms
• Current focus is on Mixed Integer Nonlinear Programming
• It has a solver-side framework component for testing Optimization Services
Impact Solver
Research Motivation

Mixed Integer Nonlinear Programming
(Mehrotra and Li, presented on Monday)

• Generalized branch and bound using adjoint lattice
• LLL and GBR basis reduction
• Interior point based search for relaxed solution
Impact Solver
work in progress

• LLL and GBR implementation
  – High quality reduced basis
  – Integrated with ellipsoidal rounding and analytical center computation

• Mixed Integer Solver
  – Mehrotra and Li’s Version of Lenstra’s and GBR algorithm in a branch and cut framework
  – More effective than branching on variables
  – Efficient tree management
Impact and Optimization Services

• Research Motivation
  – Solver service
    • distribution is not required.
  – Need standard problem instance (OSiL), result (OSrL) and option (OSoL) representation.
  – Need a standard local interface (OSInstance, OSOption, OSResult)
  – Need a standard communication interface for optimization over distributed system
    • Hooking up with solver – OShL
    • Call up a simulation or function evaluation – OScL
    • Discover solver services in OS Registry -- OSdL
Impact Solver Service

- Built for standard instances
  - OSiL: xml string/file for an optimization instance
  - OSoL: xml string/file for an optimization option
  - OSrL: xml string/file for an optimization result
- Natively uses standard local interface (in memory problem data structure)
  - OSIInstance: data structure for optimization instance
  - OSOOption: data structure for optimization option
  - OSRResult: data structure for optimization result
- Callable from client agent implemented in any language on any platform
  - C/C++
  - Java
  - .net
Impact Solver Service

- **solve**
  - Takes OSiL and OSoL and returns OSrL (string/file version)
  - Synchronous call, blocking request/response,
- **getJobID**
  - Gets a unique job id generated by the solver service
  - Critical for maintaining session and state on a distributed system
- **send**
  - Same input signature as the solve function but only returns a boolean
  - Asynchronous (server side), non-blocking call
- **retrieve**
  - Retrieving result from anywhere and anytime.
- **kill**
  - Kill remote optimization jobs
  - Critical in long running optimization jobs
  - Plays an important role in fathoming tree nodes that are solved over remote computers
- **knock**
  - Get and set instant messages from the remote optimization services
Demo

```xml
<model>
  <name>Company</name>
  <source>Andersen, Sweeney, and Williams Intro to MS</source>
  <objective>
    <min name="Total Cost"/>
  </objective>
  <constraints>
    <con>
      10 <= x1 + 0.7 + x2 <= 630
    </con>
    <con>
      10 <= 0.5*x1 + 0.8333*x2 <= 600
    </con>
    <con>
      10 <= 1.0*x1 + 0.6667*x2 <= 708
    </con>
    <con>
      10 <= 0.1*x1 + 0.25*x2 <= 135
    </con>
  </constraints>
</model>
```
Conclusion

• Impact Solver Service is natively OS-Compatible.
  – Impact solver is a scalable platform for testing research algorithms.

• Optimization Services provides a comprehensive and convenient framework for developing optimization software