Is Utility Computing suitable for providing Mathematical Programming Resources?

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Agenda

- Introduction
- Network.com (Sun)
- Amazon Elastic Computing Cloud (EC2)
- Challenges and Conclusions
GAMS Development / GAMS Software

- Roots: **Research project**
  World Bank 1976
- Pioneer in **Algebraic Modeling Systems**
  used for economic modeling
- Went **commercial** in 1987
- **Offices** in Washington, D.C and Cologne

- Professional **software tool provider, not a consulting company**
- Operating in a **segmented niche market**
- Broad **academic & commercial** user base and network

General Algebraic Modeling System
What is Utility Computing?

...the *packaging of computing resources*, such as computation and storage, as a *metered service similar to a physical public utility*…


… a *business model for computing* in which resources are made available to the user on an *as-needed* basis… ([http://www.sun.com/service/sungrid/index.jsp](http://www.sun.com/service/sungrid/index.jsp))
Predecessors: Time Sharing Systems

- Sharing expansive computing resources
- Full service operations
- Charges:
  - fixed rent
  - per usage
- Success of PC terminated businesses
Math Programming Applications

Wide Range of possible Demands:

- Lots of Memory and CPU time
- Off-line / Batch operations
- Parallel operations sometimes possible
- Optimization may fail!
- Delivery of Results time critical
- Confidentiality issues
- GUI very application specific
- …
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Network.com operated by Sun

• On-demand grid computing service

• A few hundred CPUs (AMD Opteron, 2 CPU SMP, 2 *4 GB RAM, Solaris 10)

• Pay as you go utility: 1 $ / CPU-hour

• Network of Service Provider
Using Network.com...

Advantages of Grid Computing

- Solve a certain number of scenarios faster:
  - sequential: 50 hours
  - parallel (200 CPUs): ~15 minutes

- Better results by running more scenarios*:

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GRID Specific Enhancements

1. Submission of jobs

2. “Grid Middleware”
   - Distribution
   - Execution

3. Collection of solutions

4. Processing of results
GAMS & Grid Computing

- **Scalable and Platform independent**
  - massive grids
  - multi-cpu machines
  - “1 CPU - Grid”

- Only **minor changes** to model required

- **Separation** of model and solution method
Using the GAMS GRID Facilities

Job Scheduling Host

Node 001

GAMS

Solve Loop

Model 1, Instance 001

Model 1, Instance ...

Model 1, Instance nnn

Output Job 1

Model 001

Job 1

Model 001
Results for 4096 MIPS on Condor Grid

• 20 hours wall time
• 5000 CPU hours
• Peak number of CPUs: 500
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Amazon Elastic Computing Cloud

- Access to an unlimited number of virtual machines
- Provides Hardware and OS
- Pay per Usage
Amazon EC2: Available Instances

- **Small**: 1.7 GB RAM, 1 virtual core, 160 GB HD ($0.1 / h)
- **Large**: 7.5 GB RAM, 4 virtual cores, 850 GB HD ($0.4 / h)
- **Extra Large**: 15 GB RAM, 8 virtual cores, 1690 GB HD ($0.8 / h)
- **High-CPU Medium**: 1.7 GB RAM 5 virtual cores, 350 GB ($0.20 / h)
- **High-CPU Extra Large**: 7 GB RAM, 20 virtual cores, 1690 GB HD ($0.8 / h)
Using Amazon EC2....

- Local Control via Simple Batch Scripts
- Companion Products: Simple Storage Services, Simple Queue Services,...
- Growing Network of Service Provider
Amazon EC2: Applications

- Builds
- Tests
- Projects (CPU Bursts)
- Code Escrow
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Challenges

- Interfaces
- Reliability, Scalability & Performance
- Confidentiality
- Business Models
Conclusions

- Utility computing still at a **early stage**, but may **become more important**

- **Grid Computing** offers lots of promising developments

- **Algebraic Modeling Languages** are supporting parallel environments

- **Lots of Challenges** ahead
The End

Thank you!

... Questions?
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