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**…*
(http://en.wikipedia.org/wiki/Utility_computing)

*… 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)*

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...

→More Information at: http://www.gams.com/sungrid/

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*:

#SIM	VaR error	CVaR error
1000	5.42%	6.74%
20,000	1.21%	1.49%

* http://www.tc.cornell.edu/NR/shared/Presentations/24Feb04.Garp.pdf

GRID Specific Enhancements

1. Submission of jobs

2. "Grid Middleware"
   – Distribution
   – Execution

3. Collection of solutions

4. Processing of results
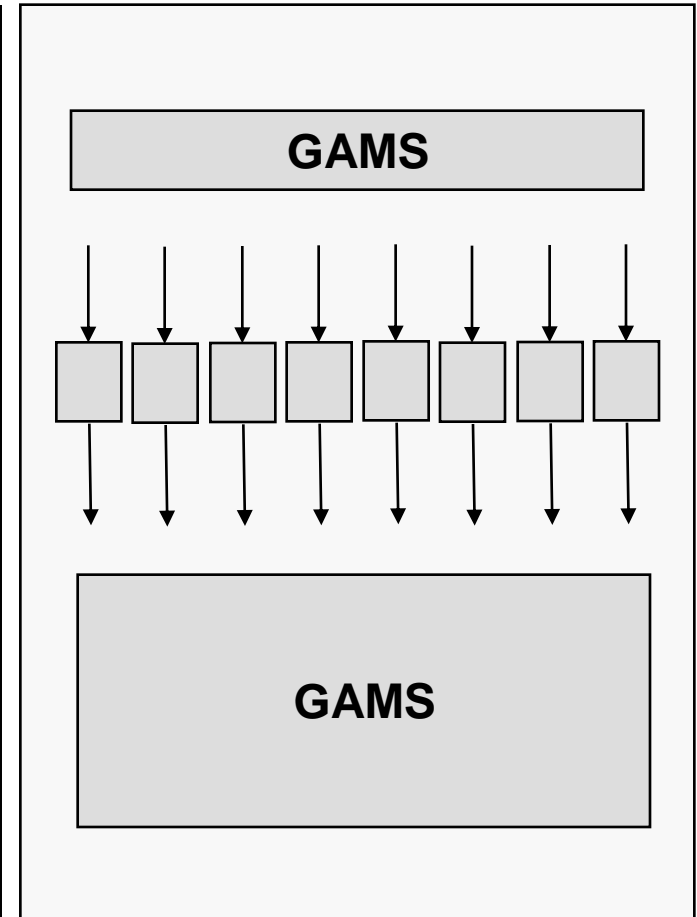
GAMS & Grid Computing

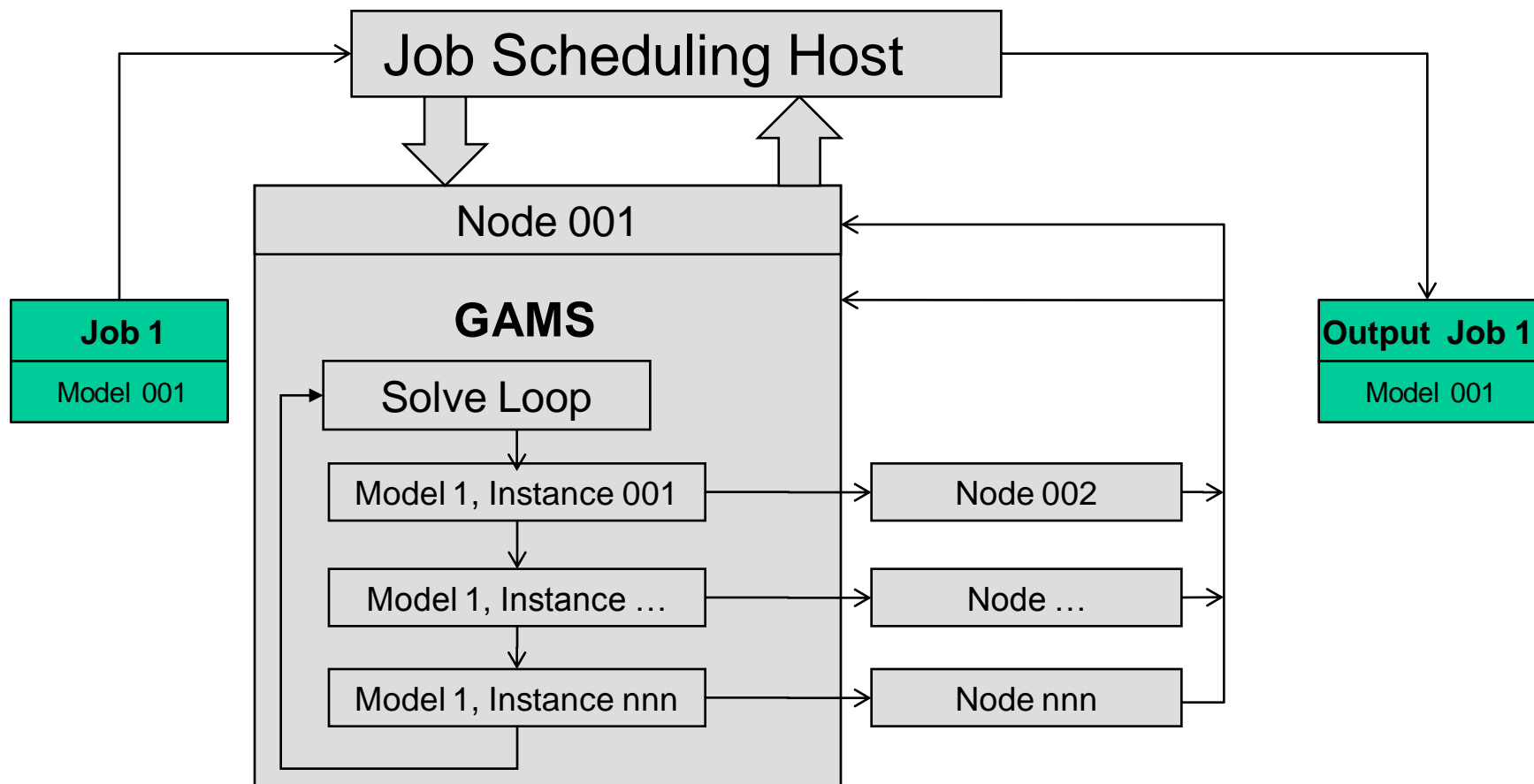- **Scalable** and **Platform independent**
  - massive grids
  - multi-cpu machines
  - "1 CPU - Grid"

- Only **minor changes** to model required

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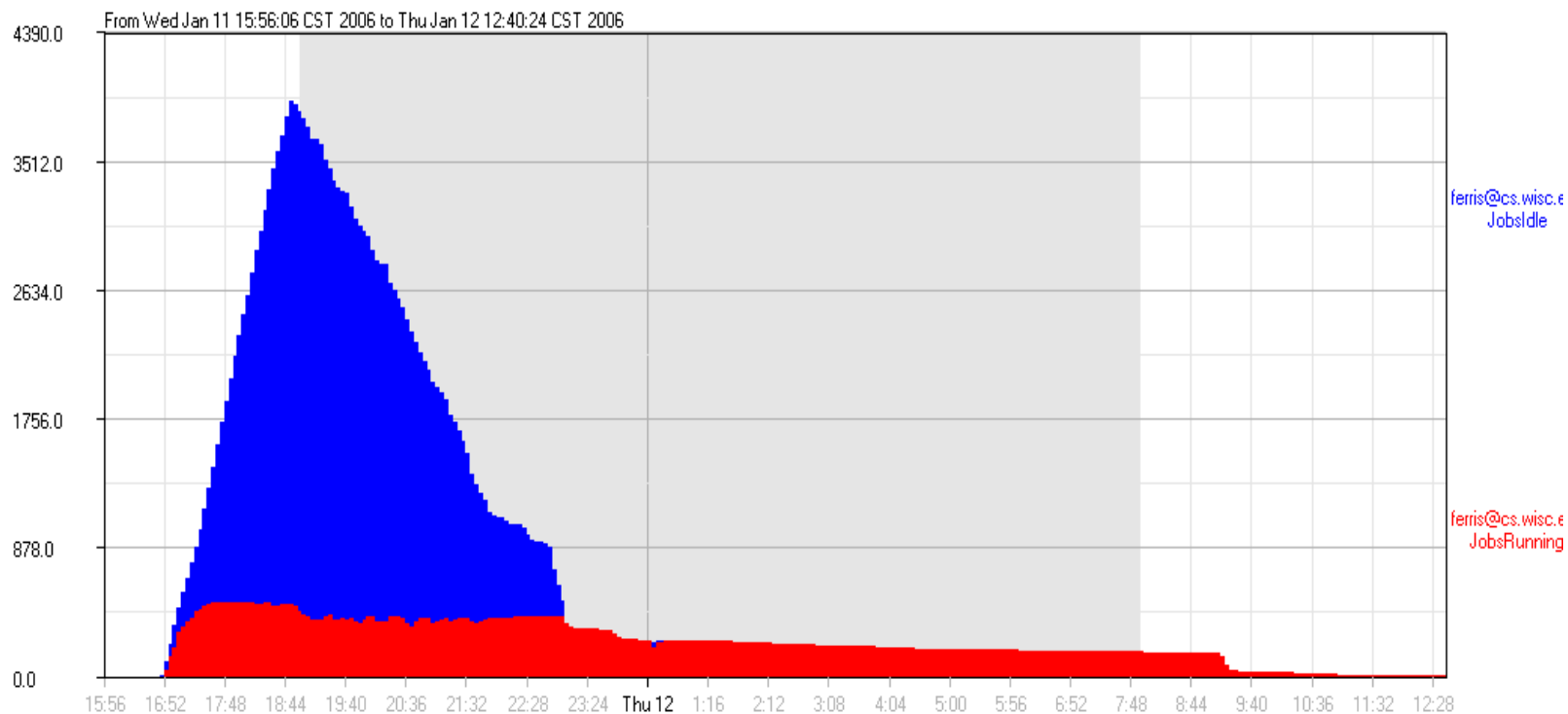
Using the GAMS GRID Facilities

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

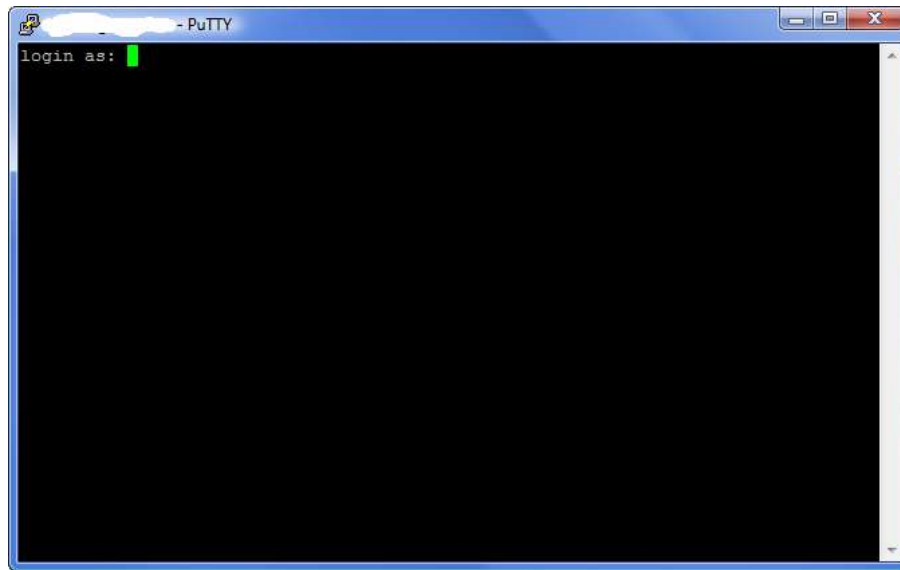# Amazon EC2: Available Instances

- **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 and Conclusions

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 enviroments**

- **Lots of Challenges** ahead

The End

Thank you!

… Questions?

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