



GPU Computing in Mainland China's Industry

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Agenda

- What is GPU Computing?
- GPU Computing in China
- Our Research in GPU Computing
- Our Collaboration with Inspur Ltd.
- Q&A

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- For several decades, computers mainly use CPUs for computing.
- What is GPU Computing?
 - Use Graphics Processing Unit (GPU) for general scientific and engineering computing
- Why GPU Computing?
 - More energy efficient
 - More computations per Watt
 - Lower price
 - More computations per Dollar

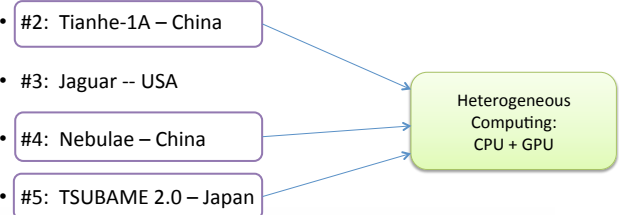
designed for computer graphics

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GPU computing is hot!

- TOP 5 Supercomputers (November 2011)
 - [\[http://www.top500.org/list/2011/11/100\]](http://www.top500.org/list/2011/11/100)
 - #1: K-Computer – Japan
 - #2: Tianhe-1A – China
 - #3: Jaguar -- USA
 - #4: Nebulae – China
 - #5: TSUBAME 2.0 – Japan



Heterogeneous Computing: CPU + GPU

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GPU computing is challenging!


- It is difficult to fully utilize the GPU computing power

	R _{max} (TFLOPS)	R _{peak} (TFLOPS)	Power (kW)
Tianhe-1A	2566 (55%)	4701	4040
Nebulae	1271 (43%)	2984.3	2580
TSUBAME 2.0	1192 (52%)	2287.63	1398.61

R_{max} - Maximal LINPACK performance achieved
 R_{peak} - Theoretical peak performance

- There are many research issues in improving the utilization ratio.

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GPU Applications

- Weather, Atmospheric, Ocean Modeling, and Space Sciences
- Medical Imaging
- Computational Finance
- Bio-Informatics and Life Sciences
- Molecular Dynamics
- Data Mining, Analytics, and Databases
- Computational Electromagnetics and Electrostatics
- Computational Fluid Dynamics
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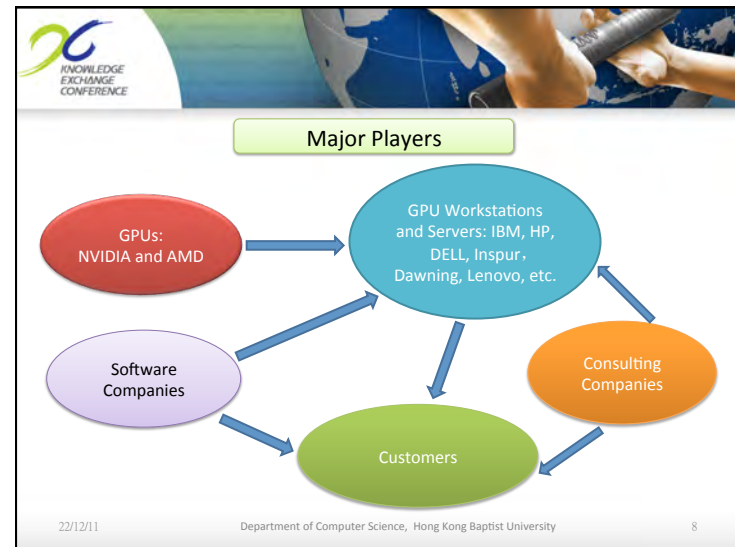
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The GPU Computing Industry in China

- Customers:**
 - oil industry, financial industry, aerial industry, etc.
 - universities, research institutes
 - governments
- Manufacturers :**
 - AMD, NVIDIA
 - DELL, HP, IBM, Supermicro, etc.
 - Dawning (曙光), Inspur(浪潮), Lenovo (联想), etc.

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GPU Products

US\$1,000



US\$10,000



US\$10,000,000



US\$100,000




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- **About Inspur Group (浪潮集团)**
 - A leading supplier of computing platforms and IT application solutions in China
 - One of the largest server manufacturers and server solution suppliers in China
 - Sales revenue exceeded 23.2 billion RMB in 2008

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- GPU servers become more and more important
- The GPU servers from different manufacturers are almost the same
 - The GPUs all come from NVIDIA or AMD
- What does Inspur need?

Good software solutions!

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- **Our Research in GPU Computing**
 - One of the earliest research groups in HK
 - Used a few desktop GPUs for “small” research projects
 - How to best utilize GPUs to finish a computing job?
 - Published many research papers
 - Trained a few Mphil/PhD students
 - Gave many talks, and organized the International Workshop on GPU Computing

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- What do we need?
 - More support in hardware platform
 - Large scale and high-impact real applications
 - Human resources

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A win-win collaboration with Inspur

- Establish the Inspur-HKBU Joint Laboratory for Heterogeneous Computing
- Inspur provides a TS10000 GPU supercomputer for our teaching and research activities
- We help Inspur in the design and optimization of GPU applications
- Publish research papers together



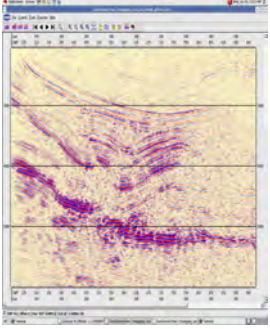
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Case I

- A project with BGP (中國石油東方地球物理勘探公司)
- PSTM: Prestack Time Migration
 - National Eleventh/Twelfth Strategic Plan Project
- Key component in petroleum prospection
- Outcome:

5x speedup as compared with multi-threaded CPU cluster version



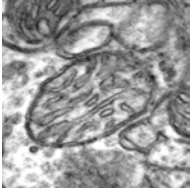
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Case II

- A project with Institute of Biophysics, Chinese Academy of Sciences
- 3D Reconstruction of Electron tomography
 - Electron tomography (ET) provides the prospect of reconstructing cells or macromolecules in nano scale
 - The reconstruction is very time consuming
- Outcome:

• Our GPU solution achieves 50x speedup
 • Reconstruction time shortened from weeks to hours



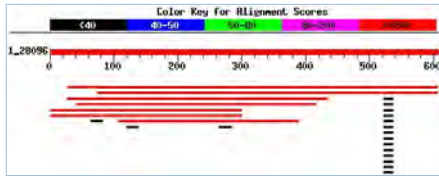
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Case III

- A project with Beijing Institute of Genomics, Chinese Academy of Sciences
- Accelerating BLASTN by GPUs
 - given a DNA query, returns the most similar DNA sequences from the DNA database
- Outcome:

35x speedup



Color Key for Alignment Scores:
<40 40-50 50-60 60-700

1_28096 0 100 200 300 400 500 600

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Thank you!



Q → [Server Rack] → A

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