Interdisciplinary Research Challenges
Group A

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Mentors: Keigo Nitadori and Huthmann Jens
Topics

- Group Re-Introduction
- Discussion Method
- Interdisciplinary Research
- Conclusion
Introduction

Group members
4 young scientists from different fields

• Atsuki Hiraguchi, Kochi Univ., Japan
  ◦ Lattice QCD
• Yu-Hsiang Tsai, Karlsruhe Institute of Technology, Germany
  ◦ SpMV on GPU (NVIDIA vs AMD)
• Koya Kobayashi, Aichi Prefectural Univ., Japan
  ◦ Deep learning (LSTM: Long Short-Term Memory)
• Carolee Nguyen, Univ. of California, USA
  ◦ Imaging (Dendritic branch terminal and length detection)
Atsuki Hiraguchi: “Quark confinement and color monopoles”

- Lattice QCD simulation
  - having been the mainstream of traditional HPC
- Up to $48^4$ lattice, $SU(2)$ model, Quench approx.
- Single node SX-ACE in Osaka univ.
Yu-Hsiang Tsai:
“Ginkgo’s SpMV on NVIDIA and AMD GPU architectures”

• Sparse Matrix Vector multiplication
• Mainstream of traditional HPC
• Compared NVIDIA Tesla V100 and AMD Radeon VII
• Porting from CUDA to HIP

<table>
<thead>
<tr>
<th></th>
<th>NVIDIA V100</th>
<th>Radeon VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warpsize</td>
<td>32</td>
<td>64</td>
</tr>
<tr>
<td>BandWidth</td>
<td>897 GB/s</td>
<td>1024 GB/s</td>
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<tr>
<td>FP64 Perf.</td>
<td>7.834 TFLOPS</td>
<td>3.360 TFLOPS</td>
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<tr>
<td>L1 Cache</td>
<td>128 KB</td>
<td>16 KB</td>
</tr>
<tr>
<td>L2 Cache</td>
<td>6 MB</td>
<td>4 MB</td>
</tr>
<tr>
<td>Price</td>
<td>US $ 10,669</td>
<td>US $ 699</td>
</tr>
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Koya Kobayashi: “Blood flow prediction using machine learning”

- LSTM: Long Short-Term Memory
  - A deep-learning method for time dependent stream like sound
- 3 days on 1 V100 GPU for training (with Keras and Python)

\[ y_i = f(x_i, x_{i-1}, \ldots, x_{i-N}) \]
Carolee Nguyen: “Automated reconstruction and quantification of regenerated Drosophila class IV da neurons”

- Depiction of total dendrite length and branch terminals parameters
- DeTerm
  - Open source software
  - CUI
  - Not easy to build and use
- Imaris
  - Commercial software ($30,000)
  - GUI
  - Better accuracy and user interface
Our Discussion
We are from different domains

- Particle Physics
- Computational Biology
- Neuro Informatics Science
- High Performance Computing
Mindmapping
Supercomputer Usability Challenges

Running Application → Building Application → Writing Application

Domain Researcher → Collaboration → System Researcher

Domain Knowledge → System Knowledge
Interdisciplinary Research
Research Goals

Domain researcher

- Wants to solve domain problems
- No system knowledge

System researcher

- Wants to solve “how to solve domain problems”
- No domain knowledge
Research Challenges

Domain Researcher

● Which software can help solve my research problem?
  ○ Accuracy
  ○ Time efficiency

● How do I use/understand the software?
  ○ Input requirements
  ○ User interface

● What do I do if there are no software to use?
  ○ Write your own software?

System Researcher

● How do we attract people to use software?

● How to understand the requirement/purpose of domain researchers?

● Flexibility vs Usability

● How to make clear documentation for the domain researchers?
Conclusion
Conclusion

● Interdisciplinary Talk
  ○ Opportunity for casual talks
  ○ BDR and R-CCS both have regular open talks
    ■ Not many go from one center to the other
    ■ One station is too much?
● Outside of Japan:
  ○ University of California, Irvine - Opportunities for collaboration in graduate school where we take one year in interdisciplinary field.
  ○ Karlsruhe Institute of Technology, Germany - Find a good time suitable for different timezone. (US in -7, Germany in +1 and Japan in +9

● Intermediate Languages / Domain Specific Languages
  ○ Danger of: Yet another thing?