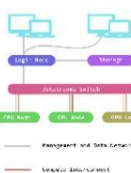


we will win with the power of

Well-designed Architecture

network and cluster overview

- **Login Node:**
 - Use JetStream2 m3.qd flavour, with 4 cores and 15GB memory
- **Compute Node:**
 - 200 Gbps bandwidth with < 0.5 μs latency
- **GPU Node:**
 - Use JetStream2 g3.large flavour, with 16 cores, 60GB memory, and dedicated 50% percent of an A100 through NVIDIA proprietary GRID driver
- **Networking:**
 - Use JetStream2's 100Gbps Ethernet to interconnect.



software choices

- Ubuntu GNU/Linux 24.04 LTS 'Noble': fast and stable
- always up to date with the latest performance and security improvements
- performance engineering tools pre-enabled and pre-loaded
- friendly to HPC applications with native support
- keep track with the modern Linux kernel 6.14
- ext4 for system root
- zfs for home directory: robust, efficient file system
- periodical snapshots, fast recovery from misoperation
- pool-based storage, easy to manage and share
- **Spack:** flexible package manager for HPC
- able to manage multiple versions of compilers, utilities, and libraries, including:
 - GCC@11.5.0, cuda@11.8
 - MPICH@3.1, FORTRAN
 - Blaspp@2025.05.28, Chameleon@1.3.0, GSI@2.8
 - Netlib Lapack / Lapacke



we will win with a team of

Diversity and Collaboration

Team Members

Yang Zhang Junior Math-CS Major



Yekai Dong Senior Computer Science Major



Haoxu Wang Junior Math-CS Major



Jiahao Huang Junior Math-CS Major



Feiran Qin Junior CS-Economics and Finance Major



Xinhe Yang Junior Computer Science Major



A Diverse Team

- ✓ Gender diversity (with female team member)
- ✓ Birthplace diversity (particularly in China)
 - members from 6 different provinces
 - with different cultural backgrounds
- ✓ Diversity of experience
 - different years of study
 - experienced HPC contestants and newbies
- ✓ Diversity of personal interest
 - take different courses: economy, algorithm, OS, AI, database, etc.
 - interested in different fields: math modeling, deep learning, network, etc.

- have different social works: student union, open source minor, etc.
- different extracurricular activities: photography, swimming, piano, etc.
- plan on different futures: doctor/master study, work, startup, etc.
- ✓ Different majors along with secondary majors)
 - ✓ Encourage females and students with interdisciplinary knowledge to join us

Cross-Skill Collaboration

Yang Zhang: Mathematics & CS

• team leader, Mathematics

Yekai Dong: Computer Science

• architecture, networking, infra

Feiran Qin: CS & Economics

• web development, networking

Jiahao Huang: Mathematics & CS

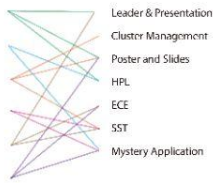
• systems, algorithm

Haoxu Wang: Mathematics & CS

• maths, algorithm

Xinhe Yang: Computer Science

• system, algorithm



...More backup members in Chemistry, Physics and other majors



we will win for

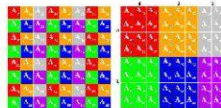
Specialized Optimizations

General Methodology

- Profiling: find out the hotspots of an application
 - Intel® VTune™ Amplifier, NVIDIA® Profiling Tools
- Code optimizing:
 - Overlap communication and computation
 - Cache optimization, data alignment, and branch prediction
- Compiling: with recent optimizing compilers and tuning options
- Tuning: mpmune, CPU affinity, NUMA binding, etc.

HPL

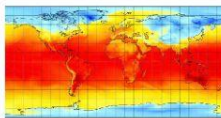
- Tune program input parameters:
 - fully understand and tune the problem size for each possible scale
 - Perform targeted adjustments of block size
 - Fine-tune the communication strategy tailored for virtual machines



HPL Process Illustration

ECE

- Use of hardware performance counters & tracing tools
- Found that Cholesky (decomposition) is one of the performance hotspots
- Express the algorithm as a fine-grained task DAG.
- Use ParSERIC to schedule tasks dynamically.
- Architecture-Aware Task Execution



Climate Data Visualization



Cholesky Decomposition Illustration

we will win since

They Support us

- Our School: Tsinghua University
 - Motto: Self Discipline and Social Commitment
 - Sprints: Actions Speak Louder than Words

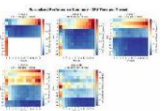


DIABLO



SST

- Thorough performance analysis
- Use MpIIP and HPC toolkit to make a clear picture of current issues
- High Synchronization Frequency & cost



Mystery Application

- Different compiling methods: Thanks to Spack
- Analysis: Scalability, communication-intensity, and GPU friendliness

we will win as we have

Team Preparation

- Our team prepares for the competition through regular weekly meetings where we discuss progress, challenges, and future plans. During these meetings, we also engage in collaborative problem-solving and share insights to refine our strategies.
- Additionally, we organize intensive development sessions to work together on key tasks and optimize our solutions.
- To ensure the growth of new members, we implement a mentoring program where experienced team members guide newcomers in solving problems and understanding the competition requirements.
- We also have access to a dedicated cluster specifically for training and preparing for the competition, which helps us test and improve our solutions effectively.
- Furthermore, we organize on-campus supercomputing competitions to attract interested students and help team members build a solid foundation.



Campus supercomputing competition



Team attending ISC25