Logistics

- **RAMEN**
  - MOU still being figured out (argh!)
  - Ready for OS install and configuration …

- Received some term paper abstracts
  - If you did not submit yours, please do so

- Received some personal project proposals

- Received some term project proposals
  - Currently there are 2 teams
  - If you are not on a team, get on one or form one

- **Schedule**
  - 5 weeks to go!
  - Gone next week, but will arrange for guest lectures
  - Need to shorten Thursday’s lecture by 10 minutes
Outline

- Motivation for parallel I/O
- TACC tutorial
  - Introduction to Parallel I/O
  - Ritu Arora, John Cazes, Robert McLay
  - Texas Advanced Computing Center (TACC)
- MPC
Motivation for Parallel I/O

- Much of the focus of parallelism is on processing
- Assumption is that the majority of the “total” time is being spent in computation
- However, at minimum, you still need to also:
  - Load the parallel program
  - Read in and initialize data at the start
  - Aggregate and write out results at the end
- Time is spent on these operations determined by:
  - Amount of “input” and “output” data
  - Performance of the I/O system
  - Only being used to move data (not computation)
Parallel I/O Architectures

- Like other components in parallel systems, "performance" can be improved with parallelism.

- What does that look like with I/O?
- Depends on where the data is
  - Depends on the parallel application
  - Depends on the parallel system being used

- Large-scale parallel machines with a large number of nodes will have data spread across many nodes
  - Necessarily will require the use of the parallel system itself for moving data to the I/O system
  - Devote special nodes and networks to support I/O
Sunway TaihuLight (#1 Top 500)

I/O system

20 PB storage
Parallel I/O Programming Interfaces

- Parallel I/O system software is mainly organized around a parallel file system
  - Integrated with the parallel I/O hardware and OS
  - Several have emerged (e.g., Lustre, GPFS, PVFS)
- Parallel file systems require an application programming interface (API) to be used
  - Issues of portability
- Higher-level parallel I/O libraries provide more support for data management

<table>
<thead>
<tr>
<th>Applications, e.g., FLASH, WRF, OpenFOAM</th>
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<tr>
<td>IO Libraries, e.g., Parallel HDF5, PNetCDF</td>
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<tr>
<td>Parallel I/O libraries, e.g., MPI-I/O</td>
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<tr>
<td>Parallel File Systems, e.g., GPFS, Lustre</td>
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<td>Data stored on Disk</td>
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CIS 631: Advanced Parallel Computing, University of Oregon
Lecture 8 – Parallel I/O Systems
See talk on CIS 631 “lecture” page