Online syllabus: Throughout the entire semester, this syllabus will be online at the URL


Course Description: Learn how to design and implement applications for extreme scale systems, including analyzing and understanding the performance of applications, the primary causes of poor performance and scalability, and how both the choice of algorithm and programming system impact achievable performance. The course covers multi-and many-core processors, interconnects in HPC systems, parallel I/O, and the impact of faults on program and algorithm design.

Prerequisites: Strong knowledge of C, C++, or Fortran, including writing, debugging, and optimizing an application. Some parallel programming experience is desirable. An understanding of basic computer architecture is strongly recommended.

Overall instructor: William Gropp, Professor of Computer Science at the University of Illinois at Urbana-Champaign. Dr. Gropp’s website can be found at http://www.cs.illinois.edu/~wgropp.

Local instructor: Craig C. Douglas whose web site is http://www.mgnet.org/~douglas.

Classrooms: Ross Hall 241 (Tu 11:00)

Class web page: http://www.mgnet.org/~douglas/Classes/hpc-xtc/2015s-index.html

Office hours: Ross Hall 227, MW 10:00-11:00, Tu, 9:00-10:00, and by appointment. Call my office phone first.

Homework: There will be some homework and a project in this course.

Exams: There will be some quizzes.

Lectures: Students will give lectures during the semester based on the PowerPoint files online. Students will offer written constructive criticism and comments on each lecture (and will be collected).

Grading: Grading will be based on the homework, quizzes, and project.

References: There are no textbooks that cover this material. There are, however, a number of good papers as well as books that cover parts of the material. These will be posted on the course website.

Learning objectives: Students should know how create extreme scale applications, analyze them for performance issues, and how to choose appropriate algorithms and data structures.

Cheating Policy: Getting caught cheating or plagiarizing will result in a failing grade and possibly much worse, including expulsion from the university and legal proceedings against you. Check with the university handbook, http://uwadmnweb.uwyo.edu/REGISTRAR/bulletin/honor.html, for more details.

Disability Policy: It is University of Wyoming policy to accommodate students, faculty, staff, and visitors with disabilities. If you have a physical, learning, sensory, or psychological disability and require accommodations, please let me know as soon as possible. You will need to register with University Disability Support Services (UDSS) in the Student Educational Opportunity offices, Room 330 Knight Hall, and provide UDSS with documentation of your disability. See the university handbook for more details.

Topics:

1. Introduction to large scale systems and application design
   a. Overview of extreme scale systems
   b. Quantifying performance
   c. Strategies for designing applications

2. Programming Extreme Scale Systems
   a. Programming Concepts
   b. Major programming systems: MPI, OpenMP, PGAS
   c. Manycore and multicore nodes
3. I/O at Scale
   a. I/O Models and Semantics
   b. I/O strategies
   c. Programming systems and libraries for I/O
4. Advanced Topics
   a. Reducing memory motion
   b. Load balancing and scalability
   c. Fault tolerance and resilience
   d. Future directions for extreme scale hardware and software