

## Math 6590.352: Extreme Scale Algorithms Online Class

**Professor:** Dana Brunson

**E-mail:** dana.brunson@okstate.edu (the best way to contact me)

**Office:** 106 Mathematical Sciences Building

**Office Phone:** (405) 744-4455

**Office Hours:** Open door and by appointment.

**Overview:** Oklahoma State University with the National Center for Supercomputing Applications Blue Waters project is pleased to offer this online course on designing and building applications for extreme scale systems for graduate students from diverse disciplines. This is a multi-university course that will be managed and instructed locally by Dana Brunson.

**Prerequisites:** Students should have a 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.

The instructor for this course is 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>

Material from last year's course is available at <http://wgropp.cs.illinois.edu/courses/cs598-s15/index.htm>.

### Course Description:

Many problems in the sciences require more computing power and I/O performance than is available on all but the largest machines. Using these systems effectively requires a quantitative approach to performance, applied from the selection of model and algorithm to the choice of programming languages and libraries. This course will introduce students to the features of extreme scale systems and how to use performance modeling to design, implement, and tune large-scale applications in simulation and data-intensive science.

### Tentative Weekly Schedule

1. Introduction to large-scale systems (1 week)
  - o Overview of extreme-scale systems
  - o Quantifying performance
2. Understanding performance – single core (4 weeks)
  - o Impact of memory on performance
  - o Performance models and estimation
  - o Vectorization
3. Parallelism on a node (2 weeks)
  - o Thread parallelism with Open MP and pthreads
  - o Memory models, correctness, and performance

4. Distributed memory systems and extreme scale (5 weeks)
  - MPI programming for extreme-scale systems
5. I/O at Scale (2 weeks)
  - I/O models and semantics
  - I/O strategies
  - Programming systems and libraries for I/O

**Course Organization:**

- Local meetings: To be determined
- <https://bw-course.ncsa.illinois.edu/> : Homework assignments and reading material, upload homework assignments, discussion forums. We'll follow the due dates shown on the homework submissions pages.

**Syllabus Attachment:** Please read the OSU syllabus attachment on the web, linked at <https://academicaffairs.okstate.edu/sites/default/files/documents/Spring%202016%20Syllabus%20Attachment.pdf>. This has a lot of important information, including instructions about disability accommodations. Please contact me privately during the first week of the course if you need accommodations as a result of a disability.

**Grading:** Your grade will be based on homework assignments and your final project.

- Homework: 80%
- Final project: 20%

Earning at least 90% guarantees an A, 80% guarantees a B, etc.