Concurrent Scientific Programming

http://www.cse.psu.edu/~madduri/teaching/CMPSC450

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Class Overview and Topics. This class introduces students to parallel programming and the design of parallel algorithms for scientific applications. We will also study challenges with concurrent execution and synchronization on current shared- and distributed-memory systems, and solution techniques.

The topics to be covered in this class include:

- Parallel Algorithm Design and Analysis: Models for algorithm analysis, Sources of concurrency, Overview of current parallel systems.
- High-performance Parallel Programming: Programming models and libraries (MPI, OpenMP, CUDA), Optimizations for serial performance, Memory locality.
- Parallelization Techniques: Divide and conquer, Balanced trees, Pointer jumping, Pipelining, Randomization.
- Applications: Dense linear algebra, Sparse matrix computations, Sorting, FFT, N-body methods, Graph Analytics.

Prerequisites. CMPSC 121, CMPSC 201 or CMPSC 202 (students must be proficient in sequential programming and C/C++); MATH 220; MATH 230 or MATH 231.


Class Material. All class presentations, lecture notes, and homework assignments will be posted on Penn State’s Angel CMS. Please send me email through Angel. We will also be using Piazza for class discussions, announcements, and for clarifications regarding homeworks and exams.

Evaluation and Grading. The class grade will be based on three homeworks (20%), online assessments (15%), class participation (5%), attendance (5%), a ‘scientific computing’ mini-project (10%), an in-class midterm exam (Feb 27, 20%), and a final exam (25%).

Attendance Policy. I strongly encourage students to attend all the lectures. Please let me know if you will be missing multiple classes for legitimate, unavoidable reasons. I will periodically take a roll call in class, and will use the aggregate attendance count for your 5% class attendance grade.

Academic Integrity. Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception.
Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others. Students must abide by the administrative policy for academic integrity (please see http://www.psu.edu/oue/aappm/). Avoid plagiarism (http://tlt.its.psu.edu/plagiarism/tutorial), and please contact me first if you are in doubt.

**Educational Equity.** Penn State welcomes students with disabilities into the University’s educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at http://equity.psu.edu/ods/ In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at http://equity.psu.edu/ods/guidelines/documentation-guidelines). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.