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

Instructor. Prof. Kamesh Madduri, 343E IST Building, madduri at cse.psu.edu, 814-865-0883. Office hours: TR 9-10.15 AM (343E IST), or by appointment (madduri.org/cal).

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.
- 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 the C language); MATH 220; MATH 230 or MATH 231.


Class Material. All class presentations, lecture notes, and homework assignments will be posted on Penn State’s Canvas CMS. Please send all class-related messages to the instructor through Canvas. We will also use Canvas for announcements, class discussions, and for clarifications regarding homework and exams.

Evaluation and Grading. The class grade will be based on homework assignments (25%), in-class quizzes (20%), class participation through scribed notes for a lecture (5%), a ‘scientific computing’ or ‘high-performance programming’ mini-project (10%), an in-class midterm exam (Feb 28, 15%), an oral exam and programming test (March 27-31, 5%), and a final exam (20%).

Attendance Policy. Class attendance is one of the most important ways students learn and understand course materials. It is a critical element of student success. On exceptional occasions, students may miss a class meeting to participate in a regularly scheduled university-approved curricular or extracurricular activity (such as Martin Luther King’s Day of Service, field trips, debate trips, choir trips, and athletic contests), or due to unavoidable or other legitimate circumstances such as illness, injury, military service, family emergency, religious observance or post-graduate,
career-related interviews when there is no opportunity for students to re-schedule these opportunities (such as employment and graduate school final interviews.)

In all cases, students should inform the instructor in advance, where possible, and discuss the implications of any absence. Missing class, even for a legitimate purpose, may mean there is work that cannot be made up, hurting the students grade in the class. Likewise, students should be prepared to provide documentation for participation in University-approved activities, as well as for career-related interviews, when requested by the instructor. Students who will miss a class in accordance with Senate Policy 42-27, should present a class absence form.

**Academic Integrity Statement.** The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect other students’ dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (refer to Senate Policy 49-20). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University’s Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9). Please note that the CSE department’s academic integrity statement also applies to this course.

**Accessibility Statement.** Penn State welcomes students with disabilities into the University’s educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources Web site provides contact information for every Penn State campus. For further information, please visit the Student Disability Resources Web site.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation. If the documentation supports your request for reasonable accommodations, your campus’s disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

**Counseling & Psychological Services (CAPS) Statement.** Students who experience personal issues that interfere with their academic performance, social development or satisfaction at Penn State are encouraged to seek confidential assistance from Counseling and Psychological Services (CAPS) Center. They can be reached at (814) 863-0395. Some of the more common concerns they can help with include anxiety, depression, difficulties in relationships (friends, roommates, or family); sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs. Crisis intervention is available from Centre County CAN HELP at 1-800-643-5432, 24 hours a day, seven days a week.