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Change log
8/3/2022 Document created.
8/21/2022 Office hours added
8/21/2022 Office hours changed

Syllabus Disclaimer

This syllabus is subject to change. You will be notified of any changes as far in advance as possible via an announcement on Piazza (and possibly Brightspace). Monitor your Purdue email daily for updates.

The syllabus is the ground truth for course policies. If the slides or other material give different information than the syllabus, that information is incorrect.

Course Information
- ECE 56300 Programming Parallel Machines
- CRN: 27663, 28560, 28618
- Meeting times: In-person classes will be at 10:30 – 11:20, MWF, 2579 Wang Hall. Recordings of lectures will be made available to all students.
- Office hours: M 12:-00 – 1:00, W 1:00 – 2:00, EE 310. T 11:00 – 12:00, Th 10 – 11:00 via Zoom at https://purdue-edu.zoom.us/j/97341373144
- Course credit hours: 3
- Course information will be distributed using Brightspace. There is one Brightspace page for both sections. Piazza will be used for questions. Piazza can be accessed at https://piazza.com/class/l6e0atu96mf1fj
- Prerequisites: The ability to program in C, C++ or Fortran.

Instructor(s) Contact Information
Provide information on the ways students can reach your Brightspace, Purdue email, phone, text, office location or dedicated student contact hours. If additional individuals are key contact persons (TAs, co-instructors, etc.), include information for them as well.
- Name of the instructor: Sam Midkiff, Professor
- Office Location: EE 310, but I will not be there this semester.
- Phone number: 494-3440 (this is *not* a good way to contact me, I give it only because I am supposed to give it.)
- Purdue Email Address: smidkiff@purdue.edu (this is a *great* way to contact me for non-technical questions. **Put "ECE 563" in the subject line**. Not putting **"ECE 563"** in the subject line can cause your email to be ignored.
- How to reach me remotely: Technical and non-private questions should be asked on Piazza. If you ask technical questions in email I will likely post the question to Piazza and answer it there. If you have something personal, ask by email or set up an appointment by email and we can discuss over Zoom.

TA Contact Information

- There is no TA for this class.

Course Description

This course will enable you to write programs targeting parallel machines, using any of the four major parallel programming paradigms: MPI (message passing), OpenMP (for shared memory machines), Pthreads thread programming (for shared memory machines.) and, I hope, GPU programming (using Cuda).   We will also discuss system architecture and memory and programming language coherency models, as these are necessary to develop correct parallel programs and to debug parallel programs when they are not correct.   We will also spend time on sequential performance optimizations.

This is not a course in parallel algorithms, although you will need implement one or more parallel algorithms for the course project.

Learning Resources, Technology & Texts

There is no required text. The lectures will follow the book *Parallel Programming in C with MPI and OpenMP*, along with supplemental material I will provide. This book may be at the local bookstores.

Available for free from the Safari database at the Purdue Library: *An Introduction to Parallel Programming*, Peter Pacheco covers MPI and OpenMP; *Programming Massively Parallel Processors*, David B. Kirk, Wen-mei Hwu covers GPU programming; *CUDA Programming*, Shane Cook cover CUDA programming.

The course will be pretty self contained, but feel free to reference these if you want more information or a different explanation.

Learning Outcomes

By the end of the course, you will be able to:

- Write a parallel program using MPI
- Write a parallel program using OpenMP
- Write a parallel program using explicit threads
- Write a GPU program using Cuda (assuming I can get GPU simulators installed for you to use.)
- Compute the performance, efficiency and performance of a parallel program
- Decide on the suitability of a parallel algorithm for a particular parallel programming model.

How to succeed in this course

- Keep up with the class

Updated August 6, 2020

- Ask questions on Piazza and in office hours if you don't understand concepts
- Do the homework and look at the solutions. Ask questions if you don't understand the solution.

Teaching Philosophy

It is my desire to give you the opportunity to learn. I cannot force you to learn, and learning a programming languages requires both an intellectual understanding of the semantics (meaning) of its features and how those features are implemented, and a practical understanding of how to use those features in a language. The first of these require the student to do the hard work of thinking about the features, and reaching out to the instructor and TAs when they are still not clear. The second of these require the student to practice writing programs, to attempt to solve programming problems on their own, and to reach out when problems appear to be taking too much time.

Assignments

Assignments	Due	Points
Homework	Throughout the semester	35
Project	Friday of Dead Week	50
Exam 1	Around October break week	7.5
Exam 2	The week before dead week, probably a take home, but shorter than the first exam.	7.5

Grading Scale

I generally do not curve, but see the note below. I guarantee that if you make in the ranges shown, you will get at least that grade:

- A: 90 – 100
- B: 80 – 89
- C: 70 – 79
- D: 60 – 69
- F: below 60

I sometimes give A- to a few of the highest B grades and C+ to a few of the highest C grades. I sometimes give B+ to a few B grades below those that received an A-, and similarly for C+. Thus, you can make a higher grade than shown above, but you will not make a lower grade.

Incompletes: According to the Grades and Grade Reports section of Academic Regulations, "A grade of incomplete (I) is a record of work that was interrupted by unavoidable absence or other causes beyond a student's control..." Further details on these circumstances and the process for assigning types of incompletes are outlined in the regulations. Please contact me as soon as you think an incomplete might be needed in this course and before final course grades are due.

Course Logistics

Test will be online with zoom monitoring and several time periods available to take it, or as take home tests.

Homework and the project

All homework will be posted and turned in to Brightspace. Instructions will be given as to the directory structure and names of files. Failure to follow these instructions may result in the homework not being graded. I will be nicer for the first few assignments.

Course Schedule

This is a rough guideline.

Week	Topic & Readings	Assignments and reading
Week 1	Intro to parallelism, overview of computer architecture	
Week 2	Overview of computer architecture, shared memory programming with OpenMP, shared memory consistency models	
Week 3	shared memory programming with OpenMP, shared memory consistency models	
Week 4	MPI and distributed memory programming: 2 lectures	
Week 5	MPI and distributed memory programming: 2 lectures	
Week 6	Alogorithm Design, Tuning applications and speedup theory	
Week 7	Strong and weak scaling, etc. theory, Isoefficiency, project lecture	
Week 8	Pthreads, GPUs	
Week 9	Take home exam	
Week 10	GPU programming	
Week 11	Machine learning and parallelism	
Week 12	Machine learning and parallelism	
Week 13	Go	
Week 14	Go, Intel AVX instructions	*Week of April 19*
Week 15	Catch up	*Dead week*

* Schedule and assignments subject to change. Any changes will be posted in the learning management system.

Some key university dates for the Spring 2022 semester:

- August 22, first day of classes
- September 5, Labor Day

- October 10-11, October Break
- November 23 – 26, Thanksgiving Vacation
- December 10, classes end (Saturday)

Attendance Policy

I do not take attendance and attendance is not required although I sincerely hope that it helps you to learn.

Even though Purdue's Covid-19 restrictions have been relaxed, please do not attend class or any in-person activity associated with this class (or in general, for that matter, but I'm only responsible for this class) if you are not well. I don't want to be sick, be it Covid-19, the flu, a cold, or whatever, and your fellow students don't want to be sick. The lectures will be available to watch.

When conflicts can be anticipated, such as for many University-sponsored activities, religious observations, or job interviews, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflict, when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by.

When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. I would appreciate also be notified in these situations if it is not an undue burden. Our course Brightspace includes a link on Attendance and Grief Absence policies under the University Policies menu.

Course Logistics

Assignment are posted and collected on Brightspace. Instructions will be given on how to structure directories, etc., when turning in an assignment.

Protect Purdue Policies will be followed. If masks are not required, I will not wear one by default, but will if you feel more comfortable.

Academic Guidance in the Event a Student is Quarantined/Isolated/Sick

Regardless of whether you have covid, the flu, a cold, the Purdue crud, or any other contagious illness, please do not attend class or in-person office hours until you are well. Let's be team human and prevent, rather than encourage, the spread of bad viruses. Videos will be available on the material covered and remote office hours are available.

Classroom Guidance Regarding Protect Purdue

Prof. Midkiff will enforce whatever the polices are in the class room, so just do what the University asks, and we'll spend our class time learning C++ and Java.

From the Provost: Any student who has substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights and the Violent Behavior Policy under University Resources in Brightspace.

Academic Integrity

I will not tolerate cheating – it is unfair to your fellow students, prevents you from learning, creates work for me, and is dishonest. I will punish cheating to the maximum extent possible, including failure in the course. Any representation of work as being yours when it is largely the work of others constitutes cheating, unless I have given permission to use external work, such as XML parsers used in the project.

Project code should never be shared and should not be placed on public repositories, unless password protected, until the semester is over. Questions about assignments should be asked on Piazza – this will serve as a safe harbor.

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

I expect all students to live up to the Purdue Honor Pledge:

The Purdue Honor Pledge "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue".

You should be familiar with the student guide for academic integrity.

1. Posting of course material on publicly accessible web pages, such as your own web page, Course Hero, Quizlet or other web sites is a violation of my copyright on the material and is prohibited. This includes course slides, videos, exams and solutions, and homework.
2. In general, notes are "considered to be 'derivative works' of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials." As such, they cannot be sold or bartered without my express written permission. See the policy with regard to commercial note taking in classes that you may wish to include in your syllabus (see part J of the Purdue student miscellaneous conduct regulations).

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. More details are available on our course Brightspace table of contents, under University Policies.

I will not tolerate rude or abusive behavior towards your fellow students, or towards the TAs, graders, or undergraduate TAs.

Accessibility

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. More details are available on our course Brightspace under Accessibility Information.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on website or can be obtained by contacting the instructors or TAs via email. You are expected to read your @purdue.edu email on a frequent basis.

Related Considerations and Guidelines
1. Keep your cell phone on to receive a Purdue ALERT text message.
2. Log into a Purdue computer connected to the network to receive any Desktop Popup Alerts.
3. If you have a "no cell phone" in class policy, allow one or two students who have signed up for Purdue ALERT to keep their phones on to receive any alerts