

CPSC 5600 - Parallel Computing

SYLLABUS AND SCHEDULE | Fall Quarter 2023

Course description

Fundamentals of parallel computing with an emphasis on parallel programming and algorithms. Parallel algorithmic analysis and development using divide and conquer, map and reduce, and data decomposition. Parallel computing implementations and performance factors.

Prerequisite: C or better in CPSC 5031 and CPSC 5042

Course information

Course code: CPSC 5600-01

Credits: 5

Lecture at: BANN 371

Class times: MW, 3:40 – 5:45

First session: 2023-09-20

Last session: 2023-12-02

Instructor information

Instructor: Braxton Cuneo

Phone: TBD

Email: bcuneo@seattleu.edu

Office: SINE 220-01

Online office: seattleu.zoom.us/j/2809286771

Learning outcomes

On successful completion of this course (i.e. by *passing* this course), you will be able to

1. Compute the work and span of a parallel algorithm.
2. Calculate the implications of Amdahl's law for a particular parallel algorithm.
3. Describe why synchronization is necessary of parallel programs.
4. Identify opportunities for data level and task level parallelism within a program.
5. Implement a parallel divide-and-conquer algorithm and empirically measure its performance relative to its sequential analog.
6. Write parallel programs using a parallel program library / framework.
7. Decompose a problem via map and reduce operations.
8. Describe how data distribution/layout can affect an algorithm's communication costs
9. Detect and correct a load imbalance.
10. Explain the impact of scheduling on parallel performance.

MSCS Program Learning outcomes

This course is an applied algorithms course, therefore...

The course strongly contributes to these program learning outcomes:

1. Demonstrate a mastery of the core areas of computer science and advanced knowledge in selected areas of the field.
2. Demonstrate the ability to understand computer science literature, with sufficient mathematical and analytical maturity, to maintain professional currency.

The course contributes to these program learning outcomes:

1. Demonstrate the ability to convey technical material through both formal written papers and oral presentations.
2. Apply appropriate computer science fundamentals and practices to development and evolution of software systems, exhibiting awareness of relevant ethical and social considerations.

Office (student) hours

I plan on hosting office hours. These office hours are TBD. In-person office hours will be at my office **(SINE 220-01)**. Remote office hours will be held over Zoom.

The time I have listed as “Office hours” is time for you. Office hours are a chance for you to meet with me one-on-one or in small groups to discuss the course, your learning, your plans for the future, or just to check in. If we are meeting over Zoom, we’ll use my Personal Meeting ID at seattleu.zoom.us/j/2809286771.

Grading Policies

Grading:

Reading	5%
Programming Assignments	40%
In-Class Activities/Quizzes	15%
Exams	40%

Letter Grade Cutoffs

A	≥ 93%	C	≥ 73%
A-	≥ 90%	C-	≥ 70%
B+	≥ 87%	D+	≥ 67%
B	≥ 83%	D	≥ 63%
B-	≥ 80%	D-	≥ 61%
C+	≥ 77%	F	< 61%

Final Grade:

Your final grade will be calculated as noted above, however; you must receive at least 60% on the Final Exam to receive a grade of C or above (to qualify for CPSC 2430). If your Final Exam grade is below 60%, the best final grade you can receive in the course will be a C-.

Additionally, the weight of any lost points in the “In-Class Activities/Quizzes” category will be transferred to the “Exam” category when calculating your Final Grade.

Programming Assignments:

All projects are due at the date and time indicated on the course Canvas site. These dates and times will remain unchanged unless explicitly stated by the instructor through an announcement via Canvas/email.

Programs will be graded according to a set of standard criteria, including but not limited to functionality, documentation and style. A rubric detailing the requirements will be posted on the course website with each assignment.

Grading Turnaround:

The assignments in this course build on one another, so the feedback process is an important part of your learning. My plan is therefore to return your assignments soon after you have submitted them – within 5 working days. Faster feedback means you’re more likely to remember what you wrote and can more easily take the feedback on board for the next assignment.

ASSIGNMENT DEADLINES AND EXTENSIONS

Bonus Days

Each of you have been granted **six (6) Bonus Days**, which are no-questions-asked one-day extensions which may be applied to **any assignment or lab**, subject to the following rules:

1. No more than **2 Bonus Days** may be applied to any one assignment or lab
2. Bonus days **cannot** be applied to **any test**, including **quizzes, midterms, and finals**
3. No Bonus Day can applied multiple times. **The maximum number of one-day extensions you may receive via Bonus Days for this class during this term is 6.**

Using Bonus Days:

Unless you notify the instructor to the contrary, your unused Bonus Days will be automatically applied to your late assignment/lab submissions. The automatic application of your Bonus Days also follows the rules outlined in the previous section.

If you do not wish to use a Bonus Day for a late assignment/lab, or if you wish to re-assign a Bonus Day from one late assignment/lab to another, you must notify the instructor before the day of the Final Exam.

Measuring Lateness:

Assignments and labs that are submitted on Canvas are considered late by the date and time of submission indicated by Canvas. Likewise, the lateness of assignments and labs that are submitted through school servers (eg. cs1) will be determined by the records and metadata of the saved file submissions, as judged by the instructor.

Further Lateness:

Bonus Days are meant to account for the common-day setbacks you may encounter during this term, and so should be used wisely. **Any lateness beyond that forgiven by Bonus Days will be addressed seriously.** In these cases, further justification, including documentation, may be required.

If not granted an extension by the instructor, submissions made after the extended deadline granted by Bonus Days will receive a 2% deduction each hour until 50 hours have passed. After 50 hours, the project will receive a grade of zero.

An agreement to receive an Incomplete (I) grade may be negotiated if your circumstances do not allow you to finish the course on time. The Incomplete Grades Policy of the university is available on the Office of the Registrar web site:

<https://www.seattleu.edu/redhawk-axis/academic-policies/>

ACADEMIC INTEGRITY TUTORIAL

<https://www.seattleu.edu/academic-integrity/resources-for-students/>

- 1) All work is required to be completed by the individual, unless EXPLICITLY noted otherwise.
- 2) Academic Integrity violations will be treated seriously.
- 3) Code samples from other sources (online, books, friends) may NOT be used without EXPLICIT permission to do so. If you reuse other code, even with modifications, you must acquire permission AND cite the source.
- 4) Submitted assignments are expected to be your own work.
- 5) Solutions or partial solutions found online are not acceptable.
- 6) Remember, if you can find code online, so can your instructor

COURSE COLLABORATION POLICIES

Of course, I'd like you to gain the most from this development experience by thinking through all the issues and developing the code on your own along with your colleagues, so here are our policies:

What's OK:

- You can casually look at the current project's work of your classmates while you are personally engaging with them (in a conversation, studying together, etc.).

What's Not OK:

- You cannot get an electronic copy of any of the current project's work of your classmates.

What's Required:

- Every line of code must be able to be verbally explained and justified by you alone. Rule of thumb: if you don't know what that bit of code does, then don't include it in your submission!
- All code obtained from sources outside of approved course resources must be documented in your code (as a comment).

I am mainly relying on an honor system of everyone following the above policies.

CHANGES TO SCHEDULE AND CURRICULUM

Your learning is my primary concern in this course, so I may modify the schedule or curriculum if, for instance, we discover we need to spend time on a certain topic and less on another.

How class will work

YOUR WORKLOAD IN THIS COURSE

For every hour in class, you can expect to devote an average of two hours outside of class for readings and preparation, as well as substantive assignments and participation exercises. As this is a five-credit class, you can reasonably expect an average of 10 hours of homework each week. I have tried to ensure that the workload is evenly distributed throughout the course, but if you find you have less than the normal amount of work one week, I suggest you read ahead for future classes.

INSTRUCTIONAL METHODS

I will regularly ask for your feedback on how the class format is working for you. Expect there to be a few changes as the quarter/semester progresses. For instance, I may modify the schedule if we discover we need to spend time on a certain topic and less on another. In any changes, I will be putting your learning first.

CLASSROOM NORMS

During our first class session, we will jointly create course norms (or “agreements”) to which we will all abide so that we have the most productive and positive remote learning environment. In face-to-face classes, regular examples have included that we agree to:

- Start and end on time
- Come to class prepared
- Participate actively in discussion
- Show one another courtesy, including when we disagree.

We may revisit these norms to focus on what works for our learning together, including norms for sessions via Zoom and norms for online discussions.

MISSED CLASSES

If you expect to be absent or to be late, **please e-mail me beforehand** (or as soon as possible). If for any reason you do miss a class, be sure to obtain notes from one of your peers to catch up. If, after going over those notes and checking the readings for the class, you still have questions, please arrange to meet me during office hours to discuss them. Remember to bring those notes with you so that we can work on your specific, focused questions.

ZOOM CLASS RECORDING

Zoom meetings of this course may be recorded. Any recordings will only be available to students registered for this class. Recordings may not be reproduced, shared with those not in the class, or uploaded to other online environments.

Academic resources to support your learning

My goal is to create a learning environment in which you can be successful and feel supported. I will work hard to create and improve the learning environment throughout the quarter based on my own observations of the course and your feedback on what would help you learn more. In return, I ask and encourage you to make the most of this learning opportunity.

I encourage you to explore the services below and to work on the assumption that you'll always be developing some new strategies that will help you become a more flexible learner. I am keen to support you in that growth, and plan to build in opportunities for us all to share new strategies with one another either in scheduled class time or via Canvas.

LIBRARY AND LEARNING COMMONS

<http://www.seattleu.edu/learningcommons/>

WRITING CENTER

The Seattle University Writing Center supports SU students from all levels of writing expertise, voices, experiences, and writing practices to achieve their writing goals. We seek to provide an accessible, anti-oppressive, and collaborative space for learning and growth through one-on-one peer consultations. The peer consultants are also students who engage in intensive study and hands-on practice to provide thoughtful feedback and to share writing strategies.

Consultations are available at any stage of the writing process, from brainstorming, organizing, and developing rough draft to revising and editing in later drafts. The Writing Center offers appointments in various modalities: in-person and online, synchronous, and asynchronous.

Please visit <https://www.seattleu.edu/writingcenter/> to learn more about the Writing Center. You can schedule an appointment and select an available modality through <https://seattleu.mywconline.com/>

LEARNING ASSISTANCE PROGRAMS

Learning Assistance Programs (LAP) provides peer tutoring, facilitated study groups, and learning strategy development through scheduled workshops and individual consultation sessions with a learning specialist. We offer these in various modalities (in-person, synchronous, and asynchronous), depending on university policy and LAP staff availability.

Please visit our website <https://www.seattleu.edu/learning-assistance/> or e-mail us at learningassistance@seattleu.edu for the most updated information about accessing services.

ENGLISH-LANGUAGE LEARNING CENTER (ELLC)

The English Language Learning Center (ELLC) offers free tutoring for all SU students who are multilingual speakers and for whom English is not their first/primary language. Experienced ELLC tutors can help you improve your English language skills and better understand American culture. We can help with any type of assignment: written essays, online discussions, oral presentations, interview practice, etc. For the schedule or to book a session please visit <https://www.seattleu.edu/ellc/ellc-tutoring/>

SUPPORT FOR REMOTE LEARNING

Remember to review the online tutorial that our Center for Digital Learning and Innovation has created to support your remote learning experience:

<https://seattleu.instructure.com/courses/1563070>

BORROW A CHROMEBOOK OR AN INTERNET HOTSPOT FROM THE LIBRARY

If you are having difficulty with remote learning because your laptop is older or your internet access is patchy, the Library is currently loaning out Chromebooks and internet hotspots. You can submit a request by emailing the Library; follow the link under “Technology Lending” at:

<https://libguides.seattleu.edu/technology#s-lg-box-23259286>

Further campus resources

I recognize that your ability to focus on your coursework does not exist in a vacuum. Your physical, mental, and emotional health and well-being is integral to your success as a student. Below are some campus resources that are available to support your overall well-being.

SU FOOD PANTRY

The SU Food Pantry provides free, supplementary food to all students, staff, and faculty with a current Seattle U ID card. The Pantry is located in Pavilion 180 (Office of Multicultural Affairs) and is part of a larger Food Security Initiative at Seattle University. Learn more at

<https://www.seattleu.edu/oma/food-security-initiative/>

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS)

CAPS offers short-term, individual therapy and referral and consultation services for currently enrolled SU students. Clinical services are confidential, provided by licensed clinicians, and free of charge. Call (206) 296-6090 to schedule an appointment. For detailed information about current services and resources visit <https://www.seattleu.edu/caps/>

TALKNOW

TalkNow offers 24/7, on-demand, emotional support from a mental health professional to talk about anything at anytime, provided by TimelyCare. There are no out-of-pocket costs or insurance requirements. For more information about the service and registration visit

<https://www.seattleu.edu/wellness/timelycare/>

988 - SUICIDE AND CRISIS LIFELINE

You can call or text 988 for 24/7 crisis support or can chat online at <https://988lifeline.org/>

University policies

SUPPORT FOR STUDENTS WITH DISABILITIES

Seattle University values diverse types of learners and is committed to ensuring that each student is afforded an equal opportunity to participate in learning experiences. Disability Services (DS) works with students with disabilities to provide reasonable accommodations to support their learning experiences. Disabilities include “invisible disabilities,” such as a learning

disability, a chronic health problem, or a mental health condition. This could include any long-term effects of COVID, even after recovery ("long-COVID"), if a health care provider determines it is a chronic health problem.

If you have, or suspect you may have, a disability that may interfere with your performance as a student in this course and have not yet been assessed by DS, please contact DS staff at DS@seattleu.edu or (206) 296-5740. Disability-based accommodations to course expectations can be made only through this process and must be approved by DS before implemented in a course. I am committed to working with you, so please consider meeting with me to discuss the logistics of implementing any accommodations approved by DS.

NOTICE ON RELIGIOUS ACCOMMODATIONS

It is the policy of Seattle University to reasonably accommodate students who, due to the observance of religious holidays, expect to be absent or endure a significant hardship during certain days of their academic course or program. Please see, Policy on Religious Accommodations for Students (<https://www.seattleu.edu/media/policies/Policy-on-Religious-Accommodations-for-Students---FINAL.PDF>).

ACADEMIC POLICIES ON THE REGISTRAR WEBSITE

<https://www.seattleu.edu/redhawk-axis/academic-policies/>

Be sure that you understand the following university academic policies, posted on the Registrar's website:

ACADEMIC INTEGRITY POLICY:

ACADEMIC GRADING GRIEVANCE POLICY

PROFESSIONAL CONDUCT POLICY

HEALTH AND SAFETY PROTOCOLS

Seattle University is committed to our educational mission and to the safety of our community members. The university continues to closely monitor COVID-19 developments and respond accordingly based on public health guidance. For more information about the university's COVID-19 response, including current policies and protocols, please visit:

<https://www.seattleu.edu/coronavirus/reopening--covid-policies/>

CHANGE IN DELIVERY OF INSTRUCTION

SU reserves the right to change the delivery of instruction for courses without prior notice due to COVID-19 or other events.

We respectfully acknowledge that this class is taking place on the homelands of the Coast Salish peoples, who continue to steward these lands and waters as they have since time immemorial. We recognize tribal nations and organizations who actively create, shape, and contribute to our thriving community at Seattle University and beyond.

We, as an academic community, should be and are committed to doing our part to engage with and amplify the voices of Native peoples and tribes. We acknowledge our collective responsibility to advance proper education of Native peoples and tribes and call for further learning and action to support the Native people of this land.