

Computer Science 6650 Scalable Distributed Systems

*Graduate Course, Khoury College of Computer Sciences
Northeastern University, Vancouver Campus
Spring 2022 Semester*

We acknowledge that the land on which we gather is the unceded territory of the Coast Salish Peoples, including the territories of the xʷməθkʷəy̓əm (Musqueam), Skwxwú7mesh (Squamish), and səlihwətal̓ (Tsleil-Waututh) Nations.

Class Hours: Friday 2:30-4:30 (Pacific time)

Class Location: Northeastern Vancouver Campus (Room 1425)

Instructor: Yvonne Coady (m.coady@northeastern.edu)

TAs: Francisco Proboste Cardenas (probostecardenas.f@northeastern.edu)
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Covers the essential elements of distributed, concurrent systems and builds upon that knowledge with engineering principles and practical experience with state-of-the-art technologies and methods for building scalable systems. Scalability is an essential quality of internet-facing systems and requires specialized skills and knowledge to build systems that scale at low cost.

NOTE: in addition to our class time every Friday 2:30-4:30 where we will be getting a good workout in groups, all students are expected to view any/all videos and references before class, and attend mock interviews as scheduled. You should allocate a **minimum of 20-25 hours a week for this course**. There are many challenges in setting scalable software up on a cloud, and giving yourself enough time is key!

Course Outcomes

- Exhibit proficiency in the design, implementation of scalable system software.
- Demonstrate the ability to systematically test and analyze system infrastructure software.
- Read, discuss, and extract key ideas from both theoretical and applied research papers published at computing conferences.

Recommended resources (there is no textbook for the course, but these are classics!)

- Java Concurrency in Practice 1st Edition, Brian Goetz, Tim Peierls, Joshua Bloch, Joseph Bowbeer, David Holmes, Doug Lea
- Distributed Systems : concepts and design, Coulouris, George F. ; Dollimore, Jean. ; Kindberg, Tim. ; Blair, Gordon. Harlow, England ; Addison-Wesley 2012
- Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, Martin Kleppmann, O'Reilly
- Distributed Systems for Fun and Profit, Mikito Takada, ([online](#))

Course Schedule (subject to adjustment!)

Week	Work Due (by Monday 9AM before class)	% of Grade	Date of Class	Topics
1	-	-	Jan 13	<i>Introduction</i>
2	Homework 1	6%	Jan 20	<i>Concurrency</i>
3	Homework 2	6%	Jan 27	<i>Architecture</i>
4	Homework 3	6%	Feb 3	<i>Fundamentals of Distributed Systems</i>
5	Homework 4	6%	Feb 10	<i>Scalable Service Design</i>
6	Homework 5	6%	Feb 17	<i>Asynchronous Systems</i>
7	Homework 6	6%	Feb 24	<i>Microservices</i>
8	Midterm Mastery	12%	Mar 3	<i>Replication, Partitioning, Consistency</i>
9	<i>SPRING BREAK!!!</i>			
10	Homework 7	6%	Mar 17	<i>Strong Consistency</i>
11	Homework 8	6%	Mar 24	<i>NoSQL Databases</i>
12	Homework 9	6%	Mar 31	<i>Serverless Systems</i>
13	Homework 10	6%	Apr 14	<i>Stream Processing</i>
14	Homework 11	6%	Apr 21	<i>Practical Considerations</i>
14	Final Mastery	12%	Apr 21	<i>Poster, Presentation, Report overview</i>
15	Final Project Due	10%	Apr 24	<i>Final report Due</i>

Course Assessment

There are four methods of assessment in this course.

- **Homework (66%)** consist of research assignments and literature reviews that will enable you to do a “deep dive” into each part of a research project. One part of each homework exercise will be a team based exploration.
- **Midterm and Final Masteries (24%)** will be a presentation of the work you have done on your Capstone Project so far, identifying any obstacles you may have encountered. This will include a detailed problem description, literature review, with possible solutions discussed in terms of tradeoffs, and a low-fidelity prototype
- **Final Project (10%)** work includes a project proposal, a written report, several presentations and a final presentation on the last day of the course. Your final deliverable will include a poster, a report/paper and a presentation.

We will use the following scale to convert numerical scores into letter grades:

A	93.00% – 100.00%
A-	90.00% – 92.99%
B+	86.00% – 89.99%
B	82.00% – 85.99%
B-	77.00% – 81.99%
C+	73.00% – 76.99%
C	69.00% – 72.99%
C-	65.00% – 68.99%
F	Less than 65.00%

Course Pedagogy

Our time in the classroom (virtual or otherwise!) will be devoted to Team Based Learning activities. In Computer Science, we seldom get anything right on the first try. We see how an attempt turned out, and we try again. Often, any solution to a problem has a series of trade-offs, all of which must be considered! Our classroom activities will reflect this approach as well; so please be prepared to present and discuss your solutions, even if you're not sure that your answer is "right"!

When you come to class, we ask that you be fully present. No phones are permitted in the classroom. If you use a laptop, use it only to take notes. Please be respectful of your fellow students and instructors by participating attentively and non-disruptively.

To create and preserve a classroom atmosphere that optimizes teaching and learning, all participants share a responsibility in creating a civil and non-disruptive forum for the discussion of ideas. Students are expected to conduct themselves at all times in a manner that does not disrupt teaching or learning. Your comments to others should be constructive and free from harassing statements.

In order for this course to be a meaningful learning experience, you will need to come to each class well-prepared, with all assigned readings and videos complete, as well as your individual work finished to the best of your ability. This emphasis on pre-class work is the reason why our class meets for only 2 hours each week. If you do not complete the pre-class work, you will have a hard time following the in-class activities, which will make it that much harder for you to successfully complete the course. Please be prepared to spend a minimum of 20-25 hours per week on this course!

Course Forum

We have a Canvas page, on which we will post all assessments, class materials, pre-class readings, pre-class videos, and grades.

Textbook: Students are not required to purchase a textbook for this course, but many resources will be posted on Canvas. While these are not the only resources available on the web, these are the ones that I will be assigning and have identified as being most useful to students. I also encourage students to share resources that they find useful so that we can (if appropriate) add them to this list.

Course Discussions: Canvas will be used for class discussion and course announcements. It also provides students with a platform for getting you help fast and efficiently from classmates. Rather than emailing questions, please consider posting your questions on Canvas.

Course Policies

Accommodations

The goal is for every student to succeed in this course. If you require any accommodations (e.g. child care during class hours, extra time to complete assignments, support for a disability), let me know immediately so that we can work out appropriate arrangements. Speak to me at the end of class or contact me by email, and we will set up a time to meet during the first week of the course.

Students who have disabilities who wish to receive academic services and/or accommodations should visit the [Disability Resource Center](#) or call (844) 688-6287. If you have already done so, please provide your letter from the DRC to the instructor early in the semester to arrange those accommodations.

Attendance and Participation

It is expected that you attend every class and participate. We begin each day at 2:30PM sharp, and promise to try to never run overtime! If you must miss a class for any reason (e.g., illness, family emergency, religious observance), contact your instructor by email. Regardless of the reason, it is your responsibility to catch up on the material you have missed, and obtain the notes from a classmate.

Students who are absent repeatedly from class will be evaluated to ascertain their ability to achieve the course objectives and to continue in the course.

Assessments

All assessments are due at **9AM** on Monday. The course assessments are due before class so that you have time to peer review each other's work, and complete all of the readings in preparation for the class.

Late Penalties

Any assessment that is late will be subject to a 50% penalty. You are allowed *one* exception to this policy, where you are allowed a reasonable extension to any assessment, with no penalty, provided you have a doctor's note or some other compelling reason. Additional exceptions will only be given under extenuating circumstances. Note that the Late Penalty only applies to Homework.

Scheduling Meetings

At any time during the course, if you have any concerns, contact me by email or let me know after class, and we will set up a one-on-one meeting at a mutually convenient time.

Technology

When we are **not** holding the class remotely, but if there was ever a need we will use Teams.

Students joining via Teams will adhere to the same rules and expectations as those attending in person: being present, actively engaging in discussions, asking questions, and participating in group activities. Because you will be working in teams where some of your team members will be on campus while others will be joining remotely, we ask all students to be fully present during the class and ensure a healthy learning environment.

This requires that students in the classroom refrain from using their phones and keep them out of sight, and refrain from browsing non-course related topics. Students joining remotely will ensure that any distractions in their near surroundings are eliminated, or at least minimized to the best of their ability. Please create a distraction-free learning environment to optimize your learning.

For those of you joining via Teams, we would all very much appreciate it if you could leave your video camera ON for the entire class. This enables us to see you all on screen, so that we can better gauge the reactions of the class, appropriately pace the class, and more quickly respond to any questions you have. (If you prefer to leave your video camera OFF, especially for reasons of personal safety and comfort, please let me know.)

Classroom Conduct

To create and preserve a classroom atmosphere that optimizes teaching and learning, all participants share a responsibility in creating a civil and non-disruptive forum for the discussion of ideas. Students are expected to conduct themselves at all times in a manner that does not disrupt teaching or learning.

Your comments to others must be constructive and free from harassing statements. You are encouraged to disagree with other students and the instructor, but such disagreements need to be respectful and be based upon facts and documentation, rather than prejudices and personalities. The instructor reserves the right to interrupt conversations that deviate from these expectations.

Repeated unprofessional or disrespectful conduct may result in a lower grade or more severe consequences.

Title IX Policy

Title IX of the USA Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance. Though our campus is located in Canada, all Northeastern University campuses follow the Title IX Policy.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty and staff.

If you or someone you know has been a survivor of a Prohibited Offense, confidential support and guidance can be found through University Health and Counseling Services staff and the Center for Spiritual Dialogue and Service clergy members. By law, those employees are not required to report allegations of sex or gender-based discrimination to the University.

Alleged violations can be reported non-confidentially to the Title IX Coordinator within The Office for Gender Equity and Compliance at: titleix@northeastern.edu and/or through NUPD (844) 688-6287. Reporting Prohibited Offenses to NUPD does NOT commit the victim/affected party to future legal action.

Faculty members are considered “responsible employees” at Northeastern University, meaning they are required to report all allegations of sex or gender-based discrimination to the Title IX Coordinator.

In case of an emergency, please call 911. Please visit <http://www.northeastern.edu/titleix> for a complete list of reporting options and resources, both on-campus and off-campus.

Collaboration and Academic Honesty

Computer science, both academically and professionally, is a collaborative discipline. In any collaboration, however, all parties are expected to make their own contributions and to generously credit the contributions of others. In our class, therefore, collaboration on assessments is encouraged, but you as an individual are responsible for understanding all the material in the assignment and doing your own work. Always strive to do your best, give generous credit to others, start early, and seek help early from both your professors and classmates.

The following rules are intended to help you get the most out of your education and to clarify the line between honest and dishonest work. The professor reserves the right to ask you to verbally explain the reasoning behind any answer or code that you turn in and to modify your project grade based on your answers. It is vitally important that you turn in work that is your own.

If you have had a substantive discussion of any assessment (homework) with a classmate, then be sure to cite them in your report. If you are unsure of what constitutes “substantive”, then ask us or err on the side of caution. You will not be penalized for working together. You must not copy answers or code from another student either by hand or electronically. Another way to think about it is that you should be talking English with one another, not code. The following rules apply to anything you hand in for a grade.

- You may not copy anyone else’s code or solution under any circumstances. This includes online sources.
- You may not permit any other student to see any part of your program or solution.
- You may not permit yourself to see any part of another student’s program or solution.
- You may consult online resources as part of your course work, but you may not copy code or solutions from online sources. If you get an idea of how to solve a programming problem from an online source, include a short citation in a code block at the top of your code file.

As with all other courses at Northeastern, you are expected to adhere to the university’s academic integrity policy (<http://www.northeastern.edu/osccr/academic-integrity>).

If you are unsure about the plagiarism policy, **please ask me!**

Feedback

Feedback is always welcome!

Your opinions are very important to us. All students are strongly encouraged to use the Teacher Rating and Course Evaluation (TRACE) system, at <https://www.northeastern.edu/trace/>, to complete your course evaluations. A reminder about TRACE should arrive via email about two weeks before the end of the course.

Thank you for taking this course, and entrusting us to shape your education here at Northeastern. I am SO excited to serve as your instructor for your BSDS class!