

ECE 454: Distributed Computing

University of Waterloo

Spring 2021

Meeting Times

Lectures: ONLINE, delivered synchronously, T/Th at 10am (LEC 041) and 4pm (LEC 042)
Tutorials: N/A

Teaching Team

Instructor: Prof. Wojciech Golab, wgolab@uwaterloo.ca
TAs: Ben Zhang, ben.zhang@uwaterloo.ca

Note: Please include "ECE 454" in the subject line of any email you send to the teaching team.

Office Hours

Instructor: ONLINE by appointment. Please bring questions to lectures.
TAs: ONLINE, TBA

Calendar Description

Calendar description: Principles of distributed computing; architectures and middleware; servers, processes, and virtualization; upper-layer network protocols, inter-process communication and remote procedure calling; concurrency, synchronization and distributed algorithms; dependable distributed systems and fault tolerance.

Instructor's overview: Distribution has become essential for scalable and reliable computation on modern hardware. This observation holds for a variety of computational tasks, ranging from caching web content to processing financial transactions and analyzing large data sets. ECE 454 will introduce students to software techniques for distributed computing with a focus on data storage and analytics.

Learning Objectives

Upon successful completion of the course, students should be able to:

- Understand the architectures, protocols and algorithms underlying modern distributed systems.
- Understand fundamental techniques for making distributed systems scalable and dependable, and reason about design trade-offs.
- Use a remote procedure call (RPC) framework to implement a simple distributed service.
- Use a scalable data processing framework to solve fundamental analytics problems.
- Use a fault-tolerant coordination service for configuration management, synchronization, and failure detection in a distributed software system.
- Use a stream processing engine to perform real-time analytics.
- Discuss the relative merits of distributed versus centralized systems.

Learning Materials

Required textbook: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems 3rd Ed., 2017.

This textbook is available online: <https://www.distributed-systems.net/>

Courseware: We will use LEARN (<https://learn.uwaterloo.ca>) to distribute lecture notes and homework materials.

Prerequisites, Corequisites and Antirequisites

Prerequisites: (ECE 252 or SE 350); Level at least 4A Computer Engineering or Electrical Engineering or Software Engineering.

Corequisites: ECE 358 (for Software Engineering students).

Antirequisites: CS 454, CS 654.

Evaluation Structure

Coursework will include the following components:

Programming assignments:	70%	(4 or 5 total, varying weights)
Quizzes or exam:	30%	(tentatively during final assessment period)

Group Work

Unless stated explicitly by the course instructor, all coursework will be completed individually. In cases where group collaboration is permitted, coursework will be completed in small groups (1-3 students). Each group member individually is responsible for learning all the material corresponding to a group deliverable, and may be required to answer technical questions posed by members of the teaching team. Members of the teaching team may assign or re-arrange groups for academic reasons. Copying material from other groups, from other courses, or from online sources is forbidden except for materials authorized explicitly by the course instructor. Unauthorized collaboration and copying of material constitute academic offences under Policy 71.

Lateness and Absence

Coursework deliverables other than exams will be penalized 1% per hour or part thereof. The instructor reserves the right to waive the lateness penalty for submissions made within a short grace period (usually about 5 minutes) after the scheduled submission deadline, or in the event of a major disruption such as a campus-wide power outage.

A missed exam will receive a grade of 0% unless the student is incapacitated during the exam due to illness. A valid medical certificate showing the degree of incapacitation must be presented within five business days of the missed exam except in cases of prolonged incapacitation, such as when a student is admitted to a hospital. The instructor reserves the right to reject medical certificates where the degree of incapacitation is based on the patient's description of his/her illness, rather than on a professional medical examination. Depending on the degree of incapacitation shown on the medical certificate, and

the manner of assessment, the instructor will either assign 0% or, at his discretion, will make alternative arrangements such as offering a make-up exam.

Submission and Pickup of Assignments

Assignment deliverables will be submitted electronically using a drop box in LEARN. Feedback from graders may be provided on paper, electronically by e-mail, or electronically using LEARN.

Grading and Regrading

All coursework items, including exams, will be graded on the basis of completeness, correctness, and clarity. Students are encouraged to ask questions related to grading during office hours, as well as using the online discussion forum.

Where appropriate, students are expected to test their own solutions to problems using appropriate input data. In the event that a student's solution differs substantially from the solution(s) accepted by the teaching team, the student may be asked to provide sample inputs and outputs to evaluate the correctness of their solution.

Students who feel that they have been graded unfairly may request that a coursework item be re-graded, in which case the entire item (i.e., assignment or exam) will be re-graded. As a result, the grade may increase, decrease, or remain unchanged. The teaching team may refuse to re-grade coursework if there is substantial concern that the solution was modified or otherwise tampered with after submission. A penalty will be applied for all re-grades, except in cases of a buggy grading script.

Fair Contingencies for Emergency Remote Teaching

To provide contingency for unforeseen circumstances, the instructor reserves the right to modify course topics and/or assessments and/or weights and/or deadlines with due notice to students. In the event of further challenges, the instructor will work with the Department/Faculty to find reasonable and fair solutions that respect rights and workloads of students, staff, and faculty.

General Policies and Information

Academic integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check [the Office of Academic Integrity](#) for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read [Policy 70, Student Petitions and Grievances, Section 4](#). When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for his/her actions. [Check [the Office of Academic Integrity](#) for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students

should refer to Policy 71, Student Discipline. For typical penalties, check Guidelines for the Assessment of Penalties.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals.

Note for students with disabilities: AccessAbility Services, located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

Turnitin.com and alternatives: Plagiarism detection software (e.g., Turnitin or MOSS) may be used to screen deliverables in this course. In the first week of the term, details will be provided on request about the arrangements for the use of plagiarism checkers and alternatives in this course.

Useful URLs

LEARN:

<https://learn.uwaterloo.ca/d2l/home/676065>

Piazza (online discussion forum):

<https://piazza.com/uwaterloo.ca/summer2021/ece454>

<https://piazza.com/uwaterloo.ca/summer2021/ece454/home>

Registrar's final exam schedule:

<https://uwaterloo.ca/registrar/final-examinations/exam-schedule>