The University of Western Ontario
London, Canada

Department of Computer Science

CS4402B/CS9635B -- Parallel and Distributed Computing

Course Outline -- Winter 2026

Course Description

The efficient usage of parallel and distributed systems (multi-processors and computer networks) is nowadays an essential task for computer scientists.

This course studies the fundamental aspects of parallel systems and aims at providing an integrated view of the various facets of software development on such systems: hardware architectures, programming languages and models, software development tools, software engineering concepts and design patterns, performance modelling and analysis, experimenting and measuring, application to scientific computing.

Course topics may include but are not limited to: hierarchical memory, cache complexity, multi-core and many-core architectures, fork-join parallelism, scheduling, scalability, GPU computing, data parallelism, pipelining, message passing (MPI), parallel and distributed data-structures, and applications of parallel and distributed computing.

Follow this link for various resources (software tools and tutorials, hardware documentation, conferences, other HPC course web sites, etc.) regarding **this course and HPC in general.**

Prerequisites for undergraduate students

- Students **must be fluent in C/C++** ; they must also be **familiar with UNIX software tools** (shell scripts, makefiles, debuggers).
- Students are expected to have background knowledge in **computer architecture** (e.g. CS3350) and **theoretical computer science** (e.g. CS3331).

Instructor

Name: Marc Moreno-Maza
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Teaching Assistants (TAs)

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Lecture Notes and Textbook

Notes of each lecture will be available on the OWL website of CS4402. The students of CS9635 have access to the OWL website of CS4402.

The following textbooks are recommended but not required:

1. Structured Parallel Programming by Michael McCool, Arch Robison, James Reinder.
2. C++ Concurrency in Action, practical multithreading by Anthony Williams
3. Programming language pragmatics (Chapter 12 only) by Michael L. Scott
4. Models of Computation Exploring the Power of Computing by John E. Savage.
5. CUDA by example by JASON SANDERS and EDWARD KANDROT.

Course and OWL Websites

The course web site is accessible here This course web site is used to post materials about the course projects.

For CS4402, the OWL web site is here. It is used to post lecture materials (slides, source code, videos, etc.) as well as for submitting assignments and quizzes. It is also used for managing the grades of CS9635 students.

For CS9635, the OWL web site is here. It is used for managing the grades of CS9635 students.

Please check both the course and OWL sites often for updates on lecture notes and errata, as well as the forum discussions and announcements in the OWL web site of CS4402.

Polices regarding email and contact

For all questions related to the course materials (lectures, assignments, quizzes, projects) students **must use the discussions (forum)** of the OWL web sites (see above) instead of contacting the instructor or the TA by email. Indeed any question about a course material is likely to be of interest to many students in the class.

Writing to the instructor or the TAs should only be done for handling a personal matter, not relevant to the course materials.

Delivery mode

The format of the course lectures and tutorials will be on-line asynchronous presentations posted on the OWL web sites.

Office hours will be one-line synchronous meetings on Zoom. The office hours will not be recorded.

The slides presented during the lectures will be posted on the OWL web site of CS4402. The students of CS9635 have access to this OWL web site.

Protection of online content

The instructor owns the intellectual property (IP) of the lecture materials even when such materials are posted online. Students are not permitted to post lecture materials including

assignment statements, assignment solutions, etc. to any websites or platforms or use the lecture recording or materials for any purpose other than other personal study.

Participants in this course are not permitted to record the Zoom sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Computer requirements

Students must have a reliable internet connection and computer that are compatible with online learning (including working microphone and webcam).

Lecture Topics

The list of topics will be something on the order of:

1. Overview of parallel and distributed computing
2. Programming patterns in parallel and distributed computing; illustration with Julia
3. Hierarchical memories, cache complexity
4. The fork-join model and the cilk concurrency platform
5. Multi-threading parallelism and performance
6. Pipelining
7. Scheduling and Synchronizing; parallelism overheads
8. Parallel Random-Access Machines.
9. Many-core programming (GPGPUs)
10. High-Performance Computing with CUDA
11. Multiprocessed parallelism, message passing (MPI)

Class Schedule

The materials (slides, recordings and other resources) of each lecture topic will be made available to the students in the course of Monday of each week of class, except for the reading week and the last week of classes.

Those materials will be accessible on the OWL web sites. Slides may also be posted on the public web site of the course.

Each student is expected to watch all the lecture recordings. Reading the slides may not be sufficient to fully comprehend the materials.

Student Evaluation

- Evaluation methods are quizzes, assignments and projects.
- Assignments and projects constitute 1/3 and 1/3 of the course mark, respectively. There is no midterm examination and no final examination either. However, there will be at least three quizzes. Quizzes constitute the last 1/3 of the course mark.
- Assignments consist of theoretical and programming exercises.
- CS 4402 projects can be theoretical work (research article presentations), practical (programming, experimentation and analysis) or a combination of both. CS 9635 projects are more advanced and must deal with current research topics, see details below.
- A quiz is a series of short and simple exercises similar to the examples of the course notes, whereas assignments consist of more advanced exercises.

- In order to successfully complete the course, a student must achieve at least 50% on assignments, 50% on projects and 50% on quizzes. This is to prevent a serious lack of effort in either area. Thus, a successful student cannot get 100% on assignments and projects and pass on the quizzes.
- A CS4402 project topic is chosen by the student from a list of topics proposed by the instructor. Project topics will be posted by February 27 and each student must choose a project topic by March 13 (at the very latest). The projects will be presented on-line synchronously by the students during the last two weeks of class, that is, the weeks of March 23 and March 30. Each project presentation runs for 15 minutes including 3 minutes for questions. Because of the class size, it is expected, but not confirmed yet, that the total duration time of the presentations will be around 10 hours, which would be divided in a number of sessions, most likely 2 hours each.
- For CS9635, there is no Assignment Two, while the Project is of much larger scale and starts during the CS4402 Assignment Two period. CS9635 projects must deal with current research topics (in the scope of the course contents) and can be related to the student thesis (in fact, this is recommended). The topic of each CS9635 project must be discussed individually with the instructor during the Assignment Two period. This implies a literature review to be done by the student and presented to the instructor during a face-to-face meeting. By March 13 (preferably earlier) the objectives of each CS9635 project must be well-defined by the student and approved by the instructor. Together with the literature review, this will give the mark for Assignment Two. Projects must then be implemented and will be presented to the CS9535 class during the Final examination period, that is, between April 6 and April 29.
- With this definition of the CS9635 project and CS9635 Assignment Two, the mark allotment is the same as for CS4402. That is, assignments, projects and quizzes constitute 1/3, 1/3 and 1/3 of the CS9635 mark, respectively.

Assignment/Project/Quiz Schedule

All dates are **tentative** and currently subject to change, although it is doubtful by any significant amount.

Evaluation Technique	**Weight**	**Posted Date** (*tentative!*)	**Due Date** (*tentative!*)	**Workload**
Assignment One	1/6	Jan. 30	Feb. 27	regular
Assignment Two	1/6	March 4	March 27	regular
Project	1/3	Feb 27	See Student Evaluation	heavy
Quiz 1	1/9	Jan 29 12:30	Jan 29 13:20	regular
Quiz 2	1/9	Feb 26 12:30	Feb 26 13:20	regular
Quiz 3	1/9	Mar 19 12:30	Mar 19 13:20	regular

If for any reason the schedule given above cannot be adhered to, the assignment, project and quiz marks will be pro-rated. For instance, if an assignment has to be cancelled for any reason, the remaining assignment weight will be prorated to add up to 1/3.

Every effort will be made to have assignments, projects and quizzes marked and handed back within 3 weeks of the hand-in date, preferably sooner.

There are no make-up quizzes.

Assignments

The submission of assignments and quizzes is electronic using OWL.

Any changes, updates, and clarifications to assignments will also be posted on the OWL website. It is your responsibility to monitor these pages closely.

When a student submits an assignment for evaluation, this student automatically certifies that the material she/he has handed in is exclusively her/his own work.

It is your responsibility to keep up-to-date backups of assignment disk files in case of system crashes or inadvertently erased files. Retain disk copies of all material handed in, as well as the actual graded assignment, to guard against the possibility of lost assignments or errors in recording marks. It is not safe to discard these materials until you are satisfied that your final mark for the course has been computed properly.

In case of questions regarding the marks, please note that no assignments will be accepted for re-marking later than one week after they have been marked.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) isÂ not permitted in the completion of any course assessments, including but not limited to: assignments, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarizationâ€”when not explicitly allowedâ€”will be treated as a scholastic offence.

General information about missed coursework

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request without supporting documentation in this course. This latter policy applies to:

- **Quizzes.** Students are allowed to miss one, and only, one quiz, without supporting documentation. The grade for a missed quiz is the average of the grades obtained for the other quizzes.

However, the following assessments are excluded from the above policy and, therefore, always require formal supporting documentation:

- **Projects.** Projects are designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration.

When a student mistakenly submits their one allowed Academic Consideration request without supporting documentation for the assessments listed above or those in the Coursework with Assessment Flexibility section below, the request cannot be recalled and reapplied. This privilege is forfeited.

By policy, instructors may deny Academic Consideration requests for the following assessments with built-in flexibility:

- **Assignments.** Students are expected to submit each of the assignments by the deadline listed. Should extenuating circumstances arise, students do not need to request Academic Consideration, and they are permitted to submit their assignment up to 48 hours past the

deadline without a late penalty. Assignments will not be accepted after this no-late-penalty period without academic consideration with documentation.

Students must familiarize themselves with the University Policy on Academic Consideration â€“ Undergraduate Students in First Entry Programs, posted here.

This policy does not apply to requests for Academic Consideration submitted for attempted or completed work, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The Academic Accommodation for Students with Disabilities policy can be found here.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrarâ€™s webpage here.

If you are unable to meet a course requirement (quiz participation or assignment due date, beyond the policies mentioned above) due to illness or other serious circumstances, you can a request for academic consideration through the Student Abscence Portal. If the request is granted, then the value (resp. due date) of the missed quiz (resp. assignment) will be reallocated (resp. extended by one week).

Accommodation policies

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The Academic Accommodation for Students with Disabilities policy can be found here.

Religious accommodation

When a recognized religious holiday or observance conflicts with an examination, test, or other scheduled academic obligation, students must request accommodation via the Universityâ€™s Student Absence Portal (SAP). This request should identify the conflict and specify which course component(s) (e.g. test, midterm, exam) are affected.

Students are encouraged to submit the SAP request as early as possible, but no later than two weeks before any examination, or one week before any mid-term test or quiz, to allow sufficient time for adjustment.

The SAP request serves as official notification to both the course instructor and the Academic Advising Office, in accordance with this University policy.

The Faculty of Science considers religious accommodations as scheduling conflicts. Instructors should provide either a make-up exam or an earlier sitting of the same exam to accommodate the student.

For more information on recognized religious holidays, please visit the Diversity Calendar posted on the Equity, Diversity & Inclusion website.

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.

Academic policies

The website for Registrarial Services is here.

In accordance with this policy. the centrally administered e-mail account provided to students will be considered the individualâ€™s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

All of the remote learning sessions for this course may be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals participating in the course for their private or group study purposes. Please contact the instructor if you have any concerns related to session recordings.

As mentioned above, participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Ethical conduct

Scholastic offences are taken **seriously** and students are directed to read the appropriate policy, specifically, the definition of what constitutes a **Scholastic Offence,** at this website.

Computer-marked, multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating. In particular, checking software, such as MOSS , Turnitin or others will be used randomly for detecting similarity in assignment submission.

All assignments are individual assignments. You may discuss approaches to problems among yourselves. However, the actual details of the work (assignment coding, answers to concept questions, etc.) must be your individual effort. Assignments that are judged to be the result of academic dishonesty will, for the student's first offence. You are responsible for reading and respecting the Computer Science Department's policy on Rules of Ethical Conduct and Scholastic Offenses.

Support services

Please visit the Science & Basic Medical Sciences Academic Counselling web page for information on add/drop courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters.

Please contact the course instructor if you require lecture in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at (519) 661-2147 if you have any questions regarding accommodation.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being. .

Learning-skills counsellors at the Student Development Centre. are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling. See also the services provided by the University Studentsâ€™ Council.

Marc Moreno Maza
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