



THE UNIVERSITY OF WINNIPEG

Applied Computer Science

Course Number: ACS-4306-001/GACS-4306-001, 070L
Course Name: Applied Parallel Programming
Course Webpage: <https://nexus.uwinnipeg.ca/d2l/home/39950>

Instructor Information

Instructor: Dr. Christopher Henry
Class Room No: 3D03
Lab Room No: Zoom
Office Hours: Fridays 12:30 – 1:30 pm
Office Hours Room No: TBD

Email: ch.henry@uwinnipeg.ca
Class Meeting Time: T/Th 2:30 - 3:45 pm
Lab Meeting Time: Thursday 4:00-5:15 pm

Important Dates

First Class: September 7th, 2021
Fall Reading Week: October 10th – 16th, 2021 (**No classes**)
Midterm Test: October 21st, 2021
Withdrawal date w/o academic penalty¹²: November 16th, 2021
Last Scheduled Class: December 8th, 2021
Final Examination (Comprehensive): TBD
The University is closed on the following dates (No Classes):
September 30th, 2021
October 11th, 2021
November 11th, 2021
December 24th, 2021 – January 5th, 2021

¹A minimum of 20% of the work on which the final grade is based will be evaluated and available to the student before the voluntary withdrawal date.

²Please contact the instructor if you are considering a VW in case there is any help you may need.

Course Objectives/Learning Outcomes

The course focusses on parallel and distributed computing in high-performance scientific application, using the parallel execution model, a generalization of the traditional single threaded paradigm. The course covers multi-core processors, concurrency, parallel execution, latency, communication and coordination among processes, message passing, shared-memory models, optimization techniques, parallel algorithms, decomposition strategies, system architecture, and performance analysis and tuning. Using the language C/C++, students gain hands-on experience writing scalable parallel applications for Graphics Processing Units.

Remote Learning

Students that can provide documentation that they are not able to come to campus can have access to the lectures via Zoom. Examples of situations where students can participate remotely are medical conditions or residing in other countries due to travel and/or visa restrictions.

All course material including lecture notes, slides and videos, sample code, assignment and lab details will be available on the course website. Class times are reserved for lectures, further discussion, and Q&A.

Students participating remotely must be available via Zoom during the lecture and lab times.

- Students must display their real/full name
- Use of video is optional (except during examinations)
- Participants must be muted when not speaking
- Students may interact via chat, voice or gestures
- Lectures and labs will be delivered live during the scheduled times via Zoom
- Lectures will be recorded and posted on the website

Students can find answers to frequently asked questions related to remote learning here: <https://www.uwinnipeg.ca/covid-19/remote-learning-faq.html>.

Note: a permitted or necessary change in mode of delivery may require adjustments to important aspects of course outlines, like class schedule and the number, nature, and weighting of assignments and/or exams.

Evaluation Criteria

Midterm Examination (25%)

There will be **one** midterm test.

Laboratories (20%)

There will be 10 laboratories: each consisting of 2% of your final grade. Laboratories will be posted on the course website. All work submitted for evaluation must be typed, and code must be commented and formatted. Submissions will be made via Nexus. Late submissions will not be accepted.

Final Examination (55%)

The final examination is comprehensive.

Exam Requirements

- Photo ID is required for students writing the exam in person
- Unless a medical certificate is provided, no accommodation is made for missed deadlines or examinations
- Midterm and final exams are open book
 - Students are permitted to view only the following authorized course material:

- Class notes, class slides, class recordings, sample code given in class, and assignment descriptions and solutions posted by the instructor
 - Course textbook
 - Student's own course notes and assignment submissions
- Students may use an external tool such as a text editor or IDE to write answers to questions before entering them into the exam
 - Students may contact the instructor to ask questions
 - External resources (or any material not listed above) are NOT PERMITTED
 - Communication with others (except the instructor) is NOT PERMITTED
 - All work must be entirely the students' own. Collaboration or sharing of work is NOT PERMITTED
 - Webcams must be turned on during examinations
 - Examinations will be made available to students 15 minutes before the scheduled examination to allow for technical difficulties (only for students writing remotely)
 - Examination submission will be via Nexus (only for students writing remotely)

Student Services and Information

Students with documented disabilities, temporary or chronic medical conditions, requiring academic accommodations for tests/exams or during lectures/laboratories are encouraged to contact Accessibility Services (AS) at 204.786.9771 or <https://www.uwinnipeg.ca/accessibility-services/> to discuss appropriate options. All information about a student's disability or medical condition remains confidential.

All students, faculty and staff have the right to participate, learn, and work in an environment that is free of harassment and discrimination. The UW Respectful Working and Learning Environment Policy may be found at <https://www.uwinnipeg.ca/respect/>.

Students may choose not to attend classes or write examinations on holy days of their religion, but they must notify their instructors at least two weeks in advance. Instructors will then provide opportunity for students to make up work or examinations without penalty. A list of religious holidays can be found in the 2020-21 Undergraduate Academic Calendar.

Final Letter Grade Assignment

Historically, numerical percentages have been converted to letter grades using the following scale. However, instructors can deviate from these values based on pedagogical nuances of a particular class, and final grades are subject to approval by the Department Review Committee.

A+	90+ - 100%	B	70 - 74%	F	below 50%
A	85 - 90%	C+	65 - 69%		
A-	80 - 84%	C	60 - 64%		
B+	75 - 79%	D	50 - 59%		

Required Textbooks

Main texts:

- D. B. Kirk, and W. W. Hwu, *Programming Massively Parallel Processors: A Hands-on Approach*. 3rd Edition, USA: Elsevier, 2016

Besides the information contained in the main texts, I may also distribute papers, and discuss appropriate material and examples from other sources. Students are responsible for all material covered in the class.

Prerequisite Information (This information can be found in the UW General Calendar)

A grade of at least C+ in ACS-2947(3), and a grade of at least C in ACS-3913(3). ACS-4306L (lab) must be taken concurrently.

Regulations, Policies, and Academic Integrity

Academic dishonesty is a very serious offense and will be dealt in accordance with the University's policies.

Avoiding Academic Misconduct and Non-academic Misconduct. Students are encouraged to familiarize themselves with the "Academic Regulations and Policies" found in the University *Academic Calendar* at:

<https://uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf>

Particular attention should be given to subsections 8 ("Student Discipline"), 9 ("Senate Appeals") and 10 ("Grade Appeals"). Please note, in particular, the subsection of Student Discipline pertaining to plagiarism and other forms of cheating.

Please note the importance of maintaining academic integrity, and to the potential consequences of engaging in plagiarism, cheating, and other forms of academic misconduct. Even "unintentional" plagiarism, as described in the UW Library video tutorial "Avoiding Plagiarism" (<https://www.youtube.com/watch?v=UvFdxRU9a8g>) is a form of academic misconduct.

Detailed information can be found at the following:

- Academic Misconduct Policy and Procedures: <https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-procedures.pdf>
- Non-Academic Misconduct Policy and Procedures: <https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-procedures.pdf>

Misuse of Filesharing Sites. Uploading essays and other assignments to essay vendor or trader sites (filesharing sites that are known providers of essays for use by others who submit them to instructors as their own work) involves "aiding and abetting" plagiarism. Students who do this can be charged with Academic Misconduct.

Non-academic misconduct. Students are expected to conduct themselves in a respectful manner on campus and in the learning environment irrespective of platform being used. Behaviour, communication, or acts that are inconsistent with a number of UW policies could be considered “non-academic” misconduct.

More detailed information can be found here:

- Respectful Working and Learning Environment Policy
<https://www.uwinnipeg.ca/respect/respect-policy.html>
- Acceptable Use of Information Technology Policy
<https://www.uwinnipeg.ca/institutional-analysis/docs/policies/acceptable-use-of-information-technology-policy.pdf>
- Non-Academic Misconduct Policy and Procedures
<https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-procedures.pdf>.

Copyright and Intellectual Property. Course materials are the property of the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides—irrespective of format. Students who upload these materials to filesharing sites, or in any other way share these materials with others outside the class without prior permission of the instructor/presenter, are in violation of copyright law and University policy. Students must also seek prior permission of the instructor/presenter before, for example, photographing, recording, or taking screenshots of slides, presentations, lectures, and notes on the board. Students found to be in violation of an instructor’s intellectual property rights could face serious consequences pursuant to the Academic Misconduct or Non-Academic Misconduct Policy; such consequences could possibly involve legal sanction under the Copyright Policy
https://copyright.uwinnipeg.ca/docs/copyright_policy_2017.pdf

Privacy

Students have rights in relation of the collecting of personal data the University of Winnipeg:
<https://www.uwinnipeg.ca/privacy/admissions-privacy-notice.html>

More information:

- Zoom and Privacy: <https://www.uwinnipeg.ca/privacy/zoom-privacy-notice.html>
- Testing/Proctoring: <https://www.uwinnipeg.ca/privacy/zoom-test-and-exam-proctoring.html>

Class Cancellation, Correspondence with Students and Withdrawing from Course

When it is necessary to cancel a class due to exceptional circumstances, every effort will be made to inform students via UWinnipeg email (and/or using the preferred form of communication, as designated in this outline).

Students have the responsibility to regularly check their UWinnipeg e-mail addresses to ensure timely receipt of correspondence from the University and/or their course instructors.

Please let course instructor know if you plan on withdrawing from the course. Note that withdrawing before the VW date does not necessarily result in a fee refund.

Course Topics

1. Course Introduction
2. Data Parallel Computing
3. Scalable Parallel Execution
4. Memory and Data Locality
5. Performance Considerations
6. Numerical Considerations
7. Parallel Patterns:
 - a. Convolution
 - b. Prefix Sum
 - c. Parallel Histogram Computation
 - d. Sparse Matrix-Vector Multiplication
 - e. Merge Sort
 - f. Graph Search
8. CUDA Dynamic Parallelism
9. Case Studies
10. Parallel Programming and Computational Thinking
11. Heterogeneous Computing Clusters
12. Advanced Topics

Note: not all the above topics may be covered.

Course Readings

Relevant textbook chapters and sections will be given during lectures.

Recommended Study Habits

Students who do well in this class attend lectures, take notes, submit all deliverables, regularly ask questions, and tend to spend an extra 3-5 hours per week doing the following:

- Read course notes and handouts
- Read the textbook before coming to class
- Attempt the problems and exercises at the end of the chapters
- Form study groups to study for the midterm and exam
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Advice: Students who fall behind find it very hard to catch up.