



THE UNIVERSITY OF WINNIPEG

APPLIED COMPUTER SCIENCE

Course Number: GACS-4306/7306-001, 070L
Course Name: Applied Parallel Programming
Course Webpage: <https://nexus.uwinnipeg.ca/d2l/home/72599>

Instructor Information

Instructor: Michael Beck
E-mail: m.beck@uwinnipeg.ca
Office Hours: Mondays 12:30 pm - 1:30 pm 3D23
Class meeting time: Tuesdays/Thursdays 11:30 am - 12:45 pm 3D04
Lab time: L-070 Mondays 4:00 - 5:00 pm 3D03

Important Dates

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| 1. First Class: | Tuesday, September 2, 2025 |
| 2. First Lab: | Monday, September 8, 2025 |
| 3. Reading week (no classes): | October 12 – 18, 2025 |
| 4. Midterm Test: | By appointment (see below) |
| 5. No lectures due to midterms | October 21 + October 23, 2025 |
| 6. Final Withdrawal Date without academic penalty*: | Wednesday, November 12, 2025 |
| 7. Last Class: | Wednesday, December 3, 2025 |
| 8. Last Lab: | Monday, December 1, 2025 |
| 9. Final Exam: | By appointment (see below) |
| 10. Final Exam Period: | December 8 – 20, 2025 |
| 11. University closures: Truth and Reconciliation Day | Tuesday, September 30, 2025 |
| Thanksgiving | Monday, October 13, 2025 |
| Remembrance Day | Tuesday, November 11, 2025 |
| 12. Make-up classes/labs on holiday closures: | Wednesday, December 3, 2025 |

*A 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.

Course Objectives / Learning Outcomes

High-end graphics processing units (GPUs) are resulting today in massively parallel computation systems that are relatively inexpensive and readily available. These GPUs can be leveraged to solve computational problems that are inherently parallel in nature, thereby realizing significant reduction in overall application runtime. The focus of this course is to teach students how to capitalize on the computing power offered by GPUs for general purpose programming. The course begins by presenting the basics of the GPU hardware architecture and memory hierarchy, and how to write a hello world-type program for GPUs. From there, different parallel algorithms are introduced as pedagogical tools to demonstrate the utility of specific hardware components of the GPU. These concepts are reinforced by weekly hands-on assignments where students gain experience writing GPU kernels using NVIDIA's CUDA programming model and interface. The ultimate goal of this course is to provide students with a foundation to write their own GPU-based code and impart a deep appreciation for the underlying operations that transpire when using any API, library, or application that benefits from GPU acceleration.

Evaluation Criteria

- Assignments: 20%
 - Graduate students are expected to complete the laboratories assigned to undergraduate students. There will be 5 assignments: each consisting of 4% of your final grade. Assignments 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.**
- Midterm Examination: 20%
 - Date by appointment in the week of October 20 (the week after reading week). Schedule for midterm slots will be presented in the lecture. Every student **must** book an appointment to have their midterm graded.
 - Total duration per student: appr. 20 minutes
 - The midterm exam encompasses all topics of the course covered so far.
- Project: 20%
 - More details will be provided in class.
 - The project consists of three main items:
 - Project Proposal Presentation (2.5% of total grade). This will happen as part of the midterm examination, appr. 5 minutes of length added to the midterm examination time (i.e., a total of 25 minutes).
 - Final Project Presentation (7.5% of total grade). This will happen as part of the course's last lectures. The student will give an appr. 15 minute long presentation.
 - Final Report (10% of total grade). Due on last lecture.
- Final Examination 40%
 - Date by appointment in the exam period. Schedule for final exam slots will be presented in the lecture/Nexus. Every student must book an appointment for final exams.

- Total duration per student: appr. 40 minutes
- The final exam encompasses all topics of the course.
- You must pass the final exam to pass the course.

Test / Exam Requirements

- Photo ID is required for the final exam.
- The use of computers, calculators, phones, or other electronic devices is not permitted during exams.
- Midterm and final exams are closed book, with no external help allowed, this includes any AI tools that the student might have used before.

Students should contact the instructor as soon as possible if extenuating circumstances require missing a lab, assignment, test or examination. A medical certificate from a practicing physician may be required before any adjustments are considered.

Students with documented disabilities, temporary or chronic medical conditions, requiring academic accommodations for tests/exams (e.g., private space) or during lectures/laboratories (e.g., note-takers) are encouraged to contact Accessibility Services (AS) at 204-786-9771 or accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a student's disability or medical condition remains confidential.

<https://www.uwinnipeg.ca/accessibility-services>

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 examinations without penalty. A list of religious holidays can be found in the 2025-26 Undergraduate Academic Calendar online at <http://uwinnipeg.ca/academics/calendar/docs/important-notes.pdf>

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+	75 – 79%	C	60 – 64%
A	85 – 89 %	B	70 – 74%	D	50 – 59%
A-	80 – 84%	C+	65 – 69%	F	below 50%

Required Text Book / Reading List

- Hwu and Krik, Programming Massively Parallel Processors, 4th Edition, Elsevier, 2022.
- Class Notes will be available on Nexus

Prerequisite Information

This information can be found in the UW General calendar:

- Students that have taken ACS-4306 will not be eligible to take GACS-4306/7306 for GACS degree credit.
- ACS-2947 with a minimum grade of C+ and ACS-3913 with a minimum grade of C [prerequisite(s)]; ACS-4306L (lab) (must be taken concurrently).

Regulations, Policies, and Academic Integrity

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).

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

Detailed information can be found at the following:

- Academic Misconduct Policy and Procedures:
<https://www.uwinnipeg.ca/policies/docs/policies/academic-misconduct-policy.pdf> and
<https://www.uwinnipeg.ca/policies/docs/procedures/academic-misconduct-procedures.pdf>
- About Academic Integrity and Misconduct, Resources and FAQs:
<https://library.uwinnipeg.ca/use-the-library/help-with-research/academic-integrity.html>

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.

Academic Integrity and AI Text-generating Tools: Students must follow principles of academic integrity (e.g., honesty, respect, fairness, and responsibility) in their use of material obtained through AI text-generating tools (e.g., ChatGPT, Bing, Notion AI). Suspected misuse of AI may result in a report to the Senate Academic Standards and Misconduct Committee. If AI tools are used, students must cite them. According to the MLA (<https://style.mla.org/citing-generative-ai/>), "you should

- a. cite a generative AI tool whenever you paraphrase, quote, or incorporate into your own work any content (whether text, image, data, or other) that was created by it
- b. acknowledge all functional uses of the tool (like editing your prose or translating words) in a note, your text, or another suitable location
- c. take care to vet the secondary sources it cites."

Non-academic misconduct: Students are expected to conduct themselves in a respectful manner on campus and in the learning environment, irrespective of the 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/policies/docs/policies/acceptable-use-of-information-technology-policy.pdf>
- Non-Academic Misconduct Policy and Procedures:
<https://www.uwinnipeg.ca/policies/docs/policies/student-non-academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/policies/docs/procedures/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://www.uwinnipeg.ca/policies/docs/policies/copyright-policy.pdf>

Privacy

Students have rights in relation to the collection of personal data by the University of Winnipeg.

- Student Privacy: <https://www.uwinnipeg.ca/privacy/admissions-privacy-notice.html>
- Zoom Privacy: <https://www.uwinnipeg.ca/privacy/zoom-privacy-notice.html>
- Exam and 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, the course instructor will make every effort to inform students via UWinnipeg email and Nexus.

Students are reminded that they have a responsibility to regularly check their UWinnipeg e-mail addresses to ensure timely receipt of correspondence from the University and/or the course instructor.

Please let the 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.

Topics to be covered (tentative)

- Course Introduction
- Data Parallel Computing
- Scalable Parallel Execution
- Memory and Data Locality
- Performance Considerations
- Numerical Considerations
- Parallel Patterns:
- Convolution
- Prefix Sum
- Parallel Histogram Computation
- Sparse Matrix-Vector Multiplication
- Merge Sort
- Graph Search
- CUDA Dynamic Parallelism
- Case Studies
- Parallel Programming and Computational Thinking
- Heterogeneous Computing Clusters
- Advanced Topics

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.

In order to ensure a safe and comfortable learning environment for everyone, we kindly ask that all students refrain from wearing or using scented products while attending class.