THE UNIVERSITY OF WINNIPEG

Applied Computer Science

Course Number: **GACS-7306-001**
Course Name: **Applied Parallel Programming**
Course Webpage: http://courses.acs.uwinnipeg.ca/4306-001/

Instructor Information

Instructor: Dr. Christopher Henry
Email: ch.henry@uwinnipeg.ca
Class Room No: 3D03
Class Meeting Time: T/Th 2:30 - 3:45 pm
Office Hours: Tuesday 1:30-2:30 pm

Important Dates

First Class:	September 3rd, 2019
Fall Reading Week:	October 13th – 19th, 2019 **(No classes)**
Midterm Test:	October 24th, 2019
Withdrawal date w/o academic penalty[1]:	November 12th, 2019
Last Scheduled Class:	November 28th, 2019
Final Examination (Comprehensive):	December 7th, 2019 (1:30 – 4:30 pm)
The University is closed on the following dates (No Classes):	
	October 14th, 2019
	November 11th, 2019
	December 23rd, 2019 – January 1st, 2020

[1]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.

Additional Course Related Information

When it is necessary to cancel a class due to exceptional circumstances, instructors will make every effort to inform students via uwinnipeg email, as well as the Departmental Assistant and Chair/Dean so that class cancellation forms can be posted outside classrooms.

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 their course instructors.

Please note that withdrawing before the VW date does not necessarily result in a fee refund.

Course Objectives/Learning Outcomes

The basis of this course is the parallel execution model, which is a generalization of the traditional single threaded paradigm. The focus is parallel and distributed computing for use in

high-performance scientific applications. Students gain considerable knowledge in 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.

Evaluation Criteria

Midterm Examination (20%)

There will be **one** midterm test.

Assignments (20%)

Graduate students are expected to complete the laboratories assigned to undergraduate students. There will be 10 assignments; each consisting of 2% of your final grade. All work submitted for evaluation must be typed, and code must be commented and formatted. Late submissions will not be accepted.

Project (20%)

Details will be provided in class.

Final Examination (40%)

The final examination is comprehensive.

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%		

Exam Requirements

- Photo ID is required
- Unless a medical certificate is provided, no accommodation is made for missed deadlines or examinations
- No equipment (*e.g.* calculators, dictionaries, handheld devices, cell phones, computers) are authorized for use in tests/exams

Student Services and Information

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

http://www.uwinnipeg.ca/accessibility.

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 online at 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 examinations without penalty. A list of religious holidays can be found in the 2019-20 Undergraduate Academic Calendar.

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)

- Consent of Department Graduate Studies Committee Chair
- Students who have taken ACS-4306 will not be eligible to take ACS-7306 for degree credit.

Misuse of Computer Facilities, Plagiarism, and Cheating

Avoiding Academic 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.

Detailed information can be found at the following:

Academic Misconduct Policy and Procedures:
https://www.uwinnipeg.ca/institutionalanalysis/docs/policies/academic-misconduct-policy.pdf and https://www.uwinnipeg.ca/institutionalanalysis/docs/policies/academic-misconduct-procedures.pdf

Non-Academic Misconduct Policy and Procedures:
https://www.uwinnipeg.ca/institutionalanalysis/docs/student-non-academic-misconduct-policy.pdf and https://www.uwinnipeg.ca/institutionalanalysis/docs/student-non-academic-misconduct-procedures.pdf

Students are strongly recommended to view the University of Winnipeg library video tutorial *Avoiding Plagiarism*, which is available at: https://www.youtube.com/watch?v=UvFdxRU9a8g

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.

Avoiding Copyright Violation. Course materials are owned by the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides. 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 photographing or recording slides, presentations, lectures, and notes on the board.

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
-

Advice: Students who fall behind find it very hard to catch up.