



# THE UNIVERSITY OF WINNIPEG

## Applied Computer Science

**Course Number:** ACS-4306-001/GACS-4306-001, 070L  
**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](mailto:ch.henry@uwinnipeg.ca)  
**Class Room No:** 3D03      **Class Meeting Time:** T/Th 2:30 - 3:45 pm  
**Lab Room No:** 3D03      **Lab Meeting Time:** Thursday 4:00-5:15 pm  
**Office Hours:** Tuesday 1:30-2:30 pm

### Important Dates

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

<sup>1</sup>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 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.

## **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. All work submitted for evaluation must be typed, and code must be commented and formatted. Late submissions will not be accepted.

### **Final Examination (55%)**

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) 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 786-9771 or [accessibilityservices@uwinnipeg.ca](mailto:accessibilityservices@uwinnipeg.ca) to discuss appropriate options. All information about a

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## **Required Textbooks**

### **Main texts:**

- D. B. Kirk, and W. W. Hwu, *Programming Massively Parallel Processors: A Hands-on Approach*. 3<sup>rd</sup> 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.

## **Misuse of Computer Facilities, Plagiarism, and Cheating**

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.

Detailed information can be found at the following:

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## **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
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