Concurrent Programming
COMP 409

McGill University, Winter 2021

Course Details

Time: Monday, Wednesday 14:35–15:55
Place: In the comfort of your own home.

Instructor: Professor Clark Verbrugge
Email: `clump@cs.mcgill.ca`

Email, Website

McGill's MyCourses will be used for course announcements, to manage assignments and for online discussions. Students are expected to monitor their McGill email account for course-related news and information.
The external course website is: `http://www.sable.mcgill.ca/~clump/comp409`

Pre-requisites

- COMP 251 (Data Structures and Algorithms).
- COMP 302 (Programming Languages and Paradigms).
- COMP 310 (Computer Systems and Organization) *or* ECSE 427 (Operating Systems).
- There is a non-trivial programming requirement; ability to program in C and Java will be required.

Students registering without the pre-requisite should consult the instructor.

Textbooks

The following texts, along with your own course notes constitute reference sources for this course.

- Maurice Herlihy, Nir Shavit, Victor Luchangco, and Michael Spear. *The Art of Multiprocessor Programming* (second edition).
  This is the primary text for the course. It does not cover all topics, but it is a good and relatively modern reference. It is a new edition published October 2020, and is available at the bookstore (or other book retailers; ebook versions may also exist). You can also use the previous *revised 1st edition*, which is available in physical form as well as at the library in e-book form.
- Gadi Taubenfeld. *Synchronization algorithms and concurrent programming.*
  A previously used text; it does not cover the same material, but it provides a different perspective.
- Gregory Andrews. *Foundations of Multithreaded, Parallel, and Distributed Programming.*
  An ancient text, but a classic one; covers some of the basics.

Evaluation

3 Assignments:	45%
2 Quizzes:	30%
Final long form assessment:	25%

Note that in place of a traditional exam we will have a "long form" assessment—basically an extra assignment released at the end of class and due at the end of the exam period. Note that this means we do not have a formal exam, and thus there is no opportunity for deferred or supplemental exams.
In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

Assignment and Exam Policy: Assignments must be submitted on time. Late assignments will only be accepted in highly-exceptional circumstances, typically requiring a medical note as well explicit permission from the instructor. Note that I do not consider your workload in other courses exceptional, no matter what courses you take!
No assignment submissions will be accepted after marked assignments have been returned, or after solutions have been discussed. Students are expected to monitor their returned work. Corrections to assignment grades will not be made later than 2 weeks after an assignment grade is given out.
McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offenses under the Code of Student Conduct and Disciplinary Procedures (see `http://www.mcgill.ca/integrity/` for more information).
In all cases, to be accepted **work submitted for this course must fully and completely represent your own efforts.** Copying assignments or tests, or allowing others to copy your work, whether whole or partial will not be tolerated.

Course Content

Note that lecture dates are approximate: topics may shift and/or span lectures.
Chapter(.section) readings from Herlihy and Shavit are shown next to topics—readings specific to the revised 1st edition have a superscript[1], readings specific to the 2nd edition have a superscript[2], and readings common to both editions have no superscript.

Lec	DoW	Date	Topic	Readings
1	**Monday**	**January 11**	Introduction	**1**
2	**Wednesday**	**January 13**	Hardware, atomicity	**B.2–B.5, B.7**
3	**Monday**	**January 18**	Mutual exclusion, Java	**2.1–2.3, A.2.1–A.2.3, A.4[1], A.4.1–A.4.3[2]**
4	**Wednesday**	**January 20**	Simple locks	**2.4–2.6[1], 2.5–2.7[2], 7.1–7.4**
5	**Monday**	**January 25**	Complex locks	**7.5**
6	**Wednesday**	**January 27**	Blocking, deadlock, races	**8.1–8.5**
7	**Monday**	**February 1**	Termination, barriers	**17.1–17.3[1], 18.1–18.3[2], A.2.4, A.4.5[2]**
8	**Wednesday**	**February 3**	Expressiveness	**4.1, 4.2, 5.1–5.3**
9	**Monday**	**February 8**	Linearizability, scheduling	**3.1–3.6**
10	**Wednesday**	**February 10**	Memory consistency	**B.5, B.7**
11	**Monday**	**February 15**	Memory consistency	
12	**Wednesday**	**February 17**	Memory models: Java	**3.8[1], A.3[2]**
13	**Monday**	**February 22**	Memory models: C++	
14	**Wednesday**	**February 24**	Concurrent data structures	**6.1–6.4, 10.1–10.6, B.8**
15	**Monday**	**March 8**	Concurrent data structures	**11.1–11.4, 9.8**
16	**Wednesday**	**March 10**	OpenMP	
17	**Monday**	**March 15**	Other programming models	
18	**Wednesday**	**March 17**	Task models	**16.1–16.5**
19	**Monday**	**March 22**	Transactional memory	**18.1–18.4[1], 20.1–20.6[2]**
20	**Wednesday**	**March 24**	Message-passing	
21	**Monday**	**March 29**	Process algebra	
22	**Wednesday**	**March 31**	Process algebra	
23	**Wednesday**	**April 7**	Dataflow	
24	**Monday**	**April 12**	No class!	
25	**Wednesday**	**April 14**	Dataflow	
26	**Thursday**	**April 15**	Catch-up and/or review	

Assignments & Quizzes

Expected assignment and quiz distribution dates and due dates are listed below. Note that this is mainly to help you in general planning; topic descriptions are vague and non-exhaustive, and both the topic and the associated dates may change. Be sure to consult MyCourses for final, official due dates.

Assig.	Main Topic	Available	Due
1	Basic concurrency and locking	Tuesday, January 26	Tuesday, February 9
2	Thread interaction and coordination	Tuesday, February 9	Tuesday, February 23
3	Concurrent data structures	Tuesday, March 16	Tuesday, March 30
4	Long-form final assignment/exam-like-thing	Friday, April 16	Friday, April 30

Quiz.	Date
1	Thursday, February 25
2	Thursday, April 1