



**Course Name:** Algorithms and Data Structures  
COMP 251 Winter 2023

**Instructors:** David Becerra

Office Hours: Tuesday 1 - Zoom

Thursday 15:00 - 16:00 Zoom

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### Course Objectives:

Welcome to COMP-251! Please read this document carefully and keep it for reference throughout the term.

COMP-251 refers to the design of correct and efficient algorithms. A correct algorithm must take all possible instances of a described problem to the right result. An efficient algorithm must find the right result in a reasonable amount of time as a function of the size of the input. To train ourselves in the process of designing correct and efficient algorithms, we will perform the following activities:

- To review algorithms' analysis and design techniques. We will also cover and practice on instances where those techniques can be applicable.
  - To review (and analyse) correct and efficient algorithms in the state of the art.
  - To design correct and efficient algorithms that solve 'real' world problems.

COMP-251 will be a combination of theory and practice. Both of them will interact during the term. The course uses the Java programming language, where questions in assignments and exams may require you to write a Java program.

Learning how to design algorithms is not easy; it is not a set of facts that one can simply memorise. You will need to study and practice to master the main concepts. This course aims to teach students a way of thinking that will enable them to build correct and efficient algorithms.

### Primary learning objectives:

By the end of this course, students will be able to:

- Analyze the correctness of an algorithm.
- Analyze the efficiency of an algorithm.
- Know algorithms in the state of the art.
- Design correct and efficient algorithms.

- Implement the designed algorithms.

**Pre-requisites:** *COMP 250 Introduction to Computer Science and MATH 240 Discrete Structures*

**Corequisite(s):** COMP321 (when available) is in my opinion a very good combination.

**Restrictions:**

Not open to students who have taken or are taking [COMP 252](#).

We share the same objectives: The description of various computational problems and the algorithms that can be used to solve them, along with their associated data structures. Proving the correctness of algorithms and determining their computational complexity.

**Required Software:**

- Java <https://www.java.com/en/>
- myCourses <https://mycourses2.mcgill.ca/>
- Discussion Board TBD
- Autograder TBD

**Class Material:**

All the material needed for this class will be available on mycourses. There is no required textbook. However, we recommend the following textbooks from which most lectures will be based upon:

- [CLRS2009] Cormen, Leiserson, Rivest, & Stein, *Introduction to Algorithms*.
- [KT2006] Kleinberg & Tardos, *Algorithm Design*.

Lecture slides will be made available in PDF form on MyCourses. Lectures will be recorded and available on MyCourses. Instructions to borrow a E-book online are available at <http://www.mcgill.ca/library/find/ebooks/borrowing-ebooks/>.

**Course Delivery:**

**Lectures:** Live-In Person (recorded) or pre-recorded (in exceptional circumstances) on Tuesday & Thursday at 2:35 - 3:55pm (EDT).

**Assignments:** The guidelines will be released in MyCourses and the solutions are expected to be submitted in our autograder. We keep the right to modify the software during the term (in exceptional circumstances).

**Contact:** All course-related email should be sent to [cs251-winter@cs.mcgill.ca](mailto:cs251-winter@cs.mcgill.ca). Emails sent to personal addresses will not likely be seen.

**Office hours:**

Please consult the COMP251 calendar in mycourses for the most up-to-date schedule including office hours and other important dates.

## Tentative Grading

Work	Weight	Comment
<b>Assignments</b> (3)	45%	Three programming assignments (15% each). 1 for Data structures. 1 for Paradigms. 1 for Graph Theory.
<b>Proofs Assessment</b> (1)	10%	Proof-based Assessment.
<b>Final Exam</b> (1)	45%	One final exam to be held during the exam period.

## Tentative Course Outline

Section	Topic	Book/Chapter	Date	Event
General	Introduction	N/A	05-Jan	
	Comp250 Review I	Chapter 3 of [CLRS2009]	10-Jan	
Data Structures	Review II - Hashing I	Chapter 11 of [CLRS2009]	12-Jan	
	Hashing II	Chapter 11 of [CLRS2009]	17-Jan	
	Disjoint Sets	Chapter 21 of [CLRS2009]	19-Jan	
	Heaps & HeapSort	Chapter 6 of [CLRS2009]	24-Jan	A1 released
	BST and AVL trees	Chapter 12 of [CLRS2009]	26-Jan	
	Red Black trees	Chapter 13 of [CLRS2009]	31-Jan	

Design and Analysis	Algorithm Paradigms	Chapter 4 of [CLRS2009]	02-Feb	Proof Released
	Divide and Conquer 1	Chapter 4 of [CLRS2009]	07-Feb	
	Divide and Conquer 2	Chapter 5 of [KT2006]	09-Feb	
	Dynamic Programming 1	Chapter 6 of [KT2006]	14-Feb	A1 Due
	Dynamic Programming 2	Chapter 6 of [KT2006]	16-Feb	A2 released
	Dynamic Programming 3	Chapter 6 of [KT2006]	21-Feb	
	Greedy Algorithms	Chapter 16 of [CLRS2009]	23-Feb	
Reading Week			28-Feb	
			02-Mar	
Graph Algorithms	Elementary Graph Algorithms	Chapter 22 of [CLRS2009]	07-Mar	
	CC / Topo-Sort	Chapter 22 of [CLRS2009]	09-Mar	A2 Due
	Network Flow 1	Chapter 26 of [CLRS2009]	14-Mar	A3 released
	Network Flow 2	Chapter 26 of [CLRS2009]	16-Mar	Proof Due I
	Single Source Shortest Path	Chapter 24 of [CLRS2009]	21-Mar	Proof Due II
	Minimum Spanning Trees	Chapter 23 of [CLRS2009]	23-Mar	Proof Due III
	Bipartite Graphs	Chapter 1 of [KT2006]	28-Mar	
General	Amortized Analysis	Chapter 17 of [CLRS2009]	30-Mar	
	Randomized algorithms	Chapter 13 of [KT2006]	04-Apr	A3 Due
	Probabilistic Analysis	Chapter 5 of [CLRS2009]	06-Apr	
	Information Final Exam		11-Apr	

## General Information

### Communication:

- **My Courses:** All official communication, including announcements, lecture material, assignments, grades will be found on My Courses.
- **Course Discussions:** TBD

- **Course Email:** All course-related email should be sent to [cs251-winter@cs.mcgill.ca](mailto:cs251-winter@cs.mcgill.ca). Emails sent to personal addresses will not likely be seen.
- **Private Email:** The professor and TA have private email accounts that you may 'exceptionally' also use, however these communication channels are for personal queries. For example: if you have a private and very personal message that you want only the instructor to address then you can email the instructor directly.
- **Office Hours:** Please take a look at all posted office hours. Come to those times without appointment.
- **After lecture:** Some optional time will be available just after class to ask questions. I do not guarantee the length of this time since other constraints may interfere.

### Assignments & Tests:

- **Assignments Delivery:** All assignments are picked-up from myCourses and submitted to TBD.
- **Late Policy:** You will be notified in advance of assignment due dates. Particularly, due date/time, location/mode for returning your solutions, and accepted formats will be announced in class, stated in the assignment outline and/or indicated on mycourses. Failure to return your assignment in time will result in penalties and possibly absence of grading. **Late submission of 24h or less will receive a penalty of 20%. In all other cases, your assignment will be refused and not graded.**
- **Additional Work:** Students will not be given the opportunity to complete additional work to upgrade their grade.
- **Grading Policy:** Assignments and exams may include guidelines and require particular formatting procedures. **Solutions that do not follow the required format will not be graded.** The quality of the presentation of your solution is important. Unreadable material, cryptic notations, or bad organization of the material may result in absence of grading. Clarity of your explanations will be an integral part of your final grade.
- **Re-grading:** Mistakes can occur when grading. Not surprisingly, requests for re-grading always involve those mistakes in which the student received fewer points than they deserved, rather than more points than they deserved. With that in mind: if you wish me to re-grade a question on an exam or assignment, I will do so. I reserve the right to re-grade other questions as well.
- **Cheating/Collaboration:** Collaboration is encouraged but your discussions should be public in the sense that anyone including the professor should be allowed to listen in. Assignments are original works created by the student alone. You are permitted and encouraged to have conversations with other students concerning the contents of the assignments and how to do them, but your work must be original. If two or more assignments are found to be identical (or portions of assignments) then all parties will lose points. This includes the student who permitted their assignment to be copied. This includes written solutions and software source code.
- **Exam Policy:** Students are responsible for all materials for the tests and exams. Exams will be a combination of all types of questions based on all sources, and students may be required to integrate theoretical concepts from the text to substantiate their arguments. Crib sheets, calculators, dictionaries are not permitted during an exam or test unless specifically stated by the professor.

### Additional Information:

The course slides are not meant as a complete set of notes or a substitute for a textbook, but simply constitute the focus of the lecture. Important gaps are left in the slides that are filled in during class, thus lecture attendance should be considered essential.

**The material covered in the classroom will be used to supplement textbook readings.**

Every chapter should be read twice. The first reading should be done prior to attending class and the second reading should be done after the class discussion of the chapter.

**Right to submit in English or French written work that is to be graded.**

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.

**Academic Integrity:** *Code of Student Conduct*

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see [www.mcgill.ca/integrity](http://www.mcgill.ca/integrity) for more information).

L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site [www.mcgill.ca/integrity](http://www.mcgill.ca/integrity)).

**Final Exam Policy:** *Regulations*

Students should not make other commitments during the final exam period. Vacation plans do not constitute valid grounds for the deferral or the rescheduling of examinations. See the Centre Calendar for the regulations governing Examinations: <https://www.mcgill.ca/exams/regulations>

Students are required to present their I.D. Card (with photo) for entrance to their examination.

**Final Exam Policy:** *Conflicts*

If you are unable to write your final examination due to scheduling conflicts, you must submit a Final Exam Conflict Form with supporting documentation at least **one month** before the start of the final examination period. Late submissions will not be accepted. For details, <https://www.mcgill.ca/exams/dates/conflicts>

**Final Exam Policy:** *Exam Timetable*

Examination schedules are posted at the Centre and on the following page approximately 6-8 weeks before the examination period commences <https://www.mcgill.ca/exams/dates>

The Centre cannot provide examination dates over the telephone.

**Student Rights and Responsibilities:**

Regulations and policies governing students at McGill University can be downloaded from the website: <https://www.mcgill.ca/students/srr/>

**Students Services and Resources:**

Various services and resources, such as email access, walksafe, library access, etc., are available to McGill students: <https://www.mcgill.ca/student-services/>

Various services and resources are offered to computer science students: <https://mcgill-csus.ca/>

**Minerva for Students:** <http://www.mcgill.ca/minerva-students/>

### **Important Note:**

In the event of extraordinary circumstances beyond the University's control, the evaluation scheme in a Course is subject to change, provided that there be timely communications to the students regarding the change.

### **Land acknowledgement:**

McGill University is on land which has long served as a site of meeting and exchange amongst Indigenous peoples, including the Haudenosaunee and Anishinabeg nations. We acknowledge and thank the diverse Indigenous people whose footsteps have marked this territory on which people of the world now gather. Please see here for more details: <https://www.mcgill.ca/edu4all/other-equity-resources/traditional-territories> .