Electrical and Computer Engineering
COMPENG 2SI3
Data Structures and Algorithms
Winter 2027

McMaster University

ENGINEERING

Instructor Information

Ratnasingham Tharmarasa
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Office: ITB-A211

Office Hours:

Wednesday 11:30 am – 1:00 pm; and by appointment

Scott Chen
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Office: ITB-A316

Office Hours:

Wednesday 12:00 am – 1:00 pm; and by appointment

Teaching Assistants

Names, contact information and office hours are provided on the course website.

Class Times

Lectures:
C01: Tuesday and Friday 12:30 pm – 1:20 pm
C02: Wednesday and Thursday 10:30 am – 11:20 am
*Section C02 will be delivered in a flipped classroom setting.

Tutorials:
T01: Wednesday 10:30 am – 11:20 am
T02: Wednesday 1:30 pm – 2:20 pm

Labs:

Lab starts on Jan. 18, on every other week, from 12:30 pm – 5:20 pm – L01 Monday,

L02 Monday, L03 Wednesday, L04 Wednesday, L05 Monday, L06 Monday, L07 Monday, L08 Monday, L09 Tuesday, L10 Tuesday

Course Dates: 01/04/2027 - 04/07/2027
Units: 3.00
Course Delivery Mode: In Person
Course Description: Data abstraction; algorithm analysis; recursion; lists; stacks; queues; trees; searching; hashing; sorting. Two lectures, one tutorial, one lab every other week; second term Prerequisite(s): ENGINEER 1D04 or ENGINEER 1P13 and COMPENG 2SH4 Antirequisite(s): COMPSCI 2C03, COMPSCI 2DM3, SFWRENG 2C03, SFWRENG 2DM3, COMPENG 2SI4

Important Links

- Mosaic
- Avenue to Learn
- Student Accessibility Services - Accommodations
- McMaster University Library
- eReserves
- Open Education Resources

Graduate Attributes

The Canadian Engineering Accreditation Board (CEAB) is a division of Engineers Canada and is responsible for accrediting undergraduate engineering programs across Canada. Accreditation by the CEAB ensures that the engineering programs meet a national standard of quality and cover essential educational requirements. Graduate Attributes are a set of qualities and skills that the CEAB expects engineering graduates to possess. These attributes are a benchmark for the learning outcomes of accredited engineering programs. This section lists the Graduate Attribute Indicators associated with the Learning Outcomes in this course.

Course Learning Objectives

- Analyze the time and space efficiency of algorithms using asymptotic complexity measures

- Explain and implement fundamental data structures, including lists, stacks, queues, trees, binary search trees, and hash tables.
- Apply and evaluate comparison-based sorting algorithms, understanding their operation, efficiency, and appropriate use cases
- Select appropriate data structures to support efficient solutions for a variety of computational problems

CEAB Graduate Attributes (GAs)

The CEAB Graduate Attributes (GAs) defined in this section are measured throughout the course and form part of the Department's continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student's actual grade in the course. For more information on accreditation, please ask your instructor or visit: http://www.engineerscanada.ca

Attributes	Indicators		Measurement Method(s)
	Number	Description	
Knowledge Base for Engineering	1.4	Competence in specialized engineering knowledge	Exams, Quizzes
Problem Analysis	2.1	Identifies and states reasonable assumptions and suitable engineering fundamentals, before proposing a solution path to a problem	Labs
Investigation	3.1	Selects appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies	Class Discussions, Labs, Quizzes
Investigation	3.2	Synthesizes the results of an investigation to reach valid conclusions	Labs
Use of Engineering Tools	5.1	Evaluates engineering tools, identifies their limitations, and selects, adapts, or extends them appropriately	Labs

Lab Safety

The Faculty of Engineering is committed to McMaster University's Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs". It is your responsibility to understand McMaster University Workplace and Environmental Health and Safety programs and policies. For information on these programs and policies please refer to McMaster University Health and Safety. The Lab Safety Handbook is available here, as well as on A2L.

It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for some of the experiments and the laboratory equipment. A laboratory-specific set of rules can also be added to ensure that students fully understand laboratory safety rules that are in place prior to their first session.

Assumed Knowledge

Programming in C++

Required Materials and Texts

Please sign in with your MacID here to view your booklist

Data Structures and Algorithm Analysis in C++
ISBN: 013284737X
Authors: M.A. Weiss
Publisher: Pearson
Edition: 4th

Optional Course Materials

Please sign in with your MacID here to view your booklist

Data Structures and Algorithms in Java
ISBN: 0672324539
Authors: R. Lafore
Publisher: Sams Publishing
Edition: 2nd

Data Structures and Problem Solving Using JAVA
ISBN: 0321322134
Authors: M.A. Weiss
Publisher: Wesley
Edition: 3rd or 4th

Easy Learning Data Structures & Algorithms C++: Graphic Data Structures & Algorithms
ISBN: 1696139910
Authors: Y. Hu
Publisher: Independently Published

Class Format

In-person attendance is required for this course.

Graduate Grading Scale

Graduate Student Grading Scale (Except for MBA and Master of Finance)

Grade	Points	Equivalent Percentage	Pass/F
A+	12	90-100	P+
A	11	85-89	
A-	10	80-84	
B+	9	77-79	P
B	8	73-76	
B-	7	70-72	
F	0	69 and under	F

MBA and Master of Finance Grading Scale

Grade	Points	Equivalent Percentage	Pass/F
A+	12	90-100	P+
A	11	85-89	
A-	10	80-84	
B+	9	75-79	P
B	8	70-74	
B-	7	60-69	
F	0	59 and under	F

Course Schedule

Note: all timings are approximate.

A weekly breakdown of the course schedule

Week	Topic	Readings
1 - 2	Algorithm Complexity Analysis: Space and time complexity, asymptotic notation, examples.	Chap. 2
3-4	Array lists and Linked lists	Sec. 3.1-5, Chap. 3
5	Stacks and queues	Sec. 3.6-7, Chap. 3
6	Recursion: Recursive algorithms, their space and time complexity analysis	Sec. 1.3, Chap. 1
7-8	Trees and binary search trees	Chap 4
9-10	Hashing	Chap 5
11-12	Sorting Algorithms: insertion sort, bubble sort, merge sort, quicksort, radix sort	Chap 7

A more detailed timeline is available on the course website.
At certain points in the course, it may make good sense to modify the schedule. The Instructor may modify elements of the course and will notify students accordingly (in class and on the course website).

Laboratory Overview

Lab	Topic
1	Asymptotic and OOD Analysis of Array List with Non-Primitive Objects, Model Code Analysis, and Experimental Evaluation of Performance
2	Implementation of Linked List with Non-Primitive Objects, Simple Sorting Implementation, Experimental Evaluation of Performance Improvement using Linked List vs. Array List on Test Bench
3	Implementation of Stack and/or Queue with Non-Primitive Objects, Experimental Evaluation of Performance Improvements
4	Implementation of Binary Search Tree with Non-Primitive Objects, Experimental Evaluation of Performance Improvements
5	Implementation of Hash Tables with Linear and Quadratic Probing with Non-Primitive Objects, Experimental Evaluation of Performance Improvements

Laboratory Operation

- Each student in the course is required to pass the lab safety quiz prior to attempting any of the laboratories. The quiz will be available on Avenue to Learn.
- Access to all labs is restricted in the interest of security and safety. Information on accessing and using the lab can be found on this webpage: https://www.eng.mcmaster.ca/ece/labs-and-health-safety#Labs-Access-and-Use
- Lab Experiments:
    - The lab assignments are programming tasks and will be posted on Avenue to Learn about one or two weeks before the lab starts.
    - The labs for this course will be held in a computer lab using C++.
    - Students are encouraged to work and even finish the lab work before their lab session.
- Lab Requirements:
    - Students must attend the lab session and demonstrate their solution to a TA. Specifically, students must show that the code runs on various inputs, answer questions regarding the algorithm and the implementation, reproduce portions of their code in front of the TA, etc.
    - The labs for this course will be partly autograded on GitHub Classroom. Students will have to demonstrate the autograding results to Teaching Assistants in the lab session.
    - The source code must be **submitted online on Avenue to Learn before the end of the lab session**. More details will be discussed in class.
    - Students are required to verify uploaded lab marks on Avenue-to-Learn after each week to ensure accuracy.
    - All work in this course is required to be done individually and, unless explicitly stated, no collaborative work is permitted.

Course Evaluation

1. Five labs (5% per lab) = 25%
2. Quizzes = 10%
    - This weight will be transferred to the final exam if the final mark is better than the quiz mark.
3. One mid-term test = 30%
    - For students with a higher mark on the final than their midterm mark, the midterm weight becomes 0%, and the final weight becomes 65%.

4. One final exam = 35%

Component	Weight
Labs (5)	25%
max(Quizzes, Final Exam)	10%
max(Midterm Exam (1), Final Exam)	30%
Final Exam (1)	35%
Total	**100%**

Grading and Evaluation Policies

- The final exam must be written; otherwise, a final grade of F will be awarded regardless of the student's course aggregate achieved without the final exam. **Furthermore, to pass the course, a student must obtain at least 30% marks on the final examination.**
- There are five labs, one mid-term exam, and one final exam to be evaluated in this course.
- No make-up midterm tests will be granted. The weight of the midterm test will be transferred to the final exam.
- Use of books, notes, other copied materials, computers or cell phones is not allowed during exams.
- In case of a Lab absence **reported on an MSAF**, the missed lab solution **must be demonstrated** during the makeup lab sessions at the end of the term. The dates and times will be announced on Avenue-to-Learn.
- In case of a Lab absence **not reported** in an MSAF, the missed lab solution can be demonstrated during the makeup lab sessions; however, **a penalty of 50% will be applied.**

Undergraduate Grading Scale

The McMaster 12 Point Grading Scale

Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66

Grade	Equivalent Grade Point	Equivalent Percentages
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49

Late Assignments

Late submissions of lab code and reports are subject to 50% penalty per day (less than one day is counted as one day).

Absences, Missed Work, Illness

- Attendance and active engagement at all classes is expected.
- Students must contact the instructor for an alternative lab session for missed labs.
- There will be no accommodation for any missed quizzes. The average of the best 70% of the quizzes will be taken. The quiz weight will be transferred to the final exam if the final mark is better than the quiz mark.
- No make-up midterm tests will be granted. The weight of the midterm test will be transferred to the final exam.

APPROVED ADVISORY STATEMENTS

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the Academic

Integrity Policy.

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity / Plagiarism

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. Avenue to Learn, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Courses with an On-line Element

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn, LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this

disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or

sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

Requests for Relief for Missed Academic Term Work

In the event of an absence for medical or other reasons, students should review and follow the Policy on Requests for Relief for Missed Academic Term Work.

Academic Accommodation for Religious, Indigenous, or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, Indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, Avenue to Learn and/or McMaster email.

Turnitin.com

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Generative AI: Use Prohibited

Students are not permitted to use generative AI in this course. In alignment with McMaster academic integrity policy, it "shall be an offence knowingly to … submit academic work for assessment that was purchased or acquired from another source". This includes work created by generative AI tools. Also stated in the policy is the following, "Contract Cheating is the act of "outsourcing of student work to third parties" (Lancaster & Clarke, 2016, p. 639) with or without payment." Using Generative AI tools is a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

Electrical and Computer Engineering Lab Safety

Information for Laboratory Safety and Important Contacts

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. It is expected that revisions and updates to this document will be done continually. A McMaster University lab manual is also available to read in every laboratory and online: https://hr.mcmaster.ca/app/uploads/2019/07/2019-McMaster-Lab-Manual.pdf

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following whether conducting lab work at school or at home:

1. Food and beverages are not permitted in the instructional laboratories.

2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.

3. Laboratory equipment should only be used for its designed purpose.

4. Proper and safe use of lab equipment should be known before using it.

5. The course TA leading the lab should be informed of any unsafe condition.

6. The location and correct use of all available safety equipment should be known.

7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.

8. Proper waste disposal procedures should be followed.

9. Personal ergonomics should be practiced when conducting lab work. https://bit.ly/3fOE71E

10. Current University health and safety issues, and protocols should be known. https://hr.mcmaster.ca/resources/covid19/workplace-health-and-safety-guidance-during-covid-19/

Location of Safety Equipment

Fire Extinguisher

On walls in halls outside of labs

First Aid Kit

Main Lobby of ITB, or dial "88" after 4:30 p.m.

Telephone

On the wall of every lab near the door

Fire Alarm Pulls

Near all building exit doors on all floors

Who to Contact	
Emergency Medical/Security:	On McMaster University Campus, call Security at extension 88 or 905-522-4135 from a cell phone.
Non-Emergency Accident or Incident:	Immediately inform the TA on duty or Course Instructor.
University Security (Enquiries/Non-Emergency):	Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.
See TA or Instructor:	For problems with heat, ventilation, fire extinguishers, or immediate repairs.
Environmental & Occupational Health Support Services (EOHSS):	For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.

In Case of a Fire (On Campus Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!

2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.

3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!

4. In the event of a fire in your work area shout “Fire!" and pull the nearest fire alarm.

5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.

6. Do not attempt to fight a major fire on your own.

7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people.

1. Douse with water from safety shower immediately or

2. Roll on floor and scream for help or

3. Wrap with fire blanket to smother flame (a coat or other non-flammable fiber

may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.

2. In power labs, press wall-mounted emergency shut-off button.

3. Inform your TA of the problem.

4. Wait for further instructions from your TA.

5. TA must file an incident report.

Protocol For Safe Laboratory Practice

In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

Defined Roles

TA	The first point of contact for lab supervision	
ECE Lab Supervisor	Steve Spencer- ITB 147	spencers@mcmaster.ca
ECE Chair	Shahram Shirani- ITB A111	shirani@mcmaster.ca
ECE Administrator	Shelby Gaudrault- ITB A111/B	gaudraus@mcmaster.ca
ECE Course Instructor	Please contact your specific course instructor directly	