COMP ENG 2SI3
Data Structures and Algorithms

COURSE OUTLINE

Please refer to course website for updated information.

COURSE DESCRIPTION

Data abstraction; algorithm analysis; recursion; lists; stacks; queues; trees; searching; hashing; sorting.

Two lectures, one tutorial, one lab every other week.

PRE-REQUISITES AND ANTI-REQUISITES

Pre-requisite(s): ENGINEER 1D04 or ENGINEER 1P13 and COMPENG 2SH4

Anti-requisite(s): COMPSCI 2C03, COMPSCI 2DM3, SFWRENG 2C03, SFWRENG 2DM3, COMPENG 2SI4

SCHEDULE and MODE OF DELIVERY

The material for this course will be delivered through a mixture of live lectures, tutorials, laboratories, online videos and textbook readings.

Lectures:
C01: Tuesday and Thursday 5:30 pm – 6:20 pm
C02: Monday and Wednesday 1:30 pm – 2:20 pm
*Section C02 will be delivered in flipped classroom setting.

Tutorials:
T01: Monday 10:30 am – 11:20 am
T02: Thursday 9:30 am – 10:20 am

Labs:

Lab starts on Jan. 19, 2025, from the even group (i.e., L02, L04 …), on every other week as follows.

L03: Mondays 2:30 pm – 5:20 pm
L04: Mondays 2:30 pm – 5:20 pm
L09: Mondays 2:30 pm – 5:20 pm
L10: Mondays 2:30 pm – 5:20 pm

L01: Wednesdays 2:30 pm – 5:20 pm
L05: Thursdays 2:30 pm – 5:20 pm
L07: Thursdays 2:30 pm – 5:20 pm
L02: Wednesdays 2:30 pm – 5:20 pm
L06: Thursdays 2:30 pm – 5:20 pm
L08: Thursdays 2:30 pm – 5:20 pm

INSTRUCTOR

C01: Dr. R. Tharmarasa
Email: thamas@mcmaster.ca
Office: ITB-A211
Phone: 905-525-9140 ext. 24171
Office Hours**:** Monday 11:30 am – 12:30 am; and by appointment

C02: Dr. S. Chen
Email: chenw184@mcmaster.ca
Office: ITB-A316
Phone: 905-525-9140 ext. 26063
Office Hours**:** Wednesday 11:00 am – 1:00 pm; and by appointment

TEACHING ASSISTANTS

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

COURSE WEBSITE/S

http://avenue.mcmaster.ca

COURSE OBJECTIVES

To provide a foundation of the concepts of data abstraction, algorithm design and performance estimation. By the end of this course, students should be able to:

1) Estimate the performance of an algorithm using asymptotic time and space complexity analysis.
2) Understand the operation of elementary data structures such as lists, stacks, queues, trees, binary search trees and hash tables; be able to implement and use them.
3) Understand the popular efficient comparison-based algorithms for sorting.
4) Choose appropriate data structures and devise efficient algorithms to solve various problems.

CEAB GRADUATE ATTRIBUTES (GAS)

Note: 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

ASSUMED KNOWLEDGE

Programming in C++.

COURSE MATERIALS

Required Texts:
M.A. Weiss, Data Structures and Algorithm Analysis in C++, 4th ed., Pearson, (ISBN 013284737X)

Additional References (not required)
[1] M.A. Weiss, Data Structures and Problem Solving Using JAVA, 3rd or 4th ed., Addison Wesley, (ISBN 0321322134).

[2] Y. Hu, Easy Learning Data Structures & Algorithms C++: Graphic Data Structures & Algorithms, Independently Published (ISBN 1696139910).
[3] R. Lafore, Data Structures and Algorithms in Java, 2nd ed., Sams Publishing, (ISBN 0672324539).

Calculator:
No calculators are permitted on tests or examinations.

COURSE OVERVIEW

Note: all timings are approximate.

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

Labs are NOT held during the first week of term.

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 video and quiz will be on Avenue to Learn.
- Access to all labs is restricted in the interest of security and safety. Although we will not access the labs on campus for this term, information on accessing and using the lab can be found on the 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.

ASSESSMENT

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 else 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.**

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. The 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, located at https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/

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 DETECTION

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., online

search, other software, etc.). For more details about McMaster's use of Turnitin.com, please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ONLINE ELEMENT

Some courses may use online elements (e.g., email, Avenue to Learn (A2L), 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 email 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 online 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.

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.

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.

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 ACCOMMODATIONS

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.

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.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

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, A2L and/or McMaster email.

www.eng.mcmaster.ca/ece

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 conditions.
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 the 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 protocol 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.
ECE Specific Instructional Laboratory Concerns: For non-emergency questions specific to the ECE laboratories, please contact 24103.

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 nonflammable 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 the 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

Leave equipment in a safe state for the next person - if you're not sure, ask!

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	steve@mail.ece.mcmaster.ca
ECE Chair	Shahram Shirani- ITB A111	shirani@mcmaster.ca
ECE Administrator	Shelby Gaudrault - ITB A111/A	gaudraus@mcmaster.ca
ECE Course Instructor	Please contact your specific instructor directly	