COMP ENG 2S14
Data Structures, Algorithms and Discrete Mathematics
Winter 2018
Course Outline

CALENDAR/COURSE DESCRIPTION
Data abstraction; algorithm analysis; recursion; lists; stacks; queues; trees; searching; hashing; sorting; sets; relations; functions; modular arithmetic; graph theory and algorithms.

PRE-REQUISITES AND ANTI-REQUISITES
Prerequisite(s): ENGINEER 1D04, COMPENG 2SH4
Antirequisite(s): COMPSCI 2C03, 2DM3, SFWRENG 2C03, 2DM4

SCHEDULE
Lectures: Tuesday, Wednesday, Friday, at 9:30 am – 10:20 am in BSB 147
Tutorial: Thursday 13:30 pm – 14:20 pm in JHE 376 and Monday 8:30-9:20am in MDCL 1309
Labs:
L01: Jan. 22, Feb. 5, Feb. 26, Mar. 12, Mar. 26, at 2:30 pm - 5:20 pm in ITB/AB111
L02: Jan. 29, Feb. 12, Mar. 5, Mar. 19, Apr. 2, at 2:30 pm - 5:20 pm in ITB/AB111
L03: Jan. 23, Feb. 6, Feb. 27, Mar. 13, Mar. 27, at 2:30 pm - 5:20 pm in ITB/AB111
L04: Jan. 30, Feb. 13, Mar. 6, Mar. 20, Apr. 3, at 2:30 pm - 5:20 pm in ITB/AB111
L05: Jan. 24, Feb. 7, Feb. 28, Mar. 14, Mar. 28, at 2:30 pm - 5:20 pm in ITB/AB111
L06: Jan. 31, Feb. 14, Mar. 7, Mar. 21, Apr. 4, at 2:30 pm - 5:20 pm in ITB/AB111
L07: Jan. 25, Feb. 8, Mar. 1, Mar. 15, Mar. 29, at 2:30 pm - 5:20 pm in ITB/AB111
L08: Feb. 1, Feb. 15, Mar. 8, Mar. 22, Apr. 5, at 2:30 pm – 5:20 pm in ITB/AB111
L09: Jan. 26, Feb. 9, Mar. 2, Mar. 16, at 2:30 pm – 5:20 pm in ITB/AB111 and Apr. 3, 5:30-8:20pm in ITB/AB111
L10: Feb. 2, Feb. 16, Mar. 9, Mar. 23, Apr. 6, at 2:30 pm – 5:20 pm in ITB/AB111
L11: Jan. 23, Feb. 6, Feb. 27, Mar. 13, Mar. 27, at 5:30 pm – 8:20 pm in ITB/AB111

Midterm Exam: March 7, 2018 from 6:00-8:00pm Room: To be announced.

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION
Dr. Steve Hranilovic
ITB-A224
hranilovic@mcmaster.ca
ext. 27620
Office Hours:
Friday 10:30 - 11:30 am
(additional times to be posted on Avenue to Learn)

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION
Note: Scheduling of TA Office hours to be posted on Avenue to Learn.

Tongyu Ge
ITB-A202
get3@mcmaster.ca
ext. 23151
Pengfei Kan
ITB-A202
kanp@mcmaster.ca
ext. 23151
Khaled Ahmed
ITB-224
ahmedk1@mcmaster.ca
ext. 26070
Majeed Khaqan
ITB-224
majeedk@mcmaster.ca
ext. 26070
COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

This course will be administered via Avenue to Learn. To access the course's Avenue to Learn page go to 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, heaps and hash tables; be able to implement and use them.
3) Understand the popular efficient comparison-based algorithms for sorting.
4) Understand elementary aspects of graph theory, shortest path and spanning tree algorithms.
5) Choose appropriate data structures and devise efficient algorithms to solve various problems.

ASSUMED KNOWLEDGE

Programming in Java. Implementation of singly and doubly linked lists.

COURSE MATERIALS


Additional References (not required)
2) A. V. Aho, J. E. Hopcroft, J. D. Ullman, Data structures and algorithms, Addison-Wesley.

Calculator:
No calculators are permitted on tests or examinations.
**COURSE OVERVIEW**

<table>
<thead>
<tr>
<th>Date/Week</th>
<th>Topic</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 4-12</td>
<td>Algorithm Complexity Analysis: Space and time complexity, asymptotic notation, examples.</td>
<td>Chap. 5</td>
</tr>
<tr>
<td>Jan. 15-19</td>
<td>Lists, stacks and queues.</td>
<td>Sec. 6.5-6, Chap. 16, 17</td>
</tr>
<tr>
<td>Jan. 22-26</td>
<td>Recursion: Recursive algorithms, their space and time complexity analysis, the divide and conquer method.</td>
<td>Chap. 7</td>
</tr>
<tr>
<td>Jan. 29-Feb. 9</td>
<td>Trees and binary search trees.</td>
<td>Chap. 18, 19 (1-3)</td>
</tr>
<tr>
<td>Feb. 12-16</td>
<td>Hashing</td>
<td>Chap. 20</td>
</tr>
<tr>
<td>Feb. 26-Mar. 7</td>
<td>Sorting Algorithms: Insertion sort, bubble sort, merge sort, quicksort, heaps, heap sort.</td>
<td>Chap. 8, Chap. 21</td>
</tr>
<tr>
<td>Mar. 8-13</td>
<td>Sets, functions and relations.</td>
<td>Class notes</td>
</tr>
<tr>
<td>Mar. 14-29</td>
<td>Elements of graph theory. Graph algorithms: Dijkstra's Algorithm, Bellman-Ford Algorithm, Prim's Algorithm.</td>
<td>Class notes and Chap. 14</td>
</tr>
<tr>
<td>Apr. 2-Apr. 9</td>
<td>Modular Arithmetic</td>
<td>Class notes</td>
</tr>
</tbody>
</table>

**Note: all timings are approximate.**

**LABORATORY OVERVIEW**

<table>
<thead>
<tr>
<th>Date/Week</th>
<th>Topic</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 22 - Feb. 2</td>
<td>Implementation of arithmetic operations with huge integers. Experimental evaluation of performance.</td>
<td>TBA</td>
</tr>
<tr>
<td>Feb. 5 – 16</td>
<td>Implementation of arithmetic operations with huge integers. Experimental evaluation of performance.</td>
<td>TBA</td>
</tr>
<tr>
<td>Feb. 26-Mar. 9</td>
<td>Application of trees</td>
<td>TBA</td>
</tr>
<tr>
<td>Mar. 12-23</td>
<td>Application of hash tables or heaps</td>
<td>TBA</td>
</tr>
<tr>
<td>Mar. 26-Apr. 6</td>
<td>Graph algorithms</td>
<td>TBA</td>
</tr>
</tbody>
</table>

**LABORATORY OPERATION**

The lab assignments are programming tasks and will be posted on Avenue To Learn about one or two weeks before the lab starts. Students are encouraged to work and even finish the lab work before their lab session. Students must attend the lab session and to demonstrate their solution in front of 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 source code and the report (if a report is required) must be submitted online on Avenue to Learn before the end of the lab session. More details will be discussed in class. Students have to attend the lab from the beginning of the lab session. They are allowed to leave the lab room only after they demonstrate their code. **Students who arrive late will be considered absent!**
## ASSESSMENT

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Assignments</td>
<td>25%</td>
</tr>
<tr>
<td>Max(Midterm Test, Final Exam)</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

In order to obtain a passing grade in the course the weighted average of the final and midterm exams must be at least 50%. The weighted average is computed as follows: \( \frac{1}{3} \times \text{Midterm} + \frac{2}{3} \times \text{Final} \).

### Policies on missed/late work:
- In case that the midterm test is missed the weight of the midterm will be automatically transferred to the final exam – **no MSAF is required**.
- In case of a Lab absence **reported on a McMaster Student Absence Form** (MSAF), the missed lab solution **must be demonstrated** in the following lab sessions: (L01, L02) April 2, (L05, L06) April 4, (L07, L08) April 5, (L09, L10) April 6 from 5:30-8:20pm or (L03, L04, L11) April 9 from 2:30-5:20pm in ITB/AB111.
- In case of a Lab absence not **reported** in an MSAF, the missed lab solution can be demonstrated during the makeup lab sessions listed above, however, **a penalty of 50% will be applied**.

## ACCREDITATION LEARNING OUTCOMES

Note: The **Learning Outcomes** 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](http://www.engineerscanada.ca).

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Indicators</th>
<th>Measurement Methods(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate the asymptotic time and space complexities of algorithms.</td>
<td>7.3</td>
<td>Lab report</td>
</tr>
<tr>
<td>Provide effective arguments to support the claims regarding their</td>
<td></td>
<td></td>
</tr>
<tr>
<td>evaluation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand recursive algorithms and perform their asymptotic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>complexity analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand the operation of simple data structures such as array-based</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lists, linked lists, stacks, queues, trees, binary search trees,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>binary heaps and hash tables.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implement the above mentioned data structures using the Java</td>
<td>7.1</td>
<td>Lab interview</td>
</tr>
<tr>
<td>programming language. Describe the algorithms underlying the operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>on the data structures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use the above mentioned data structures in applications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are able to manage time appropriately</td>
<td>11.2</td>
<td>Lab interview</td>
</tr>
<tr>
<td>Understand the popular efficient comparison-based sorting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>algorithms (Mergesort, Quicksort and Heapsort) and perform their</td>
<td></td>
<td></td>
</tr>
<tr>
<td>asymptotic complexity analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose appropriate data structures and develop efficient algorithms</td>
<td>4.1, 4.3</td>
<td>Lab reports</td>
</tr>
<tr>
<td>to solve various problems.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**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.

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.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at [http://www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity)

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

**ACADEMIC ACCOMMODATIONS**

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University’s Policy for Academic Accommodation of Students with Disabilities.

**NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK**

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": [http://www.mcmaster.ca/msaf/](http://www.mcmaster.ca/msaf/)

**NOTICE REGARDING POSSIBLE COURSE MODIFICATION**

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the
opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

**ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK**

In this course, we will be using Avenue to Learn. Students should be aware that, when they access the electronic components of this course, 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 this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

---

**Electrical and Computer Engineering Lab Safety**

**Information for Laboratory Safety and Important Contacts**

This document is for users of ECE instructional laboratories in the Information Technology Building.

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.

**General Health and Safety Principles**

Good laboratory practice requires that every laboratory worker and supervisor observe the following:
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.

**Location of Safety Equipment**

<table>
<thead>
<tr>
<th><strong>Fire Extinguisher</strong></th>
<th><strong>First Aid Kit</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>On walls in halls outside of labs</td>
<td>ITB A111, or dial “88” after 4:30 p.m.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Telephone</strong></th>
<th><strong>Fire Alarm Pulls</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>On the wall of every lab near the door</td>
<td>Near all building exit doors on all floors</td>
</tr>
</tbody>
</table>
In Case of a Fire (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.

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
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 Lab, 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
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

<table>
<thead>
<tr>
<th>Role</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA</td>
<td>The first point of contact for lab supervision</td>
</tr>
<tr>
<td>ECE Lab Supervisor</td>
<td>Steve Spencer- ITB 147 <a href="mailto:steve@mail.ece.mcmaster.ca">steve@mail.ece.mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Chair</td>
<td>Tim Davidson- ITB A111 <a href="mailto:davidson@mcmaster.ca">davidson@mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Administrator</td>
<td>Kerri Hastings- ITB A111 <a href="mailto:hastings@mcmaster.ca">hastings@mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Course Instructor</td>
<td>Please contact your specific course instructor directly</td>
</tr>
</tbody>
</table>