

# Course Outline

## SFWRENG 2CO3: Data Structures and Algorithms–Winter 2024

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### 1 Administrative Details

**Term** Winter 2024.

**Lectures** Three lectures per week (January 8, 2024–April 10, 2024).

- ▶ Monday: 1:30PM–2:20PM (JHE 264).
- ▶ Wednesday: 1:30PM–2:20PM (JHE 264).
- ▶ Thursday: 1:30PM–2:20PM (JHE 264).

**Tutorials** Starting January 12, there is one tutorial per week.

- ▶ T01: 9:30AM–10:20AM on Friday (HH 104).
- ▶ T02: 12:30PM–1:20PM on Monday (ABB B118).
- ▶ T03: 12:30PM–1:20PM on Monday (ABB 271).

**Website** Avenue to Learn (<https://avenue.mcmaster.ca>).

Announcements, course material, assignments, submission of assignments, and miscellaneous material.

**Office hours** See Avenue to Learn for updates.

- ▶ Wednesday: 2:45PM–5:00PM (ITB 124).
- ▶ Thursday: 2:45PM–5:00PM (ITB 124).

**Prerequisite(s)** SFWRENG 2DM3.

### Instructor

Jelle Hellings ([jhellings@mcmaster.ca](mailto:jhellings@mcmaster.ca), <https://jhellings.nl>)  
ITB, room 124 ([floor map](#)).

### Teaching Assistants

- ▶ Derron Li ([li1578@mcmaster.ca](mailto:li1578@mcmaster.ca)).
- ▶ Celine Sana ([sanay@mcmaster.ca](mailto:sanay@mcmaster.ca)).
- ▶ Viransh Shah ([shahv47@mcmaster.ca](mailto:shahv47@mcmaster.ca)).
- ▶ Amin Toloekashefpakdel ([toLoekaa@mcmaster.ca](mailto:toLoekaa@mcmaster.ca)).

## Course and learning objectives

A core part of *software engineering* is understanding what your programs do and being able to select the right tools and solutions for programming challenges. To do so, every software engineer needs a solid training in *analyzing* the details of programs.

In this course, we provide an introduction to such analysis. We will focus on the study of *algorithms* (methods that solve computational problems) and on *data structures* (representations of collections of data that enable efficient processing of that data). Algorithms and data structures are the basic building blocks of any problem that can be solved by a computer program. For both algorithms and data structures, we look at how we can reason about their *correctness* and their *cost* (e.g., running time behavior or memory use).

In addition, this course will put the analysis of algorithms and data structures in *practice* by studying algorithm and data structures design strategies that can be applied to solve many practical problems. By doing so, we also introduce a useful toolbox of standard fundamental algorithms and data structures that can be applied directly to a wide range of practical problems. Our coverage of search, sort, and string algorithms and coverage of data structures covers a large portion of the algorithms and data structures programmers use on a daily basis and that are provided by standard programming language libraries (such as the *C++ Standard Library* and the `java.util` package of the Java Platform). Furthermore, we look at graphs, which can serve as an abstract representation of many sources of data, and fundamental graph algorithms that answer questions on that data.

### Learning objectives

- ▶ Analyzing correctness of Algorithms.
- ▶ Analyzing the complexity of Algorithms.
- ▶ Fundamental search and sorting algorithms (e.g., binary search, mergesort, quicksort, heapsort).
- ▶ Fundamental data structures (e.g., lists, dynamic arrays, search trees, hash tables) and abstract data types (e.g., stacks, queues).
- ▶ Graphs representations and graph algorithms (e.g., BFS and DFS, topological search, spanning trees, shortest paths).
- ▶ Basic string algorithms, automata, and regular expressions (if time allows).

## 2 Materials & Fees

We use the textbook *Algorithms*, 4th edition, by Robert Sedgwick and Kevin Wayne. Available via the [McMaster Campus Store](#).

In this course, we cover the following material from the book:

- ▶ 1. *Fundamentals*, Section 1.3–1.5. Note: Chapter 1 is rather verbose and does not cover all fundamentals necessary for this course. Hence, prioritize the course notes that can be found on Avenue to Learn regarding the fundamentals.
- ▶ 2. *Sorting*, Section 2.1–2.5.
- ▶ 3. *Searching*, Section 3.1–3.5.
- ▶ 4. *Graphs*, Section 4.1–4.4.
- ▶ 5. *Strings*, Section 5.1–5.4 (if time allows).

See the study guide for further details.

### 3 Course components

The course consists of the following parts:

**Textbook.** The *textbook*, which contains most of the material covered in this course. In the study guide, we indicate which chapters and sections of the textbook we will cover. Furthermore, we indicate which exercises in the book are relevant to the course material we covered: these exercises are a good starting point to figure out whether you understood the material.

**Course notes.** The *course notes* cover important material not covered by the textbook.

**Lectures and slides.** The *lectures* will introduce the main topics of the course. The lectures will cover some material not included in the textbook. At the same time, the textbook will cover some material not included in the lectures. Hence, the textbook and the lectures are not replacements for each other. The slides of the lectures are available via Avenue to Learn.

**Tutorials.** The *tutorials* will go deeper into the material. The TAs will discuss exercises that practically introduce the course material, will discuss advanced exercises (on the difficulty level of assignments), provide detailed examples of the course material, and will answer questions on the course material. To make the most use of the tutorials, we advise you to always prepare by reviewing the previous lectures (and the corresponding course material in the book) before partaking in the tutorials.

**Assignments.** The *twelve assignments* will cover the main topics of the course and are a good indication of what *our expectations* of the learning outcomes. For each assignment, we will organize a general feedback session during the lectures to discuss their solutions. Furthermore, there is room in the tutorials (or during office hours) to get detailed feedback on your individual solutions. Feedback on the assignments can reveal deficiencies in your understanding of the course material, which you should address before the exam.

**Final Exam.** The *final exam* can cover any part of the course material listed in this study guide. This includes all course material covered by the textbook, the lectures, the tutorials, and all course material practiced in the assignments.

In addition, we provide assignments of previous years and their solutions as advanced practice exercises and we provide a try-out exam (which will be discussed in one of the last lectures).

**How to study** Keep up with the textbook, preferably *before* the lectures. See Section 2 and the study guide for which parts of the textbook are relevant. Being prepared before the lecture allows you to ask targeted questions about the course material.

Follow each lecture and tutorial. Use the tutorials to practice the material seen in the textbook and during the lectures. During the tutorials, *TAs can help with exercises, example assignments, and understanding assignments.*

The assignments require that you understand the material you are working with: get initial practice via exercises *before* diving into the assignments. Learn from your mistakes during the assignments: the exam will cover the same material as the assignments. Hence, understanding the material of the assignments completely will translate directly to your exam preparation.

*TAs cannot help make the assignments, provide answers, or verify your answers.*

Take the opportunity to practice the try-out exam before the final lectures in which we discuss the try-out exam. The final exam will have the same format and similar difficulty as the try-out exam.

## 4 Course Overview and Assessment

There is a closed-book final exam. Furthermore there are *twelve* assignments:

**Final Exam** 47.5% of the final grade.

**Assignments** Twelve assignments of which the best *ten* count, 5.25% of the final grade each.  
The deadlines are as follows:

- ▶ *January 21, January 28.*
- ▶ *February 4, February 11, February 18, February 26.*
- ▶ *March 4, March 11, March 18, March 25.*
- ▶ *April 3, April 10.*

Assignments are posted on Avenue to Learn and solutions must be submitted via Avenue to Learn. Each assignment will include a description of the criteria that are used to evaluate the assignment.

**Assignments are only visible after you complete the survey *Plagiarism and Academic Dishonesty*. You can find this survey under [Resources](#) > [Survey](#).**

Each assignment will have specific instructions on the submission format. For most assignments, your submission must be a PDF file (e.g., generate a PDF via  $\LaTeX$  or via your favourite word processor) and the main *textual content* of the file must be your solution to the assignments. Handwritten documents will not be accepted or graded.

**Submissions that do not follow the assignment-specific instructions will get a grade of zero.**

**Bonus grades** are awarded at the discretion of the instructor for any feedback that leads to the improvement of the course material.

### Late submission policy

All assignments will be made public more than two weeks in advance of their deadline. We require students to *submit on time*. Late submissions will receive a late penalty of 20% on the score per day late and submissions five days (or more) past the due date are not accepted.

All assignments have a five-hour grace period for submissions: if you submit your work up until five hours late (e.g., to deal with technical issues or other unforeseen circumstances), then we consider your submission to be on time. In this case, *there is no need to notify us*.

Technical or other issues are not an excuse for late submissions: if you encounter issues that prevent you from submitting, then e-mail the instructor *before* the deadline and include the solutions you failed to submit in your message.

### Missed work and extensions

Assignment solutions are discussed in the first lecture after *ten days after the deadline*. Hence, only in exceptional circumstances will a deadline be extended by more than ten days.

Requests for relief must always follow the [Policy on Requests for Relief for Missed Academic Term Work](#).

Students that request relief via a *Self Report (Type A) request* via the McMaster Student Absence Form, e.g., due to missed academic work resulting from medical or personal situations lasting up to three (3) calendar days, will receive a three (3) calendar day extension on their assignment deadline. Students must immediately follow up with the instructor after submitting the Self-Report (Type A) request. Failure to do so may negate the opportunity for relief.

For students that request relief via an *Administrative Report (Type B) request* via the McMaster Student Absence Form, the appropriate relief will be determined by the instructor based on the situation. If the

student's situation requires a long-term extension (more than ten days after the assignment deadline), then a replacement assignment will be provided. Students must immediately follow up with the instructor after being notified their request has been processed. Failure to do so may negate the opportunity for relief.

## 5 Plagiarism and Academic Dishonesty

**Plagiarism is a serious academic offense and will be handled accordingly.  
All suspicions will be reported to the Office of Academic Integrity.**

(in accordance with the [Academic Integrity Policy](#).)

All assignments are *individual* assignments: do not submit work of others. All parts of your submission *must* be your own work and be based on your own ideas and conclusions. Only *discuss or share* any parts of your submissions with your TA or instructor.

You are *responsible for protecting* your work: you are strongly advised to password-protect and lock your electronic devices (e.g., laptop) and to not share your logins with partners or friends!

If you *submit* work, you will be asked once to *confirm* that you are aware of the *Plagiarism and Academic Dishonesty* policy of this course outlined in this section, that you are aware of the [Academic Integrity Policy](#), and that you have completed the submitted work entirely yourself. Furthermore, by submitting work, you agree to automated and manual plagiarism checking of all submitted work.

In case of doubt, contact the instructor *before handing in your work*.

**All cases of academic dishonesty will be handled in accordance with the [Academic Integrity Policy](#) via the [Office of Academic Integrity](#).**

**Academic Dishonesty—Assignments and Online Resources** The usage of online resources to study the course material is allowed, e.g., online lectures that provide an alternative explanation of the material of the course. *Do not* seek online resources to aid in solving your assignments, however, as the usage of online resources for your assignments (even as inspiration) constitutes academic dishonesty.

In general, we recommend to avoid services such as YouTube, GeeksforGeeks, Stack Overflow, Reddit, Chegg, ChatGPT, Quora, and others with respect to assignment-related questions.

Include unambiguously citations of sources you used outside the course material.

**Academic Dishonesty—Penalties** If any part of your solutions to an assignment are obtained via academic dishonesty (e.g., via plagiarism, inappropriate collaboration, generative AI, or other means), then we will apply a zero grade to the entire assignment (first case offence) or advise a zero grade for the entire assignment (appeal, second case offences).

Assignments for which your grade is reduced due to academic dishonesty will always count toward your final grade (hence, as one of your best ten assignment grades).

## 6 Advisory statements

### 6.1 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](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>.

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.

### 6.2 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. 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 <https://www.mcmaster.ca/academicintegrity>.

### 6.3 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.

### 6.4 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.

## 6.5 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 to 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.

## 6.6 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](mailto:sas@mcmaster.ca) to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

## 6.7 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](#).

## 6.8 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.

## 6.9 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.

## 6.10 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.