

<https://courseoutline.auckland.ac.nz/dco/course/COMPSCI/220/1213>

COMPSCI 220 : Algorithms and Data Structures

Science

2021 Semester One (1213) (15 POINTS)

Course Prescription

An introduction to the analysis of algorithms and data structures. Common abstract data types and their implementations. Asymptotic complexity analysis. Sorting and searching algorithms. Depth-first and breadth-first search and applications. Graph optimisation problems.

Course Overview

COMPSCI 220 is a stage-2 course that is a compulsory for all computer science majors.

This course extends the algorithm and data structure material taught at Stage 1, and examines practical and theoretical aspects of program performance. You will learn how to store and process data efficiently and how to assess how well your program scales when it needs to handle more data. A course such as this is a standard part of a Computer Science degrees worldwide and the material is equally important in many areas of practical and theoretical computer science.

Specifically, this course builds on the basic data structures that are covered in COMPSCI 105/107/130, uses them to implement problem-solving methods, and analyzes the resulting algorithms. Such an analysis shows how efficient an algorithm is. A good algorithm can make the difference between a program being practically useful or useless. We will learn how to analyze an algorithm for efficiency, and which data structure to use when programming the algorithm. In doing so, we encounter some classical algorithms. One such example are graph algorithms. Due to their natural structure, graphs have many real-world applications. By studying some fundamental graph concepts and key algorithms we will answer questions such as "How does Google Maps find the shortest driving distance?" between two cities.

Course Requirements

Prerequisite: COMPSCI 120 and 15 points from COMPSCI 105, 107, 130

Capabilities Developed in this Course

- Capability 1: Disciplinary Knowledge and Practice
- Capability 2: Critical Thinking
- Capability 3: Solution Seeking
- Capability 4: Communication and Engagement
- Capability 5: Independence and Integrity

Graduate Profile: [Bachelor of Science](#)

Learning Outcomes

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

1. Express a precise relation between two functions using the Big-O, Big-Omega, and Big-Theta notation (Capability 1, 2 and 5)
2. Express an algorithm's performance using asymptotic notation (Capability 1, 2 and 5)
3. Compare the performance of various algorithms and data structures in a given situation and select the best one. (Capability 1, 2 and 3)
4. Write a recurrence describing the performance of an algorithm given a formal or informal description, and solve simple recurrences (Capability 1 and 3)
5. Program and execute by hand advanced sorting algorithms (including heapsort, quicksort, mergesort) (Capability 1, 2, 3 and 4)
6. Program and execute by hand the fast graph algorithms for standard problems: graph traversals and applications; graph optimization problems (e.g. shortest paths, minimum spanning trees) (Capability 1, 2, 3 and 4)

Assessments

Assessment Type	Percentage	Classification
Assignments	30%	Individual Coursework
Test	15%	Individual Test
Final Exam	55%	Individual Examination
3 types	100%	

Assessment Type	Learning Outcome Addressed					
	1	2	3	4	5	6
Assignments	✓			✓	✓	✓
Test	✓	✓	✓	✓		
Final Exam	✓	✓	✓	✓	✓	✓

Tuākana

This is a core CS course so all our Tuākana have already taken it and many of our teina have either already taken it or are about to!

Weekly wānanga that are open to all our teina are offered throughout the semester and you will receive more information from our School's Tuākana coordinators once the semester starts.

For more information about the Tuākana program in general, please see <https://www.auckland.ac.nz/en/science/study-with-us/maori-and-pacific-at-the-faculty/tuakana-programme.html>

Special Requirements

1. Students are required to pass the practical (coursework) **and** theory (test and exam) parts of the course and achieve an overall pass.

Workload Expectations

This course is a standard 15 point course and students are expected to spend 10 hours per week involved in each 15 point course that they are enrolled in.

- For this course, you can expect 3 hours of lectures and a 1 hour tutorial each week.
- Each assignment (there are four) is expected to take roughly 15 hours.
- Each week you spend some time on practice problems from the coursebook, textbook, tutorials, and ones you have devised yourself.
- As a rough guide, assuming you have done the above, you should spend up to 10 hours studying for the midterm and 15-20 hours studying for the exam.

Delivery Mode

Campus Experience

Attendance is expected at scheduled activities including lectures and tutorials.

Lectures will be available as recordings. Other learning activities including tutorials will not be available as recordings.

The course will not include live online events.

Attendance on campus is required for the test and exam.

The activities for the course are scheduled as a standard weekly timetable.

This course is available for remote students.

Learning Resources

A coursebook is available from the student resource centre that students should bring to lectures.

Also recommended is the more detailed textbook "An Introduction to Algorithms and Data Structures" (4th edition) by M.J. Dinneen, G. Gimelfarb and M.C. Wilson (2016), which is freely available at <https://www.cs.auckland.ac.nz/textbookCS220/>.

Pre-recorded short videos that cover most topics in the course are available on Mark Wilson's Youtube Channel (<https://www.youtube.com/channel/UCYGisJ9oMHYhhNnNWEDYMHQ>) for the first half of the course and on David Welch's channel (https://www.youtube.com/channel/UCIpeG3GbU_8NEbloqPGZW_w) for the second half of the course. These videos are intended to supplement the in-person lectures.

Student Feedback

During the course Class Representatives in each class can take feedback to the staff responsible for the course and staff-student consultative committees.

At the end of the course students will be invited to give feedback on the course and teaching through a tool called SET or Qualtrics. The lecturers and course co-ordinators will consider all feedback.

Your feedback helps to improve the course and its delivery for all students.

Digital Resources

Course materials are made available in a learning and collaboration tool called Canvas which also includes reading lists and lecture recordings (where available).

Please remember that the recording of any class on a personal device requires the permission of the instructor.

Academic Integrity

The University of Auckland will not tolerate cheating, or assisting others to cheat, and views cheating in coursework as a serious academic offence. The work that a student submits for grading must be the student's own work, reflecting their learning. Where work from other sources is used, it must be properly acknowledged and referenced. This requirement also applies to sources on the internet. A student's assessed work may be reviewed against online source material using computerised detection mechanisms.

Copyright

The content and delivery of content in this course are protected by copyright. Material belonging to others may have been used in this course and copied by and solely for the educational purposes of the University under license.

You may copy the course content for the purposes of private study or research, but you may not upload onto any third party site, make a further copy or sell, alter or further reproduce or distribute any part of the course content to another person.

Inclusive Learning

All students are asked to discuss any impairment related requirements privately, face to face and/or in written form with the course coordinator, lecturer or tutor.

Student Disability Services also provides support for students with a wide range of impairments, both visible and invisible, to succeed and excel at the University. For more information and contact details, please visit the [Student Disability Services' website](http://disability.auckland.ac.nz) <http://disability.auckland.ac.nz>

Special Circumstances

If your ability to complete assessed coursework is affected by illness or other personal circumstances outside of your control, contact a member of teaching staff as soon as possible before the assessment is due.

If your personal circumstances significantly affect your performance, or preparation, for an exam or eligible written test, refer to the University's [aegrotat or compassionate consideration page](https://www.auckland.ac.nz/en/students/academic-information/exams-and-final-results/during-exams/aegrotat-and-compassionate-consideration.html) <https://www.auckland.ac.nz/en/students/academic-information/exams-and-final-results/during-exams/aegrotat-and-compassionate-consideration.html>.

This should be done as soon as possible and no later than seven days after the affected test or exam date.

Learning Continuity

In the event of an unexpected disruption we undertake to maintain the continuity and standard of teaching and learning in all your courses throughout the year. If there are unexpected disruptions the University has contingency plans to ensure that access to your course continues and your assessment is fair, and not compromised. Some adjustments may need to be made in emergencies. You will be kept fully informed by your course co-ordinator, and if disruption occurs you should refer to the University Website for information about how to proceed.

Level 1: Delivered normally as specified in delivery mode

Level 2: You will not be required to attend in person. All teaching and assessment will have a remote option.

Level 3 / 4: All teaching activities and assessments are delivered remotely

Student Charter and Responsibilities

The Student Charter assumes and acknowledges that students are active participants in the learning process and that they have responsibilities to the institution and the international community of scholars. The University expects that students will act at all times in a way that demonstrates respect for the rights of other students and staff so that the learning environment is both safe and productive. For further information visit [Student Charter](https://www.auckland.ac.nz/en/students/forms-policies-and-guidelines/student-policies-and-guidelines/student-charter.html) <https://www.auckland.ac.nz/en/students/forms-policies-and-guidelines/student-policies-and-guidelines/student-charter.html>.

Disclaimer

Elements of this outline may be subject to change. The latest information about the course will be available for enrolled students in Canvas.

In this course you may be asked to submit your coursework assessments digitally. The University reserves the right to conduct scheduled tests and examinations for this course online or through the use of computers or other electronic devices. Where tests or examinations are conducted online remote invigilation arrangements may be used. The final decision on the completion mode for a test or examination, and remote invigilation arrangements where applicable, will be advised to students at least 10 days prior to the scheduled date of the assessment, or in the case of an examination when the examination timetable is published.