



# COMP225

## Algorithms and Data Structures

S1 Day 2019

*Dept of Computing*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

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Credit points

3

Prerequisites

COMP125 and 3cp from (MATH132-MATH136 or DMTH137 or STAT150 or STAT170 or STAT171 or STAT175)

Corequisites

Co-badged status

#### Unit description

This unit provides a study of algorithms, data structures and programming techniques. The topics covered include: trees; graphs and heaps; advanced sorting techniques; elements of storage management; and complexity. The presentation emphasises the role of data abstraction and correctness proofs.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.

Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.

Be able to apply commonly used data structures (including trees, graphs, lists and their variations).

Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.

Be able to describe results of analysing algorithms.

## General Assessment Information

### Standards and Grading

The final mark for the unit will be calculated by combining the marks for all assessment tasks according to the percentage weightings shown in the assessment summary.

**Late penalty:** Late submission of assignments will normally accrue a late penalty of up to 20% reduction for each day late.

**Extension requests:** Please note if you cannot submit on time because of illness or other circumstances, please contact the lecturer **before** the due date. If you experience a disruption to studies ([http://www.students.mq.edu.au/student\\_admin/manage\\_your\\_study\\_program/disruption\\_to\\_studies/](http://www.students.mq.edu.au/student_admin/manage_your_study_program/disruption_to_studies/)), you should notify the university. Please note that this is a centralised process, and resolution can take some time. This may mean, for example, that you are notified that your disruption request has been approved only after any reasonable length extension for an assignment could be granted: for instance, the assignment might have already been handed back. **With respect to assignments, you should therefore also notify the lecturer responsible for the assignment, and submit a solution to the assignment via iLearn, at the same time as you lodge your official disruption notification.** Failure to do so means that an

extension may not be possible, leaving only some other remedy listed under the disruption to study outcomes schedule (e.g. partake in assessment task next available session).

### Special Consideration

If you receive [special consideration](#) for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn ([bit.ly/FSESupp](http://bit.ly/FSESupp)) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

## Summary of achievement required corresponding to each final grade

- HD and D  
Overall the quality of the work demonstrates a mature and considered appreciation of the programming and algorithmic concepts, and an excellent technical mastery of Java programming (sufficient to complete the advanced programming tasks). A systematic demonstration of the ability to problem solve independently and a thorough knowledge of how to critique the proposed solution, in terms of performance, correctness and other technical issues.
- Cr  
Overall the quality of the work demonstrates a reasonable appreciation of the programming and algorithmic concepts, and a good technical mastery of Java programming (sufficient to complete the required programming tasks). A systematic demonstration of the ability to solve basic problems and to present the solutions clearly with an attempt to give reasons why they meet their stated objectives. Some knowledge of how to critique the proposed solution, in terms of performance, correctness and other technical issues is demonstrated, but the answers given might not cover all cases.
- P The quality of work demonstrates a basic technical mastery of the Java language, a basic understanding of how to program using the studied algorithms and a knowledge of how to implement and use the basic algorithmic data structures and programming techniques introduced in the course. The assessment work demonstrates a basic understanding of performance and correctness issues relative to all of the algorithms and data structures studied in the unit, and the appropriateness of a particular algorithm relative to a given data structure.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Assignment 1</a>	15%	No	Week 7, after the break
<a href="#">In class test</a>	10%	No	Week 9
<a href="#">Assignment 2</a>	20%	No	Week 12
<a href="#">Final exam</a>	45%	No	Examination period
<a href="#">Weekly exercises</a>	5%	No	Weeks 2--12
<a href="#">Participation</a>	5%	No	Weeks 2--13

### Assignment 1

Due: **Week 7, after the break**

Weighting: **15%**

In this assignment you will be asked to design and analyse an algorithm based on material studied in weeks 1--5. Your algorithm will be implemented in the Java programming language using some of the design techniques taught in lectures and the weekly exercises. The focus is on correctness and the ability to write programs on list or tree data structures.

Submission method: via iLearn.

On successful completion you will be able to:

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.
- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.

### In class test

Due: **Week 9**

Weighting: **10%**

In class test (during lectures) based on tutorial questions in weeks 1--9.

Submission method: on paper.

On successful completion you will be able to:

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.
- Be able to describe results of analysing algorithms.

## Assignment 2

Due: **Week 12**

Weighting: **20%**

You will be asked to design and implement an algorithm in Java based on graph data structures using some of the more advanced techniques discussed in lectures.

Submission method: via iLearn.

On successful completion you will be able to:

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.
- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.

## Final exam

Due: **Examination period**

Weighting: **45%**

A formal written examination based on lectures, class work (weeks 1--12) and activities and assignments.

Submission method: Formal examination organised by the University.

On successful completion you will be able to:

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.

- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.
- Be able to describe results of analysing algorithms.

## Weekly exercises

Due: **Weeks 2--12**

Weighting: **5%**

Each week you will be asked to submit the solutions to problems based on lecture material.

On successful completion you will be able to:

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.
- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.
- Be able to describe results of analysing algorithms.

## Participation

Due: **Weeks 2--13**

Weighting: **5%**

The participation assessment encourages active and consistent engagement in COMP225 content. There are two ways to obtain marks.

(a) Attend a weekly workshop and complete additional participation exercises (0.5 mark from the tutor at the workshop).

(b) Good citizenship eg consistent posting useful comments and contributions related to the material on the forum.

Only tutors may nominate students for good citizenship participation (b), and Mark and Annabelle will be happy to consider such nominations.

On successful completion you will be able to:

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.

- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.
- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.
- Be able to describe results of analysing algorithms.

## Delivery and Resources

### Technology required

- [Eclipse](#) - download Eclipse IDE for Java Developers: The practical work in this unit involves programming in Java ([www.java.com](http://www.java.com)) using the Eclipse Integrated Development Environment ([www.eclipse.org](http://www.eclipse.org))
- [Java SE JDK](#) - download Java SE 8 to be compatible with the labs: Note that you need the Java JDK which includes the compiler tools, rather than the Java Runtime Environment (JRE) which you might already have installed on your computer to allow you to run Java applications.
- Any additional Java libraries will be made available for download.
- Learning Management System [iLearn](#) : This will be used primarily to enable email broadcasts and give access to Assessment marks.
- The lecture audio will be recorded, and will be available via iLearn.

### Classes

Each week you should attend **3 hours of lectures** and **a two-hour mixed classes**. For details of days, times and rooms consult the [timetables webpage](#).

You should have selected one two-hour mixed classes session at enrolment. **You must attend the session you are enrolled in.**

Please note that you are **expected** to attend most of the mixed classes because that is your opportunity to seek clarification of any parts of the course and exercises you do not understand. Note that you will not be required to submit work every week, however the in-class quiz will be strongly based on the weekly exercises. You are therefore **strongly advised** to complete the set class exercises, and to seek clarification when you are unable to complete a question.

### Recommended Texts

The following texts can be used to supplement the material covered in lectures:

Robert Sedgewick and Kevin Wayne. Algorithms (4th edition) - available online at <https://algs4.c>



[s.princeton.edu/home/](https://s.princeton.edu/home/)

Clifford Shaffer. Data Structures and Algorithm Analysis - available online at <https://people.cs.vt.edu/shaffer/Book/JAVA3e20130328.pdf>

Adam Drozdek [2005]. *Data Structures and Algorithms in Java* (2nd ed. or 3rd edition). Boston: Thomson Course Technology.

There is also a [companion website](#) by the publisher, containing data files for exercises. In addition, Drozdek has Java code from the book available on his [webpage](#). (Note that these are written for Java 1.4.)

## Unit Pages

The unit will make use of discussions hosted within iLearn. Please post questions there, they will be monitored by the staff on the unit.

## Teaching and Learning Strategy

COMP225 is taught via lectures and mixed classes in the laboratory. Lectures are used to introduce new theoretic material, give examples of the use these techniques and put them in a wider context. Mixed classes give you the opportunity to interact with your peers. You will be given problems to solve each week prior to each session; preparing solutions is important because it will allow you to discuss the problems effectively with your tutor thereby making the most of this activity. The aim of the mixed classes is to help you to develop problem-solving skills and teamwork, and you will be expected to work on problems in class. Mixed classes give you an opportunity to practice your programming skills, and to implement many of the ideas discussed in lectures. Each week you will be given a number of problems to work on; it is important that you keep up with these problems as doing so will help you understand the material in the unit and prepare you for the work in assignments and quizzes. Some of the questions are designated **priority** and they will be the ones that will be discussed in detail and on which the quizzes may be based. Additional questions are provided for extension and general practice.

Lecture notes will be made available each week but these notes are intended as an outline of the lecture only and are not a substitute for your own notes or the textbook.

## Unit Schedule

Week 1	Review of algorithms and related concepts
Week 2	Algorithm Correctness and Efficiency
Week 3	Algorithm Design Strategies
Week 4	Sorting
Week 5	Binary Trees
Week 6	Binary Trees (cont.)
Week 7	Priority Queues, Heaps and Heapsort

15-28 April	Mid semester break
Week 8	Programming with Maps and Hashtables
Week 9	Graph Algorithms
Week 10	Graph Algorithms (cont.)
Week 11	Advanced Trees
Week 12	An Introduction to Computability
Week 13	Revision

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Undergraduate students seeking more policy resources can visit the [Student Policy Gateway \(https://students.mq.edu.au/support/study/student-policy-gateway\)](https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/study/getting-started/student-conduct>

## Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be

made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

### Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

### Learning outcomes

- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).

- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.

## **Assessment tasks**

- Assignment 1
- Assignment 2
- Final exam
- Participation

## **Capable of Professional and Personal Judgement and Initiative**

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

## **Assessment tasks**

- In class test
- Participation

## **Commitment to Continuous Learning**

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

## **Learning outcomes**

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.

## **Assessment tasks**

- In class test
- Final exam
- Weekly exercises
- Participation

## Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

### Learning outcomes

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.
- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).

### Assessment tasks

- Assignment 1
- Assignment 2
- Final exam
- Weekly exercises

## Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

### Learning outcomes

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be aware of the importance of correctness for algorithms, and able to apply strategies for achieving correctness.
- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).

- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.
- Be able to describe results of analysing algorithms.

## **Assessment tasks**

- Assignment 1
- In class test
- Assignment 2
- Final exam
- Weekly exercises

## **Problem Solving and Research Capability**

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

## **Learning outcomes**

- Be familiar with a variety of algorithm design techniques and understand how they can improve either efficiency or clarity.
- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.

## **Assessment tasks**

- Assignment 1
- In class test
- Assignment 2
- Final exam
- Weekly exercises

## **Effective Communication**

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication

technologies as appropriate.

This graduate capability is supported by:

## **Learning outcomes**

- Be able to apply commonly used data structures (including trees, graphs, lists and their variations).
- Carrying out advanced and broadly based problem solving - most particularly when designing and writing programs in Java to meet a given specification.
- Be able to describe results of analysing algorithms.

## **Assessment tasks**

- Final exam
- Participation

## **Engaged and Ethical Local and Global citizens**

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

### **Assessment task**

- Participation

## **Socially and Environmentally Active and Responsible**

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

### **Assessment task**

- Participation

## **Changes from Previous Offering**

There is no programming test.

The weightings for each component are slightly different than last year.

Marks are awarded for submission and correct completion of weekly exercises.

Marks are awarded for participation as explained.

## Changes since First Published

Date	Description
06/03/ 2019	Add Kate Stefanov as tutor. Add Neil Murphy as PAL leader.
21/02/ 2019	The wording for the participation assessment was adjusted to clarify how marks are awarded.