

COMP2230: Algorithms

Callaghan

Semester 2 - 2019



THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA

OVERVIEW

Course Description

This course introduces students to the notion of efficiency and computational complexity. The basic data structures encountered in first year, such as lists, trees and graphs, are reviewed in light of their efficiency and common usage scenario. Asymptotic measures of complexity are covered, and recurrence relations are introduced as an analytical tool. Problem-solving techniques such as the greedy strategy, divide-and-conquer, dynamic programming, and graph searching are covered. These techniques are illustrated upon optimization problems chosen for their practical relevance.

Assumed Knowledge SENG1120

Contact Hours MATH1510
Callaghan
Lecture
Face to Face On Campus
2 hour(s) per Week for Full Term

Tutorial
Face to Face On Campus
2 hour(s) per Week for Full Term

Unit Weighting 10
Workload Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

COURSE OUTLINE

CONTACTS

Course Coordinator **Callaghan**
A/Pr Yuqing Lin
Yuqing.Lin@newcastle.edu.au
(02) 4921 6076
Consultation: Appointment via email.

Teaching Staff Other teaching staff will be advised on the course Blackboard site.

School Office **School of Electrical Engineering and Computing**
ICT307
ICT Building
Callaghan
+61 2 4921 5330
9.00am-1.00pm and 2.00pm-5.00pm (Monday to Friday)

SYLLABUS

Course Content

1. Preliminaries (review of basic mathematical notions, data structures, induction, basic combinatorics).
2. Elementary algorithmics (worst-case vs. average case, basic examples, elementary operations).
3. Asymptotic Notation (big O, Omega and Theta).
4. Analysis of Algorithms (loops, recurrence relations).
5. Data structures (graphs, trees, heaps, disjoint sets).
6. Searching and sorting
7. Greedy algorithms.
8. Divide-and-Conquer.
9. Dynamic programming.
10. Text-serach Algorithms.
11. Introduction to the topics of computational complexity, heuristics, metaheuristics and approximation algorithms.

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. apply basic techniques to analyse the performance of algorithms
2. explain the most important algorithms used in various common computer science applications;
3. apply efficient algorithm design techniques and understand the limitations of algorithms.

Course Materials

Recommended Text:

- "Introduction to Design and Analysis of Algorithms" by A. Levitin, Addison Wesley, 2012.
- "Fundamentals of Algorithms" by G. Brassard and P. Bratley, Prentice Hall, 1996.
- "Algorithms" by Richard Johnsonbaugh and Marcus Schaefer, Pearson Prentice Hall, 2004.

COMPULSORY REQUIREMENTS

In order to pass this course, each student must complete ALL of the following compulsory requirements:

Contact Hour Requirements:

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Course Assessment Requirements:

- Assessment 7 - Formal Examination: Minimum Grade / Mark Requirement - Students must obtain a specified minimum grade / mark in this assessment item to pass the course. Students whose overall mark in the course is 50% or more, but who score less than 40% in the compulsory item and thus fail to demonstrate the required proficiency, will be awarded a Criterion Fail grade, which will show as FF on their formal transcript. However, students in this position who have scored at least 25% in the compulsory item will be allowed to undertake a supplementary 'capped' assessment in which they can score at most 50% of the possible mark for that item.

Pre-Placement Requirements:

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SCHEDULE

Week	Week Begins	Topic	Learning Activity	Assessment Due
1	29 Jul	Course Overview Introduction to Algorithms Review of Mathematical Concepts		
2	5 Aug	Analysis of Algorithms: - Asymptotic Notation - Solving Recurrences		Tutorials start
3	12 Aug	Review of Data Structures	Quiz 1	
4	19 Aug	Topological Sort Backtracking	Midterm Test 1	
5	26 Aug	Games Depth First Search Breath First Search		
6	2 Sep	Searching Sorted Arrays Divide and Conquer Sorting Algorithms	Quiz 2	
7	9 Sep	Sorting Algorithms continued Greedy Algorithms		
8	16 Sep	Greedy Algorithms continued	Midterm Test 2	
9	23 Sep	Dynamic Programming		
Mid Semester Break				
Mid Semester Break				
10	14 Oct	P and NP Coping with Np-Completeness	Assignment	
11	21 Oct	Text Searching		
12	28 Oct	Tying Loose Ends	Quiz 3	
13	4 Nov	No Lecture - Study Week		
Exam Period				
Exam Period				
Exam Period				

ASSESSMENTS

This course has 7 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Test 1 Quiz	Week 3	Individual	3%	1
2	Midterm 1	Week 4	Individual	13%	1, 2
3	Test 2 Quiz	Week 6	Individual	3%	2
4	Midterm 2	Week 8	Individual	13%	1, 2, 3
5	Assignment	Week 12	Individual	25%	2, 3
6	Test 3 Quiz	Week 12	Individual	3%	3
7	Formal Examination*	Exam period	Individual	40%	1, 2, 3

* This assessment has a compulsory requirement.

Late Submissions

The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Test 1 Quiz

Assessment Type	Quiz
Purpose	Quizzes are designed to reinforce students' understanding of the material and provide ongoing feedback. The quizzes are used both as an assessment and as a learning tool.
Description	Quizzes consist mainly of multiple choice and true/false questions.
Weighting	3%
Due Date	Week 3
Submission Method	Online
Assessment Criteria	All questions are equally worth.
Return Method	Online
Feedback Provided	Online - . The answers are marked automatically upon the completion of the quiz, and both submitted and correct answers are displayed.

Assessment 2 - Midterm 1

Assessment Type	In Term Test
Purpose	The purpose and benefit of the class tests is to provide the students with regular feedback on their learning. These tests highlight areas of concern and may stimulate discussion with tutors and lecturers. Midterm Test 2 will also serve as a preparation for the final exam.
Description	Midterm Tests are done in class, in the lectures.
Weighting	13%
Due Date	Week 4
Submission Method	In Class
Assessment Criteria	Each question and part of the question is worth specified number of points; to earn the points students must show all the workings and not just the end result.
Return Method	In Class
Feedback Provided	Returned Work - Marked papers will be returned to possible, and no more than 3 weeks after the test date.. Individual feedback is provided within the marked paper; class feedback describing common mistakes, etc., is posted in Blackboard.

Assessment 3 - Test 2 Quiz

Assessment Type	Quiz
Purpose	Quizzes are designed to reinforce students' understanding of the material and provide ongoing feedback. The quizzes are used both as an assessment and as a learning tool.
Description	Quizzes consist mainly of multiple choice and true/false questions.
Weighting	3%
Due Date	Week 6
Submission Method	Online
Assessment Criteria	All questions are equally worth.
Return Method	Online
Feedback Provided	Online - . The answers are marked automatically upon the completion of the quiz, and both submitted and correct answers are displayed.

Assessment 4 - Midterm 2

Assessment Type	In Term Test
Purpose	The purpose and benefit of the class tests is to provide the students with regular feedback on their learning. These tests highlight areas of concern and may stimulate discussion with tutors and lecturers. Midterm Tests also serve as a preparation for the final exam.
Description	Midterm Tests are done in class, in the lectures.
Weighting	13%
Due Date	Week 8
Submission Method	In Class
Assessment Criteria	Each question and part of the question is worth specified number of points; to earn the points students must show all the workings and not just the end result.
Return Method	In Class
Feedback Provided	Returned Work - Marked papers will be returned to possible, and no more than 3 weeks after the test date. Individual feedback is provided within the marked paper; class feedback describing common mistakes, etc., is posted in Blackboard.

Assessment 5 - Assignment

Assessment Type	Written Assignment
Purpose	The purpose of the assignment is to demonstrate the ability to design an algorithm for a given problem using the basic algorithms and design techniques presented in the course.
Description	Students will be required to design and implement an algorithm to solve a given problem.
Weighting	25%
Due Date	Week 12
Submission Method	Online
Assessment Criteria	Submission will be assessed on the basis of efficiency of the algorithm, correct implementation and code style, as well as the correctness and presentation of the results.
Return Method	Online
Feedback Provided	Online - Assignments will be marked as soon as possible, and no more than 3 weeks after the assignment due date. Individual feedback will be provided in a marking sheet and made available to each student pair separately via Blackboard; class feedback describing common mistakes, etc., will be posted in Blackboard.

Assessment 6 - Test 3 Quiz

Assessment Type	Quiz
Purpose	Quizzes are designed to reinforce students' understanding of the material and provide ongoing feedback. The quizzes are used both as an assessment and as a learning tool.
Description	Quizzes consist mainly of multiple choice and true/false questions.
Weighting	3%
Due Date	Week 12
Submission Method	Online
Assessment Criteria	All questions are equally worth.
Return Method	Online
Feedback Provided	Online - . The answers are marked automatically upon the completion of the quiz, and both submitted and correct answers are displayed.

Assessment 7 - Formal Examination

Assessment Type	Formal Examination
Purpose	The final formal examination is designed to test the individual student's knowledge of the course material and their ability to describe, analyse and apply various algorithms.
Description	There will be both true/false/multiple choice questions and long questions.
Weighting	40%
Compulsory Requirements	Minimum Grade / Mark Requirement - Students must obtain a specified minimum grade / mark in this assessment item to pass the course..
Due Date	Exam period
Submission Method	Formal Exam
Assessment Criteria	Each question and part of the question is worth specified number of points; to earn the points students must show all the workings and not just the end result.
Return Method	Not Returned
Feedback Provided	No Feedback - . Apart from the exam mark posted in Blackboard, students will not get other feedback on their formal examination.

Opportunity to Reattempt

Students WILL be given the opportunity to reattempt this assessment.
Refer to course outline for details.

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.
65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.

*Skills are those identified for the purposes of assessment task(s).

Attendance

Attendance/participation will be recorded in the following components:

- Lecture (Method of recording: Students will sign an attendance sheet.)
- Tutorial (Method of recording: Students will sign an attendance sheet.)

Retention of Assignment Scripts

In 2018, the University of Newcastle will undergo its 5 yearly accreditation cycle with Engineers Australia. Part of this routine process is the collection of a sample of student assignments over a 1+ year period. The objective is to provide the accrediting panel an indication of educational rigour across all courses. In 2017, we will commence collecting sample assignments from each and every assessment task, across the full spectrum of marks. They will be provided to the panel but not de-identified. If you object to your assignment being retained with your name associated, please indicate this on the submission, and if retained, we will de-identify your paper. All papers will be destroyed at the completion of the accreditation process.

Communication Methods

Communication methods used in this course include:

- Blackboard Course Site: Students will receive communications via the posting of content or announcements on the Blackboard course site.
- Email: Students will receive communications via their student email account.
- Face to Face: Communication will be provided via face to face meetings or supervision.

Course Evaluation

Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.

Academic Misconduct

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to

<https://policies.newcastle.edu.au/document/view-current.php?id=35>.

Adverse Circumstances

You are entitled to apply for special consideration because adverse circumstances have had an impact on your performance in an assessment item. This includes applying for an extension of time to complete an assessment item. Prior to applying you must refer to the Adverse Circumstances Affecting Assessment Items Procedure, available at <https://policies.newcastle.edu.au/document/view-current.php?id=236>. All applications for Adverse Circumstances must be lodged via the online Adverse Circumstances system, along with supporting documentation.

Important Policy Information

The 'HELP for Students' tab in UoNline contains important information that all students should be familiar with, including various systems, policies and procedures.

	University of Newcastle Computer Science Graduate Profile Statements	Taught	Practised	Assessed	Level of Capability
1	Knowledge of basic science and computer science fundamentals.				
2	In depth technical competence in the discipline of computer science	☑	☑	☑	2
3	An ability to carry out problem analysis, requirements capture, problem formulation and integrated software development for the solution of a problem.				
4	Capacity to continue developing relevant knowledge, skills and expertise in computer science throughout their careers.	☑	☑	☑	2
5	An ability to communicate effectively with other Computer Scientists, Software Engineers, other professional disciplines, managers and the community generally.	☑	☑	☑	2
6	Ability to undertake and co-ordinate large computer science projects and to identify problems, their formulation and solution.				
7	Ability to function effectively as an individual, a team member in multidisciplinary and multicultural teams and as leader/manager with capacity to assist and encourage those under their direction.				
8	Understanding of social, cultural, global and business opportunities of the professional computer scientist; understanding the need for and principles of sustainability and adaptability				
9	Understanding of professional and ethical responsibilities and a commitment to them.				
10	Understanding of entrepreneurship; need of and process of innovation, as well as the need of and capacity for lifelong learning.				

	University of Newcastle Bachelor of Engineering Graduate Profile Statements	Taught	Practised	Assessed	Level of capability
	Knowledge Base				
1	1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.				
2	1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.				
3	1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.	☑	☑	☑	2
4	1.4. Discernment of knowledge development and research directions within the engineering discipline.	☑	☑	☑	2
5	1.5. Knowledge of contextual factors impacting the engineering discipline.				
6	1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.				
	Engineering Ability				
7	2.1. Application of established engineering methods to complex engineering problem solving.				
8	2.2. Fluent application of engineering techniques, tools and resources.				
9	2.3. Application of systematic engineering synthesis and design processes.				
10	2.4. Application of systematic approaches to the conduct and management of engineering projects.				
	Professional Attributes				
11	3.1. Ethical conduct and professional accountability				
12	3.2. Effective oral and written communication in professional and lay domains.	☑	☑	☑	2
13	3.3. Creative, innovative and pro-active demeanour.				
14	3.4. Professional use and management of information.	☑	☑	☑	2
15	3.5. Orderly management of self, and professional conduct.				
16	3.6. Effective team membership and team leadership.				

This course outline was approved by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.

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