UNSW Course Outline

COMP4141 Theory of Computation - 2024

Published on the 28 Jan 2024

General Course Information

Course Code : COMP4141
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Computer Science and Engineering
Delivery Mode : Multimodal
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Computability: formal languages and problems, Turing Machines (TMs), computability, (semi-)decidability, universal TMs, Church-Turing thesis, halting problem, reduction and undecidability proofs, examples; Complexity: run time, space, complexity classes, non-

determinism and NP, polynomial reductions and NP completeness, optimisation problems and approximation, randomisation; Languages and Automata: regular expressions and languages, finite automata, determinisation, context-free grammars and languages (CFLs), Chomsky normal form, word problems, pumping lemma, push-down automata, decidability problems for CFLs; Semantics and Correctness: while programs, assertions and program correctness, Hoare logic, loops and loop invariants, relative completeness of Hoare logic (and its role in a proof of Gödel's incompleteness result)

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Understand what problems can (and cannot) be solved by computation of various types (regular and context-free languages, pumping lemmas, recursion theory, undecidability, approximation problems)
CLO2 : Understand the notion of computational complexity and complexity classes (Logspace, P,NP, IP, PSPACE, Polynomial Hierarchy, Probabilistic Classes
CLO3 : Understand how we can express computation (finite state automata, push-down automata, Turing Machines, Probabilistic Turing Machines)

Course Learning Outcomes	Assessment Item
CLO1 : Understand what problems can (and cannot) be solved by computation of various types (regular and context-free languages, pumping lemmas, recursion theory, undecidability, approximation problems)	• Assignments • Final Exam
CLO2 : Understand the notion of computational complexity and complexity classes (Logspace, P,NP, IP, PSPACE, Polynomial Hierarchy, Probabilistic Classes	• Assignments • Final Exam
CLO3 : Understand how we can express computation (finite state automata, push-down automata, Turing Machines, Probabilistic Turing Machines)	• Assignments • Final Exam

Learning and Teaching Technologies

EdStem | WebCMS, Formatif | Echo 360

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignments Assessment Format: Individual	50%	Start Date: Not Applicable Due Date: Weekly
Final Exam Assessment Format: Individual	50%	Start Date: Not Applicable Due Date: 24 hours after release

Assessment Details

Assignments

Assessment Overview

Weekly problem sets

Course Learning Outcomes

- CLO1 : Understand what problems can (and cannot) be solved by computation of various types (regular and context-free languages, pumping lemmas, recursion theory, undecidability, approximation problems)
- CLO2 : Understand the notion of computational complexity and complexity classes (Logspace, P,NP, IP, PSPACE, Polynomial Hierarchy, Probabilistic Classes
- CLO3 : Understand how we can express computation (finite state automata, push-down automata, Turing Machines, Probabilistic Turing Machines)

Detailed Assessment Description

Weekly assessment tasks are to be completed in the formatif system. Tutors will provide ongoing feedback so that students can complete the tasks satisfactorily. Consequently, students must attempt the task well in advance of the tutorial - but will have several days after the tutorial to complete the task.

The grade for this assessment item is determined by the number and difficulty level of tasks completed.

Submission notes

Assessment items to be submitted weekly in formatif

Assignment submission Turnitin type

This is not a Turnitin assignment

Final Exam

Course Learning Outcomes

- CLO1 : Understand what problems can (and cannot) be solved by computation of various types (regular and context-free languages, pumping lemmas, recursion theory, undecidability, approximation problems)
- CLO2 : Understand the notion of computational complexity and complexity classes (Logspace, P,NP, IP, PSPACE, Polynomial Hierarchy, Probabilistic Classes
- CLO3 : Understand how we can express computation (finite state automata, push-down automata, Turing Machines, Probabilistic Turing Machines)

Detailed Assessment Description

The final exam will be a 24-hour take-home exam. The exam questions will be made available on the course website on the day of the exam.

Hurdle rules

Students must receive a grade of 40% or higher on this assessment item to pass the course.

General Assessment Information

Grading Basis

Standard

Requirements to pass course

Students must achieve a minimum grade of 40% on the final exam and an overall grade of 50% in order to pass the course.

Course Schedule

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

The following is a **tentative** schedule of when topics will be covered:

Week Topic Reading in Sipser

Week 1 - Sets, functions, languages, finite automata
Chapters 0 & 1

Week 2 - Regular languages

Chapter 1

Week 3 - Context-Free languages, PDAs, non-CFLs
Chapters 2 & 4

Week 4 - Turing Machines, Recursive and Recursively enumerable languages
Chapter 3

Week 5 - Undecidability, Halting Problem, Reductions, Rice's Theorem
Chapters 3 & 4

Week 6 - "Flexibility week"

Week 7 - Time and space complexity, P and NP
Chapter 7

Week 8 &9 - NP-completeness, SAT, PTIME reductions
Chapter 7

Week 10 - PSPACE, LogSPACE, Savitch's Theorem, Alternation
Chapters 8 & 9

Week 11 - Probabilistic complexity, Approximation and Optimization
Chapter 10

Course Resources

Prescribed Resources

The prescribed textbook for this course is M Sipser, , 3rd edition.

Recommended Resources

Other useful references for the material covered are:

- H.R. Lewis and C.H. Papadimitriou, Elements of the Theory of Computation
- J.E. Hopcroft and J.D. Ullman, Introduction to the Theory of Computation

Course Evaluation and Development

This course is being continuously improved and we will conduct a survey through the myExperience survey at the end of session to obtain feedback on the quality of the various

course components.

Last year students noted that the feedback on assessments was too slow and the availability of formatif tasks was limited. This will be addressed this year by having all tasks prepared prior to the commencement of the course, and increasing the number of markers available.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
	Paul Hunter					Yes	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient

time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School Contact Information

CSE Help! - on the Ground Floor of K17

- For assistance with coursework assessments.

The Nucleus Student Hub - https://nucleus.unsw.edu.au/en/contact-us

- Course enrolment queries.

Grievance Officer - grievance-officer@cse.unsw.edu.au

- If the course convenor gives an inadequate response to a query or when the courses convenor does not respond to a query about assessment.

Student Reps - stureps@cse.unsw.edu.au

- If some aspect of a course needs urgent improvement. (e.g. Nobody responding to forum queries, cannot understand the lecturer)

You should **never** contact any of the following people directly:

- Vice Chancellor

- Pro-vice Chancellor Education (PVCE)

- Head of School

- CSE administrative staff

- CSE teaching support staff

They will simply bounce the email to one of the above, thereby creating an unnecessary level of indirection and a delay in the response.