School of Information and Physical Sciences

COMP2270: Theory of Computation

Callaghan

Semester 1 - 2024

COURSE OUTLINE

OVERVIEW

Course Description

This course introduces formal models of computation and the problems that they can solve. It presents Turing machines and equivalent models of computation. It also discusses the fundamental limitations of what can be computed. It covers finite state machines, regular expressions and regular grammars as well as context-free languages and grammars and non-context free grammars. It includes algorithms and decision procedures for regular and context-free languages, Turing machine, decidability and complexity analysis

Academic Progress Requirements

Nil

Assumed Knowledge

MATH1510 Discrete Mathematics, SENG1120 Data Structures

Contact Hours

Callaghan
Lecture
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1

Tutorial
Face to Face On Campus
2 hour(s) per week(s) for 12 week(s) starting Week 2

Unit Weighting Workload

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

CONTACTS

Course Coordinator

Callaghan
Dr Nasimul Noman
Nasimul.Noman@newcastle.edu.au
(02) 4042 0488
Consultation: Please make an appointment via email, preferably on Wednesday between 11:00~13:00.

Teaching Staff

Other teaching staff will be advised on the course Canvas site.

School Office

School of Information and Physical Sciences
SR233, Social Sciences Building
Callaghan
CESE-SIPS-Admin@newcastle.edu.au
+61 2 4921 5513
9am-5pm (Mon-Fri)

SYLLABUS

Course Content

1. Preliminaries (review of basic mathematical concepts)
2. Finite automata
3. Language theory
4. Turing machine
5. Decidability and reducibility
6. Complexity theory

Course Learning Outcomes

On successful completion of this course, students will be able to:
1. Explain the importance of automata as modelling tools and apply them to computational problems

2. Explain the role of context-free languages and their limitations

3. Explain the basis of theory of computation, in particular the role of key problems in defining classes of equivalent problems from a computational perspective

4. Discuss the limitations of computational procedures

Course Materials

Lecture Materials:

- Students enrolled in the course can login at https://canvas.newcastle.edu.au/ to access the Canvas LMS used to deliver this course. You need to visit the Canvas site on a regular basis for up to date lecture materials.

Multi-Media Resource:

- Every week a couple of videos on core concepts will be released in the Canvas. Students are expected to watch those videos before they attend the weekly lectures. The basic ideas learnt from these videos will enable students to have a better engagement in the lectures and tutorials.

Recommended Reading:

- A selection of publicly available lecture notes and other type of material may be added to the list of learning materials and texts if required. The information regarding such a material will be announced in Canvas.

Required Text:

- Automata, Computability and Complexity: Theory and Applications,
  - Elaine Rich, Pearson Education, Inc., 2008. ISBN: 0-13-228806-0, ISBN: 978-0-13-228806-4.

COMPULSORY REQUIREMENTS

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

Contact Hour Requirements:

-

Course Assessment Requirements:

- Assessment 5 - Formal Examination: Pass requirement 40% - Must obtain 40% 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.

Compulsory Placement and WHS Requirements:

-

SCHEDULE

Week	Week Begins	Topic	Learning Activity	Assessment Due
1	26 Feb	Background knowledge revision: logic, sets, proof techniques.		
2	4 Mar	Languages and Strings. Hierarchies. Computation. Closure properties.		
3	11 Mar	Finite State Machines: non-determinism vs. determinism		
4	18 Mar	Regular languages, expressions and grammars		
5	25 Mar	Non regular languages: Pumping Lemma. Closure		Assignment 1 (29/03/2024)
6	1 Apr	Context-free languages: grammars and parse trees		
7	8 Apr	Pushdown automata		
Mid-Semester Recess				
Mid-Semester Recess				
8	29 Apr	Non context-free languages: Pumping Lemma and Decidability. Closure		Class Test (01/05/2024)
9	6 May	Decidable languages: Turing Machines		
10	13 May	Church-Turing thesis and the unsolvability of the Halting Problem		Assignment 2 (17/05/2024)

11	20 May	Decidable, semi-decidable and undecidable languages (and proofs)		
12	27 May	Complexity theory and Revision of the hierarchy.		
13	3 Jun	Extra revision (if needed)		
Examination Period				
Examination Period				

ASSESSMENTS

This course has 5 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Assignment 1	Week 5 (29/03/2024 23:59)	Individual	15%	1, 2
2	Assignment 2	Weel 10 (17/05/2024 23:59)	Individual	15%	1, 2, 3
3	Class Test	Week 8 (01/05/2024)	Individual	20%	1, 2, 3
4	Online multiple choice questions	Ongoing assessment from Week 2 to Week 12.	Individual	10%	1, 2, 3, 4
5	Formal Examination*	Exam Period.	Individual	40%	1, 2, 3, 4

* 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 - Assignment 1

Assessment Type Written Assignment
Purpose This written assessment meets the course objectives of knowledge acquisition and demonstrated ability to solve problems in the area of formal languages and automata.
Description In this assessment emphasis will be given in proving correctness, following algorithmic procedures which are given in lectures and in the textbook. Some exercises may involve the formulation of a given problem in terms of a language recognition problem and be addressed with the formal languages methods discussed in lectures.
Weighting 15%
Length Students will have around 2 weeks to complete this
Due Date Week 5 (29/03/2024 23:59)
Submission Method Online
Assessment Criteria Detailed assessment criteria for each assessment task and any additional material will be available on the course Canvas site no less than two weeks prior to the due date of each assessment
Return Method Online
Feedback Provided Returned Work - .

Assessment 2 - Assignment 2

Assessment Type Written Assignment
Purpose This written assessment meets the course objectives of knowledge acquisition and demonstrated ability to solve problems in the area of formal languages and automata.
Description In this assessment emphasis will be given in proving correctness, following algorithmic procedures which are given in lectures and in the textbook. Some exercises may involve the formulation of a given problem in terms of a language recognition problem and be addressed with the formal languages methods discussed in lectures.
Weighting 15%

Length	Students will have around 2 weeks to complete this
Due Date	Weel 10 (17/05/2024 23:59)
Submission Method	Online
Assessment Criteria	Detailed assessment criteria for each assessment task and any additional material will be available on the course Canvas site no less than two weeks prior to the due date of each assessment.
Return Method	Online
Feedback Provided	Returned Work - .

Assessment 3 - Class Test

Assessment Type	In Term Test
Purpose	The purpose and benefit of the class exam is to assess the progress and provide the students with regular feedback on their learning.
Description	These tests highlight areas of concern and may stimulate discussion with tutors and lecturers. Mid-term exam is not the only one way of doing this and students should actively participate in tutorials and engage in discussions during the whole term.
Weighting	20%
Due Date	Week 8 (01/05/2024)
Submission Method	In Class
Assessment Criteria	In assessing the answers, emphasis will be given to correctness, following algorithmic, arithmetic procedures and proof techniques taught in lectures, tutorials and the textbook.
Return Method	In Class
Feedback Provided	Returned Work - .

Assessment 4 - Online multiple choice questions

Assessment Type	Online Learning Activity
Purpose	The purpose and benefit of weekly online quiz is to keep the students' learning up to date with the progress of the course.
Description	These weekly quizzes are intended to check a student's understanding of the core concepts delivered every week throughout the course. The performance of a student in these quizzes will highlight the area that the student needs to focus on and will facilitate the participation of the student in lectures and tutorials.
Weighting	10%
Due Date	Ongoing assessment from Week 2 to Week 12.
Submission Method	Online Each quiz is available only for 2 weeks and cannot be submitted after the due date (Wednesdays 23:59). Failure to complete a quiz within the 2 weeks will result in a zero mark for that quiz.
Assessment Criteria	Correctness of the submitted answers.
Return Method	Online
Feedback Provided	No Feedback - .

Assessment 5 - 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 hypothesise from this material.
Description	In the final exam, students will face short answer type questions students have seen in lectures and tutorials.
Weighting	40%
Compulsory Requirements	Pass requirement 40% - Must obtain 40% in this assessment item to pass the course..
Due Date	Exam Period.
Submission Method	Formal Exam Non-programmable calculators are permitted.
Assessment Criteria	In assessing the answers, emphasis will be given to correctness, following algorithmic, arithmetic procedures and proof techniques taught in lectures, tutorials and the textbook.
Return Method	Not Returned
Feedback Provided	No Feedback - .

Opportunity to Reattempt	Students WILL be given the opportunity to reattempt this assessment. Refer to “Compulsory Requirements” section 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).

Communication Methods

Communication methods used in this course include:

- Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site.
- Email: Students will receive communications via their student email account.

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.
A short survey may be conducted during the semester for necessary adjustment of the course.
As a result of student feedback, the following changes have been made to this offering of the course:

- Minor adjustment in the course delivery and contents.

Oral Interviews (Vivas)

As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.

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

The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:

1. the assessment item is a major assessment item; or
2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;
3. you are requesting a change of placement; or
4. the course has a compulsory attendance requirement.

Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:
https://policies.newcastle.edu.au/document/view-current.php?id=236

Important Policy Information

The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/respect-at-uni/policies-and-procedures that support a safe and respectful environment at the University.

Other Information

1. The teaching/assessment schedule is subject to change. Changes will be posted on Canvas LMS.
2. Detailed assessment criteria for each assessment task and any additional material will be available on the Canvas site no less than two weeks prior to the due date of each assessment.
3. The assignments and test will be returned. It is strongly recommended that students keep a copy of any material submitted.
4. The marks will be available in Canvas site. If you have any questions about the marking, discuss it with your demonstrator and if necessary with the course coordinator.
5. All assignments must be done and submitted individually.

GRADUATE PROFILE STATEMENTS

The following table illustrates how this course contributes towards building the skills students will need to work in their profession.

Level of capability

- Level 1 indicates an introduction to a topic at a university level
- Levels 2 and 3 indicate progressive reinforcement of that topic
- Level 4 indicates skills commensurate with a graduate – entry to professional practice
- Level 5 indicates highly specialist or professional ability

Bachelor of Computer Science

	University of Newcastle Bachelor of Computer Science Graduate Profile Statement	Taught	Practised	Assessed	Level of capability
1	Knowledge of basic science and computer science fundamentals	X	X	X	2
2	In depth technical competence in the discipline of computer science	X	X	X	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				
5	An ability to communicate effectively with other Computer Scientists, Software Engineers, other professional disciplines, managers and the community generally				
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				

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.