Subject Information Guide

Computability and Intractability MAT4CI

Semester 1, 2014

Administration and contact details

Host Department	**Department of Mathematics and Statistics**
Host Institution	**La Trobe University**
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Subject details

Handbook entry URL	
Subject homepage URL	
Honours student hand-out URL	
Start date:	**5/03/2014**
End date:	**28/05/2014**
Contact hours per week:	**3**
Lecture day and time:	**Wed 10AM, 11AM and 3PM**
Description of electronic access arrangements for students (for example, WebCT)	**Email**

Subject content

1. Subject content description

This subject offers an introduction to the mathematics of computational complexity, including classic complexity classes such as logspace, polynomial time, nondeterministic polynomial time, polynomial hierarchy, polynomial space as well as algorithmic undecidability and the arithmetical hierarchy. A broad range of problems are examined, from graph theory, combinatorics and applied discrete mathematics, logic, algebra and matrices and tilings. A focus is on developing the techniques to analyse and classify the complexity of computational problems that a mathematician (or computer

scientist) may encounter, and to develop a rigorous appreciation for the many outstanding unsolved problems in the theory of computational complexity.

Week-by-week topic overview

The following may be subject to change.

Week 1. Cardinality, halting problem and Turing machines. Languages and problems.
Week 2. Nondeterminism, time and space complexity classes
Week 3. NP, logspace and P versus Exptime.
Week 4. Reduction and oracles
Week 5. Satisfiability and variants
Week 6. Graph problems.
Week 7. Cook-Levin Theorem: Satisfiability is NP-complete.
Week 8. Savitch's Theorem and P versus NP on oracles
Week 9. Busy Beaver and recursive enumerability.
Week 10. Undecidability and the arithmetical hierarchy.
Week 11. Undecidability: semigroup word problem.
Week 12. Undecidability: Post's correspondence problem, matrix mortality, tiling problems.

2. Assumed prerequisite knowledge and capabilities

The subject has no specific pre-requisites beyond the ability to construct detailed written arguments in fresh contexts. A familiarity with basic concepts of graph theory, matrix multiplication, Boolean algebra, sets and cardinality, ordered sets, big O growth rates, finite state automata and/or Turing machines will be useful but can be picked up along the way.

3. Learning outcomes and objectives

AQF specific Program Learning Outcomes and Learning Outcome Descriptors:

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject
Is familiar with a broad range of commonly encountered complexity classes and can use this knowledge to classify the complexity of previously unseen mathematical problems.	K1
Can present clear succinct written arguments explaining elaborate technical constructions associated with reductions between computational problems	S2, S5
Can construct original interpretations of problems from one part of mathematics into a problem from a different part of mathematics.	S1, A2
Can read and modify advanced level proofs in mathematics and theoretical computer science	S3
Can independently read technical material and use it in the context of other class activities	A3

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

4. Learning resources

The subject has printed notes. Cost to be announced.

5. Assessment

Exam/assignment/classwork breakdown					
Exam	40 %	**3 Assignments**	60 %	**Class work**	0 %
Assignment due dates		**26/03/2014**	**30/04/2014**	**28/05/2014**	Click here to enter a date.
Approximate exam date (take home exam: roughly 3 days).				**5/06/2014**	

Institution Honours program details

Weight of subject in total honours assessment at host department	1/8
Thesis/subject split at host department	3/8
Honours grade ranges at host department:	
H1	80-100
H2a	70-80
H2b	60-70
H3	50-60