DMTH237
Discrete Mathematics II
S1 Day 2015
Dept of Mathematics

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General Information

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Unit Convenor
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Credit points
3

Prerequisites
DMTH137 or MATH133 or MATH136

Corequisites
Co-badged status

Unit description
The purpose of this unit is to give a grounding in discrete mathematics. It is important preparation for both theoretical computing and abstract algebra. In particular, the unit: explores the concept of computability, and the measures of computational complexity and finite state machines; studies recurrence relations and generating functions; provides an introduction to matrices with applications to systems of linear equations and vectors; applies graph theory to a range of problems; and examines a variety of error correcting and public key cryptography codes

Important Academic Dates
Information about important academic dates including deadlines for withdrawing from units are available at https://students.mq.edu.au/important-dates

Learning Outcomes

1. Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate
mathematical or computational techniques.

2. Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.

3. Expressing yourself clearly and logically in writing.

4. Able to appreciate what kinds of problems are capable of being solved with a computer; in particular appreciating that there are some problems that are logically intractable.

### Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Five assignments</td>
<td>20%</td>
<td>see unit website</td>
</tr>
<tr>
<td>1 Project</td>
<td>20%</td>
<td>see unit website</td>
</tr>
<tr>
<td>Final examination</td>
<td>60%</td>
<td>University Examination Period</td>
</tr>
<tr>
<td>online quizzes</td>
<td>0%</td>
<td>see unit website</td>
</tr>
</tbody>
</table>

**Five assignments**

Due: see unit website  
Weighting: 20%

For specific details, see the [unit website](https://unitguides.mq.edu.au/unit_offerings/45580/unit_guide/print).

This Assessment Task relates to the following Learning Outcomes:

- Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.

- Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.

- Expressing yourself clearly and logically in writing.

- Able to appreciate what kinds of problems are capable of being solved with a computer; in particular appreciating that there are some problems that are logically intractable.
1 Project

Due: see unit website  
Weighting: 20%

RSA Project. Consult the unit website.

This Assessment Task relates to the following Learning Outcomes:

- Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.

- Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.

- Able to appreciate what kinds of problems are capable of being solved with a computer; in particular appreciating that there are some problems that are logically intractable.

Final examination

Due: University Examination Period  
Weighting: 60%

See the unit website concerning the "expected participation" required for an expectation of achieving a satisfactory grade overall.

This Assessment Task relates to the following Learning Outcomes:

- Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.

- Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.

- Expressing yourself clearly and logically in writing.

- Able to appreciate what kinds of problems are capable of being solved with a computer; in particular appreciating that there are some problems that are logically intractable.
online quizzes

Due: see unit website
Weighting: 0%

These quizzes are effectively home-work, but are “compulsory”.

This Assessment Task relates to the following Learning Outcomes:

• Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.

• Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.

• Able to appreciate what kinds of problems are capable of being solved with a computer; in particular appreciating that there are some problems that are logically intractable.

Delivery and Resources

Classes

Lectures: you should attend two hours of each lecture stream each week, making a total of four hours.

Tutorials: you should attend one tutorial each week.

Practicals: you should attend one practical each week.

Workshops: available for students wanting to see more examples and ask further questions. Attendance is strongly recommended.

Online lecture notes

• W.W.Chen: Lecture notes on Discrete Mathematics
• C.Cooper: Mathematics Notes, DMTH237 — Discrete Mathematics
• C.Cooper: Mathematics Notes, DMTH237 — Languages and Machines

Recommended Texts and/or Materials

• Grimaldi, Discrete and Combinatorial Mathematics (Addison-Wesley-Longman 2003)
• RL Graham, DE Knuth, O Patashnik, Concrete mathematics: a foundation for computer science (Addison-Wesley 1994)
• WD Hillis, The pattern on the stone. The simple ideas that make computers work. (Weidenfeld, Nicolson 1998)
• A Hodges, Alan Turing: the enigma (Vintage 1992)
• DE Knuth, The art of computer programming - Fundamental algorithms (1973) Addison-Wesley
• M Minsky, Computation: finite and infinite machines (1967) Prentice-Hall

These and similar texts are available in the Library.

Technology Used and Required

Students are expected to have access to an internet enabled computer with a web browser and Adobe Reader software. Several areas of the university provide wireless access for portable computers. There are computers for student use in the Library and in the Numeracy Centre (C5A 255).

Difficulties with your home computer or internet connection do not constitute a reasonable excuse for lateness of, or failure to submit, assessment tasks.

Unit Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Task</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23/02/2015</td>
<td>Complex numbers: Cooper, Chen</td>
<td>Languages</td>
</tr>
<tr>
<td>2</td>
<td>02/03/2015</td>
<td>Introduction to finite-state machines (FSMs)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>09/03/2015</td>
<td>Introduction to matrix theory: Cooper, Chen</td>
<td>Reduction of FSMs</td>
</tr>
<tr>
<td>4</td>
<td>16/03/2015</td>
<td>Non-deterministic finite-state acceptors (FSAs)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>23/03/2015</td>
<td>Revision of counting techniques: Cooper, Chen</td>
<td>FSAs and regular languages</td>
</tr>
<tr>
<td>6</td>
<td>30/03/2015</td>
<td>Generating functions</td>
<td>Turing machines</td>
</tr>
</tbody>
</table>
### Generating functions
- Turing machines
- FSA

### Recurrence relations
- Extended Turing machines
- A3

### The Busy Beaver and Halting problems
- Q5

### Integers mod \( m \) and cryptography
- A4

### Graph algorithms: Cooper, Chen
- Polynomial codes
- Q6

### Matrix codes
- A5

### Revision
- Q7

This table is a rough guide to the timing of the material in DMTH237. Please note that the order and weeks of topics is likely to change. The assignment, test and quiz dates are fixed. Once complete, this table may not be updated during semester.

Attendance at lectures and tutorials is the only sure way to find out the where the schedule of topics is up to.

**Policies and Procedures**

Macquarie University policies and procedures are accessible from [Policy Central](http://mq.edu.au/policy/docs/). Students should be aware of the following policies in particular with regard to Learning and Teaching:


In addition, a number of other policies can be found in the [Learning and Teaching Category](http://mq.edu.au/policy/docs/) of 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/support/student_conduct/](https://students.mq.edu.au/support/student_conduct/)

**Results**

Results shown in [iLearn](https://ilearn.mq.edu.au) 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.

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) 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 Enquiry Service
For all student enquiries, visit Student Connect at ask.mq.edu.au

Equity 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.

IT Help
For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

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

• Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.

• Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.

• Expressing yourself clearly and logically in writing.

Assessment tasks

• Five assignments

• 1 Project

• Final examination

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

• Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.

• Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.

• Expressing yourself clearly and logically in writing.

Assessment tasks

• Five assignments

• 1 Project
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**

- Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.
- Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.
- Expressing yourself clearly and logically in writing.

**Assessment tasks**

- Five assignments
- Final examination

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:

**Learning outcome**

- Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.
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**

- Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.
- Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer programs work and can be used.
- Expressing yourself clearly and logically in writing.

**Assessment tasks**

- Five assignments
- 1 Project
- Final examination

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**

- Demonstrate a well-developed knowledge of the principles, concepts and mathematical techniques, particularly as applied to problems requiring or applicable to computational methods and techniques. Solving problems, including: - formulating a precise mathematical question from a "real world" problem; - identifying and applying appropriate mathematical or computational techniques.
- Construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, particularly in areas concerning how computer
programs work and can be used.

- Expressing yourself clearly and logically in writing.

**Assessment task**

- 1 Project

**Changes from Previous Offering**

Tutorials and Practical Sessions commence in Week 1. This is primarily to give those students that have entered the DMTH237 via the mathematics pathway (MATH135, MATH136, etc.) rather than the usual prerequisite unit DMTH137 for Computer Science & Information Systems students. The material for 1st week tutorials and Practicals is revision of the basic topics: Logic, Set Theory, Counting methods.

**extra requirements**

In order to obtain a passing grade in this unit, students are required to demonstrate their mastery of the required basic skills and techniques by passing all seven (7) on-line quizzes. Students who do not meet this requirement will have their grade capped at F 49.

Satisfactory performance on supervised assessment tasks, such as tests and the final exam, is necessary to pass this unit. If there is a significant difference between a student's marks on supervised assessment tasks and on unsupervised assessment tasks, the scaling of these tasks may be adjusted when determining the final grade, to reflect more appropriately that student's performance on supervised tasks.

**Changes since First Published**

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/03/2015</td>
<td>Updated old links (to 2014 unit website) to the correct 2015 unit website pages. 3 instances on pages 3 &amp; 4 in the table of Assessments.</td>
</tr>
</tbody>
</table>