DMTH237

Discrete Mathematics II

S1 Day 2017

Dept of Mathematics

Contents

General Information

Unit convenor and teaching staff
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most days

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://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

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.

General Assessment Information

HURDLES: The online quizzes may be attempted as many times as necessary during the teaching period. There will be no additional make-up opportunity once the teaching period has finished. There are no other hurdle tasks. In particular, this means that there are no second chance examinations and assessments if you obtain a low score at your first attempt. Students should aim to get at least 65% for the course work (out of 50 marks) in order to be reasonably confident of passing the unit.

IMPORTANT: If you have a valid reason to apply for Disruption to Study for your final examination, you **must** make yourself available for the week of 24–28 July 2017. If you are not available at that time, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

Assessment Tasks

Name	Weighting	Hurdle	Due
Three assignments	30%	No	Wednesday weeks 5, 9, 12
1 Project	20%	No	3 May
Final examination	50%	No	University Examination Period
online quizzes	0%	Yes	weeks 3, 4, 6, 7, 8, 10, 13

Three assignments

Due: **Wednesday weeks 5, 9, 12**
Weighting: **30%**

For specific details, see the unit iLearn site.

On successful completion you will be able to:

- 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: **3 May**
Weighting: **20%**

FSA Project. Consult the unit iLearn website. This project is submitted online and immediate feedback is given. Update your submitted solutions as frequently as necessary to correctly perform the required programming task.

On successful completion you will be able to:

- 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: **50%**

See the unit iLearn site concerning the “expected participation" required for an expectation of

achieving a satisfactory grade overall.

On successful completion you will be able to:

- 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: **weeks 3, 4, 6, 7, 8, 10, 13**
Weighting: **0%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

The quizzes are competency tests to ensure that all students who pass this unit possess certain basic skills. You can repeat them as many times as it takes in order to pass. **You must pass all 7 quizzes to pass this unit.**

On successful completion you will be able to:

- 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.
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Delivery and Resources

Textbooks and online resources

There is no single required text for this unit. Some of the topics are covered in the text used with DMTH137:

- *Discrete Mathematics and Its Applications* by K.H. Rosen; 7th edition, McGraw-Hill

The following link to sets of online lecture notes as used in previous years, for DMTH237. These cover all the material, and provide exercises and examples:

- Discrete Mathematics DMTH237 by W.W.L. Chen
- Languages and Machines by C.D.H.C. Cooper
- DMTH237 — Discrete Mathematics by C.D.H.C. Cooper

You may download and study these, to get different view-points and explanations of the same material. The online notes are intended primarily as a source of reference. These are not intended to be treated as the only source for learning.

Free Online Textbooks

The following online texts contain material mostly studied in DMTH137, with some of the Algebra topics from this unit. They are a good source for alternative viewpoints, worked examples and exercises with some solutions.

- Alan Doerr and Kenneth Levasseur, *Applied Discrete Structures*.
- E.A. Bender & S.G. Williamson, *Foundations of Combinatorics with Applications*.
- Oscar Levin, *Discrete Mathematics: an open introduction*.

These are particularly recommended for students who have not studied DMTH137 to do independent study.

Recommended reading

- Grimaldi, *Discrete and Combinatorial Mathematics* (Addison-Wesley-Longman 2003)
- JL Gersting, *Mathematical Structures for Computer Science* (Freeman, 7th edition 2014)
- 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)
- DR Hofstadter, *Godel, Escher, Bach: an eternal braid* (1979) The Harvester Press
- DE Knuth, *The art of computer programming - Fundamental algorithms* (1973) Addison-Wesley

- M Minsky, *Computation: finite and infinite machines* (1967) Prentice-Hall
- S Singh, *The Code Book* (1999) Fourth Estate

These and similar texts are available in the Library.

More notes on elementary topics are available at:

- *Elementary Mathematics* by W.W.L Chen

Other similar texts are available in the Library, and for reference in the Numeracy Centre (E7B G.88)

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

WEEK	BEGINNING	ALGEBRA	LANGUAGES & MACHINES	TASK DUE
1	27/02/2017	Trigonometry: Cooper, Chen	Languages	
2	06/03/2017	Linear systems and matrices: Cooper, Chen	Introduction to finite-state machines (FSMs)	
3	13/03/2017		Reduction of FSMs	Q1
4	20/03/2017		Non-deterministic finite-state acceptors (FSAs)	Q2
5	27/03/2017	Counting, Inclusion-Exclusion, generating functions: Cooper, Chen	FSAs and regular languages	A1
6	03/04/2017	Continued		Q3
7	10/04/2017	Recurrence relations	Turing machines	Q4
MID-SESSION BREAK				
8	01/05/2017		Turing machines	FSA Q5
9	08/05/2017	Graph algorithms: Cooper, Chen	Extended Turing machines	A2

10	15/05/2017		The Busy Beaver and Halting problems	Q6
11	22/05/2017		Integers mod *m* and cryptography	
12	29/05/2017		Polynomial codes	A3
13	05/06/2017	**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, project and quiz dates are fixed.

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. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy_2016.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

In addition, a number of other policies can be found in the Learning and Teaching Category 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/

Results

Results shown in *iLearn*, 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://stu

dents.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 Services and 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.

Student Enquiries

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

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

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

Graduate Capabilities

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

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 outcomes

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- 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

- Three assignments
- 1 Project

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

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.
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Assessment task

- Three assignments

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

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Assessment tasks

- Three assignments

- 1 Project
- Final examination
- online quizzes

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.
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Assessment tasks

- Three assignments
- 1 Project
- Final examination
- online quizzes

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

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Assessment tasks

- Three assignments
- 1 Project
- Final examination
- online quizzes

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.
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- Expressing yourself clearly and logically in writing.

Assessment tasks

- Three assignments
- Final examination

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

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.

Changes from Previous Offering

Tutorials and Practical Sessions commence in Week 2. However there are two revision quizzes due by the end of Week 2, so students should spend time in Week 1 revising topics from the pre-requisite unit of DMTH137. Given that DMTH237 has an alternate entrance pathway (via MATH135, MATH136, etc.) avoiding DMTH137, there may be some topics which those students have not studied yet; e.g., Logic, Set Theory, Counting methods. Lecture notes for these are available along with the Cooper notes for DMTH237. These should be studied during the first 1–2 weeks.

The 1st topic in the Algebra & Graph Theory stream “Complex numbers” is now replaced by “Trigonometry”.