SUBJECT OUTLINE

37181 Discrete Mathematics

Course area UTS: Science
Delivery Spring 2019; City
Credit points 6cp
Result type Grade and marks

Attendance: 4hpw

Subject coordinator

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Teaching staff

Lectures: Murray Elder

Workshops: Mustafa Barodawala, Thomas Goodwin, Sophie Ryan, Quin (Jerry) Shen

Subject description

This subject gives students the foundation for logical thinking and working, essential for computer scientists and mathematics majors. It covers from scratch the basics of logic, set theory (mathematical notation), functions, counting, proving mathematical statements, analysing the complexity and correctness of algorithms, and some basic number theory.

Subject learning objectives (SLOs)

Upon successful completion of this subject students should be able to:

1. Solve simple problems in discrete mathematics and apply this knowledge to solve selected problems arising in other parts of science, in engineering and business
2. Understand and apply knowledge of discrete mathematics and its theoretical underpinnings by constructing logical, clearly presented and justified arguments incorporating deductive reasoning
3. Identify where the basic concepts of discrete mathamatics are useful in addressing a real world problem
4. Engage in group discussions to decide upon the appropriate choice of techniques from discrete mathematics to describe a wide variety of problems from fields including the physical sciences, engineering and business

Course intended learning outcomes (CILOs)

This subject also contributes specifically to the development of following course intended learning outcomes:

- An understanding of the nature, practice and application of the chosen science discipline.Disciplinary knowledge and its appropriate application (1.0)
- Encompasses problem solving, critical thinking and analysis attributes and an understanding of the scientific method knowledge acquisition. (2.0)
- The ability to acquire, develop, employ and integrate a range of technical, practical and professional skills, in appropriate and ethical ways within a professional context, autonomously and collaboratively and across a range of disciplinary and professional areas, e.g. time management skills, personal organisation skills, teamwork skills, computing skills, laboratory skills, data handling, quantitative and graphical literacy skills. (3.0)
- An understanding of the different forms of communication - writing, reading, speaking, listening -, including visual and graphical, within science and beyond and the ability to apply these appropriately and effectively for different audiences. (6.0)

Contribution to the development of graduate attributes

1. Disciplinary knowledge and its appropriate application

The lectures and workshops will allow students to develop practical and theoretical skills in discrete mathematics.

2. An Enquiry-oriented approach

The collaborative approach to problem formulations and solutions used in the workshops helps students develop skills in idenitifying and evaluating alternative approaches to solving problems.

3. Professional skills and their appropriate application

The ability to work effectively and responsibly in a group is emphasised in the group-based discussion components of the workshops.

6. Communication skills

Presentation of written and oral solutions to problems using appropriate professional language is emphasised in the workshops and assessment. All assessment taks require the appropriate presentation of information, reasoning and conclusions and require students to gain meaning from instructions (written or verbal) and problem statements.

Teaching and learning strategies

Subject delivery (per week): one 2 hour interactive lecture, one 2 hour interactive workshop. These are delivered on-campus.

The workshops reinforce the content and skills learned, working collaboratively at whiteboards in small groups. They also include a short formative quiz in alternate weeks. The structure of the "Whitebord Workshops" will be fully explained in the first session.

UTSOnline will be used to disseminate learning materials in the form of course notes, lecture slides, lecture recordings, homework and worksheets with solutions.

Feedback by rapid return of quiz and test grades, worked solutions available online for assessment tasks, and informal feedback in the whiteboard workshop.

Content (topics)

In this subject we will study the foundations of discrete mathematics. To this end, we will cover:

- basics of propositional logic: truth tables, quantifiers, simple proof structures (direct, indirect)
- mathematical induction, well ordering principle
- formal mathematical notation: set theory, functions
- graph theory, trees
- counting
- pigeonhole principle
- basic number theory, RSA

Program

Week/Session	Dates	Description
1	22-26 Jul	Lecture 1: Logic; truth tables; quantified statements. **Notes:** Workshop 1 Thursday and Friday. No workshop Monday.

2	29 Jul - 2 Aug	Lecture 2: Proofs; basic number theory. **Notes:** Workshop 2 including Quiz 1, Thursday and Friday. Workshop 1 Monday (no quiz).
3	5-9 Aug	Lecture 3: Set theory. **Notes:** Workshop 3 including quiz 2, Thursday and Friday. Workshop 2 including quiz 1 Monday.
4	12-16 Aug	Lecture 4: Mathematical induction; well ordering principle; correctness of computer code. **Notes:** Workshop 4 including quiz 3, Thursday and Friday. Workshop 3 including quiz 2 Monday.
5	19-23 Aug	Lecture 5: Relations, functions, countable/uncountable. **Notes:** Workshop 5 including quiz 4, Thursday and Friday. Workshop 4 including quiz 3, Monday.
6	26-30 Aug	Lecture 6: Countable; Big O complexity. **Notes:** Workshop 6 Thursday and Friday. Workshop 5 including quiz 4, Monday.
7	2-6 Sep	Drop in session during lecture time for the team assignment **Notes:** Workshop 6 Monday. No workshops Thursday and Friday. Team assignment due Friday 5pm
STUVAC		Stu Vac: No lecture or workshops.

8	16-20 Sep	Lecture 7: Counting: binomial theorem, permutations, combinations, pigeonhole principle, combinatorial proofs. **Notes:** Workshop 7 Thursday and Friday.
9	23-27 Sep	Lecture 8: Number theory. **Notes:** Workshop 8 including quiz 5 Thursday and Friday. Workshop 7 Monday
10	30 Sep - 4 Oct	Lecture 9: RSA cryptosystem; more number theory. **Notes:** Workshop 8 including quiz 5 Monday. No workshop Thursday and Friday (due to public holiday next monday) Homework sheet 9 will be extra big to cover RSA.
11	7-11 Oct	Lecture 10: Graph theory. **Notes:** Workshop 9 including quiz 6 Thursday and Friday. No workshop Monday (public holiday).
12	14-18 Oct	Lecture 11: Trees. **Notes:** Workshop 10 Thursday and Friday. Workshop 9 including quiz 6 Monday.
		Revision week, Monday 21 Oct only: Workshop 10

Assessment

Assessment task 1: In-class quizzes

Intent: This assessment task (in-workshop quiz) contributes to the development of the following graduate attributes:

1. disciplinary knowledge and its appropriate application

2. an enquiry-based approach

6. communication skills

Objective(s): This assessment task addresses subject learning objective(s):

1, 2, 3 and 4

This assessment task contributes to the development of course intended learning outcome(s):

1.0, 2.0 and 6.0

Type: Quiz/test

Groupwork: Individual

Weight: 30%

Task: Quiz during workshops. These exercises contribute to the development of disciplinary knowledge. Students will need to express mathematical ideas by writing proofs and drawing diagrams representing connections and mathematical objects. This will develop communication skills.

Due: In class in during workshops -- see schedule for dates. 6 quizzes in total.

Criteria: Students will be assessed on:

accuracy of analysis;

clarity of communication.

Further information: 1 A4 page double-sided of handwritten/printed notes allowed.

Assessment task 2: Team assignment

Intent: This assessment task (team assignment) contributes to the development of the following graduate attributes:

1. disciplinary knowledge and its appropriate application

2. an enquiry-based approach

3. Professional skills and their appropriate application

6. Communication skills

Objective(s): This assessment task addresses subject learning objective(s):

1, 2 and 3

This assessment task contributes to the development of course intended learning outcome(s):

1.0, 2.0, 3.0 and 6.0

Type: Exercises

Groupwork: Group, group assessed

Weight: 20%

Task: Students will be given more extensive problems that can be solved using the ideas developed during the first 6 weeks. Students will need to express mathematical ideas by writing proofs and drawing diagrams representing connections and mathematical objects. This will develop communication skills.

Students will work in groups of three. In your group you will collaboratively problem solve and write answers in the form of clear and correct proofs using correct mathematical notation.

Each team member should make a meaningful contribution to the task. In addition to the assignment questions submitted collectively, each team member will be required to describe their individual contribution. More details to be provided on the assignment.

Due: Friday 6 September 2019

Criteria: Students will be assessed on:

accuracy of solution, including determining a correct approach to address the question asked

clarity of communication

individual contribution to the team

Assessment task 3: Final Examination

Intent: This assessment task (formal 2 hour exam) contributes to the development of the following graduate attributes:

1. disciplinary knowledge and its appropriate application

2. an enquiry-oriented approach

6. communication skills

Objective(s): This assessment task addresses subject learning objective(s):

1, 2 and 3

This assessment task contributes to the development of course intended learning outcome(s):

1.0, 2.0 and 6.0

Type: Examination

Groupwork: Individual

Weight: 50%

Task: Completion of a two hour exam. This is a restricted open book exam: 3 pages A4 double-sided notes allowed (hadwritten/printed).

Length: 2 hours plus 10 minutes reading time.

Due: Formal Exam period

Criteria: Students will be assessed on:

accuracy of solution, including determining a correct approach to address the question asked;

clarity of communication

Assessment feedback
Quizzes and assignments will be returned in the next class, and answers/solutions posted on UTSOnline.

Minimum requirements
Students must obtain at least 40% of the marks available for the final examination in order to pass this subject. If 40% is not reached, an X grade fail may be awarded for the subject, irrespective of an overall mark greater than 50.

Recommended texts
Any textbook called "Discrete Mathematics" will be useful, for example

- Susanna Epp, Discrete Mathematics with Applications
- Ralf Grimaldi, Discrete and Combinatorial Mathematics, An Applied Introduction

References
Course notes and lecture slides will be provided on UTSOnline, as the semester progresses.

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Academic liaison officers
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Mathematics & Science Study Centre

The Mathematics and Science Study Centre (MSSC) operates a Drop-in Room located on UTS City Campus, in Building 4, level 3, room 331 (CB04.03.331). Academic staff members are available for one-to-one assistance. For timetabling and other MSSC resources see:

w: https://tinyurl.com/UTS-maths-study-centre

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