



MONASH University
Information Technology

FIT4010
Advanced topics in algorithms and discrete structures

Unit Guide

Semester 1, 2012

The information contained in this unit guide is correct at time of publication. The University has the right to change any of the elements contained in this document at any time.

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FIT4010 Advanced topics in algorithms and discrete structures - Semester 1, 2012

Algorithms are the most fundamental area for all aspects of computer science and software engineering. Discrete structures, such as those treated in graph theory, set theory, combinatorics and symbolic logic form the mathematical underpinning of the study of algorithms. As well-designed algorithms and data structures are essential for the good performance of an information system, an in-depth understanding of the theoretical properties of algorithms is essential for any computer scientist. As importantly, the theoretical investigation of algorithms leads to a deeper understanding of problem structures and classes of problems and the knowledge of a large variety of algorithm types enables the designer to approach a new problem from different angles. Topics for this unit include: Computability and Complexity Automata Theory Advanced Analysis and Design of Algorithms Parallel and Distributed Algorithms Numerical Algorithms Cryptographic algorithms Spatial/geometric algorithms

Mode of Delivery

Clayton (Day)

Contact Hours

2 hrs lectures/wk, 1 hr laboratory or tutorial/wk

Workload

- two hour lecture and
- one hour tutorial (or laboratory) (requiring advance preparation)
- a minimum of 3 hours of personal study per one hour of contact time in order to satisfy the reading and assignment expectations.

Unit Relationships

Prerequisites

Completion of the Bachelor of Computer Science or equivalent to the entry requirements for the Honours program. Students must also have enrolment approval from the Honours Coordinator.

Chief Examiner

Kimbal Marriott

Campus Lecturer

Clayton

Mark Carman

Consultation hours: Tuesday 2pm - 3pm or make email appointment

FIT4010 Advanced topics in algorithms and discrete structures - Semester 1, 2012

Kim Marriott

Consultation hours: Tuesday 2pm - 3pm or make email appointment

Academic Overview

Outcomes

At the completion of this unit students will have:

- an improved understanding of the issues involved in designing algorithms in the chosen specialisation area(s) and in analysing their performance;
- an understanding of the mathematical formalisms that are relevant for these algorithms;
- learned to recognise tasks that can be solved with these algorithms;
- the ability to judge the limitations of these methods. With successful completion of the unit the students;
- the ability to choose and apply algorithms and data structures in the chosen specialisation area(s);
- the ability to evaluate the performance of algorithms using formal approaches;
- the ability to design modified algorithms in the chosen area to suit particular problem structures.

Graduate Attributes

Monash prepares its graduates to be:

1. responsible and effective global citizens who:

- a. engage in an internationalised world
- b. exhibit cross-cultural competence
- c. demonstrate ethical values

critical and creative scholars who:

- a. produce innovative solutions to problems
- b. apply research skills to a range of challenges
- c. communicate perceptively and effectively

Assessment Summary

Assignment and Examination, relative weight depending on topic composition. When no exam is given students will be expected to demonstrate their knowledge by solving practical problems and maybe required to give an oral report.

Assessment Task	Value	Due Date
Assignment 1 - Modelling with MiniZinc	50%	16 April 2012
Assignment 2 - Building an Automated Planning system using SAT, Heuristic Search and/or NLP techniques	50%	4 June 2012

Teaching Approach

Lecture and tutorials or problem classes

This teaching and learning approach provides facilitated learning, practical exploration and peer learning.

Feedback

Our feedback to You

Types of feedback you can expect to receive in this unit are:

- Informal feedback on progress in labs/tutes
- Graded assignments with comments
- Solutions to tutes, labs and assignments

Your feedback to Us

Monash is committed to excellence in education and regularly seeks feedback from students, employers and staff. One of the key formal ways students have to provide feedback is through SETU, Student Evaluation of Teacher and Unit. The University's student evaluation policy requires that every unit is evaluated each year. Students are strongly encouraged to complete the surveys. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied and areas for improvement.

For more information on Monash's educational strategy, and on student evaluations, see:

<http://www.monash.edu.au/about/monash-directions/directions.html>

<http://www.policy.monash.edu/policy-bank/academic/education/quality/student-evaluation-policy.html>

Previous Student Evaluations of this unit

The changes we made last year worked well and we received a high student evaluation. We plan to update the material slightly to reflect advances in the field.

If you wish to view how previous students rated this unit, please go to

<https://emuapps.monash.edu.au/unitevaluations/index.jsp>

Required Resources

Please check with your lecturer before purchasing any Required Resources. Prescribed texts are available for you to borrow in the library, and prescribed software is available in student labs.

You will be using the MiniZinc modelling language.

This is available from: <http://www.g12.csse.unimelb.edu.au/minizinc/>

Unit Schedule

Week	Activities	Assessment
0		No formal assessment or activities are undertaken in week 0
1	Introduction to constrained optimization	
2	Modelling with MiniZinc	Assignment 1 handed out
3	Linear Programming	
4	Mixed Integer Programming (MIP)	
5	Constraint Propagation (CP)	
6	SAT techniques and planning applications	
7	Heuristic search methods	Assignment 1 due 16 April 2012
8	Non-Linear Programming (NLP)	Assignment 2 handed out
9	Local and stochastic search methods	
10	Tabu search and evolutionary methods	
11	Advanced methods: Network flow, lazy FD	
12	Research directions in constrained optimization	
	SWOT VAC	No formal assessment is undertaken SWOT VAC. Assignment 2 due 4 June 2012
	Examination period	LINK to Assessment Policy: http://policy.monash.edu.au/policy-bank/academic/education/assessment/assessment-in-coursework-policy.html

*Unit Schedule details will be maintained and communicated to you via your MUSO (Blackboard or Moodle) learning system.

Assessment Requirements

Assessment Policy

Faculty Policy - Unit Assessment Hurdles

(<http://www.infotech.monash.edu.au/resources/staff/edgov/policies/assessment-examinations/unit-assessment-hu>)

Assessment Tasks

Participation

Students are expected to attend lectures and tutorials. However this is not mandatory.

• Assessment task 1

Title:

Assignment 1 - Modelling with MiniZinc

Description:

In this assignment students will model a relatively simple constrained optimization problem using MiniZinc. They will be required to create models that work with a variety of different underlying solving techniques: MIP, CP and SAT.

They will need to construct test data and then evaluate their models with this data.

Produce a written report that describes their models, test data and the results of the evaluation. The report should also try and explain reasons for differences in behaviour of these models.

Weighting:

50%

Criteria for assessment:

The quality of the models: correctness, efficiency, clarity and documentation.

The quality of the test data: coverage.

The quality of the written report including the quality of the evaluation and analysis of the differences in behaviour.

Due date:

16 April 2012

• Assessment task 2

Title:

Assignment 2 - Building an Automated Planning system using SAT, Heuristic Search and/or NLP techniques

Description:

In this assignment students will investigate certain planning domains from the International Planning Competition. They will build a system to encode planning problems from that domain into SAT, Heuristic Search and / or non-linear programming formulations, which can then be solved using the aforementioned techniques.

Students will need to show that their system works as desired (can discover reasonable plans) on a number of different problems (of increasing difficulty) from the chosen domain.

Students will need to produce a written report describing their system and their evaluation of it.

Weighting:

50%

Criteria for assessment:

The quality of the planning system: its ability to find reasonable plans, its speed, and the type (complexity) of problems it can deal with.

The quality of the written report including the quality of the evaluation and analysis.

Due date:

4 June 2012

Examinations

Assignment submission

It is a University requirement

(<http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-procedures.html>) for students to submit an assignment coversheet for each assessment item. Faculty Assignment coversheets can be found at <http://www.infotech.monash.edu.au/resources/student/forms/>. Please check with your Lecturer on the submission method for your assignment coversheet (e.g. attach a file to the online assignment submission, hand-in a hard copy, or use an online quiz).

Online submission

If Electronic Submission has been approved for your unit, please submit your work via the VLE site for this unit, which you can access via links in the my.monash portal.

Extensions and penalties

Submission must be made by the due date otherwise penalties will be enforced.

You must negotiate any extensions formally with your campus unit leader via the in-semester special consideration process:

<http://www.infotech.monash.edu.au/resources/student/equity/special-consideration.html>.

Returning assignments

Students can expect assignments to be returned within two weeks of the submission date or after receipt, whichever is later.

Resubmission of assignments

Resubmission is not allowed unless special consideration applies in which case the course leaders may allow the student to resubmit an assignment.

Other Information

Policies

Monash has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and to provide advice on how they might uphold them. You can find Monash's Education Policies at:

<http://policy.monash.edu.au/policy-bank/academic/education/index.html>

Key educational policies include:

- Plagiarism
(<http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-policy.html>)
- Assessment
(<http://www.policy.monash.edu/policy-bank/academic/education/assessment/assessment-in-coursework-p>)
- Special Consideration
(<http://www.policy.monash.edu/policy-bank/academic/education/assessment/special-consideration-policy.h>)
- Grading Scale
(<http://www.policy.monash.edu/policy-bank/academic/education/assessment/grading-scale-policy.html>)
- Discipline: Student Policy
(<http://www.policy.monash.edu/policy-bank/academic/education/conduct/student-discipline-policy.html>)
- Academic Calendar and Semesters (<http://www.monash.edu.au/students/key-dates/>);
- Orientation and Transition (<http://www.infotech.monash.edu.au/resources/student/orientation/>);
and
- Academic and Administrative Complaints and Grievances Policy
(<http://www.policy.monash.edu/policy-bank/academic/education/management/complaints-grievance-policy>)
- Codes of Practice for Teaching and Learning
(<http://www.policy.monash.edu.au/policy-bank/academic/education/conduct/suppdocs/code-of-practice-tea>)

Student services

The University provides many different kinds of support services for you. Contact your tutor if you need advice and see the range of services available at www.monash.edu.au/students. For Sunway see <http://www.monash.edu.my/Student-services>, and for South Africa see <http://www.monash.ac.za/current/>

The Monash University Library provides a range of services and resources that enable you to save time and be more effective in your learning and research. Go to <http://www.lib.monash.edu.au> or the library tab in my.monash portal for more information. At Sunway, visit the Library and Learning Commons at <http://www.lib.monash.edu.my/>. At South Africa visit <http://www.lib.monash.ac.za/>.

Academic support services may be available for students who have a disability or medical condition. Registration with the Disability Liaison Unit is required. Further information is available as follows:

- Website: <http://monash.edu/equity-diversity/disability/index.html>;
- Email: dlu@monash.edu
- Drop In: Equity and Diversity Centre, Level 1 Gallery Building (Building 55), Monash University, Clayton Campus, or Student Community Services Department, Level 2, Building 2, Monash University, Sunway Campus
- Telephone: 03 9905 5704, or contact the Student Advisor, Student Community Services at 03 55146018 at Sunway

Other

Reading List

There are several recommended books for this subject:

- Introduction to Mathematical Programming. W. L. Winston. Duxbury Press, 1995.
- Introduction to Operations Research. F.S. Hillier and G.J. Lieberman. McGraw-Hill, 8th Ed, 2005.
- Constraint Programming - An Introduction. K. Marriott and P. Stuckey. MIT Press, 1998.
- Numerical Optimization. J. Nocedal & S. Wright. Springer, 2006.
- Automated Planning: Theory and Practice. D. Nau, M. Ghallab and P. Traverso. Morgan Kaufmann 2004.

In addition to this, selected research papers will be referenced throughout the unit.

The lecture material will be loosely based on this material and will be available through Moodle.