FIT4012
Advanced topics in computational science

Unit Guide

Semester 2, 2013

Last updated: 24 Jul 2013

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All sciences are increasingly relying on computational support and the growth of many branches of science has only become possible due to the availability of efficient computational methods. The common basis of such methods are; numerical methods and high performance computing. Topics for this unit include: Numerical Methods, High Performance and Parallel Computing, Optimisation and Operations Research Bioinformatics, Simulation, Visualisation and Modelling.

Mode of Delivery

Clayton (Day)

Contact Hours

2 hrs lectures/wk

Workload requirements

Weekly workload commitments are:

- 2 hour lecture
- a minimum of 5 hours personal study and lecture preparation
- a minimum of 5 hours for working on programming and written assessments

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

Associate Professor Jon McCormack

Campus Lecturer

Clayton

Jon McCormack

Aldeida Aleti

Academic Overview

Learning Outcomes

At the completion of this unit students will:

- understand the place of computational methods in the chosen field of specialisation and their relation to non-computational approaches;
- compare and contrast alternative computational approaches in this domain;
- critically evaluate the limits and capabilities of these methods;
- be able to select, design and test computer programs in the domain;
- where appropriate, be able to use the standard computational packages in the chosen domain effectively for practical problem solving.

Unit Schedule

Week	Activities	Assessment
0	Review recommended reading	No formal assessment or activities are undertaken in week 0
1	Introduction to Evolutionary Simulation and Synthesis	
2	Evolutionary Algorithms	
3	Genetic Algorithms and Evolutionary Strategies	Programming Exercises due Week 3, Friday, 5pm
4	Adaptive Intelligence	
5	Learning Classifiers	
6	Hybrid Models and Special forms of Evolution	Written Essay due Week 6, Friday, 5pm
7	Combinatorial Problems and Computational Complexity	
8	Systematic, Local and Stochastic Search	
9	Stochastic Local Search Methods	Problem Solving and Programming Exercise due Week 9, Friday, 5pm
10	Generalised Local Search Machines	
11	Constrained Problems and Constraint-Handling Techniques	
12	Multicriteria Decision-Making	Research Proposal due Week 12, Friday, 5pm
	SWOT VAC	No formal assessment is undertaken in SWOT VAC
	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 learning system.

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
Programming Exercises	30%	Week 3, Friday, 5pm
Written Essay	20%	Week 6, Friday, 5pm
Problem Solving and Programming Exercise	30%	Week 9, Friday, 5pm
Research Proposal	20%	Week 12, Friday, 5pm

Teaching Approach

Research activities

Students are encouraged to explore the research literature, combined with practical problem-solving and learning support from their lecturers.

Assessment Requirements

Assessment Policy

Faculty Policy - Unit Assessment Hurdles
(http://www.infotech.monash.edu.au/resources/staff/edgov/policies/assessment-examinations/unit-assessment-hu

Academic Integrity - Please see the Demystifying Citing and Referencing tutorial at
http://lib.monash.edu/tutorials/citing/

Assessment Tasks

Participation

- **Assessment task 1**

  Title:
  Programming Exercises
  Description:
  Short programming exercises on evolutionary simulation and synthesis.
  Weighting:
  30%
  Criteria for assessment:

    - Correctness
    - Accuracy
    - Efficiency
    - Quality of documentation
    - Quality of results
    - Evidence of testing
    - Statistical analysis
    - Coding use
    - Inventiveness of solutions

  Due date:
  Week 3, Friday, 5pm

- **Assessment task 2**

  Title:
  Written Essay
  Description:
  Write a short academic paper on a topic in evolutionary simulation and synthesis. The lecturer will provide a list of possible topics.
  Weighting:
  20%
  Criteria for assessment:
  Marks will be awarded based on the criteria listed below. The questions listed indicate the kind of questions that will be asked when your work is assessed.

    - Logical structure: is the paper well structured (e.g. title, abstract, introduction, body, conclusion, references)? Does it present its material in a logical and clear way?

♦Writing quality: does every word count? Has the author avoided 'padding out' the text with waffle in order to get to the necessary word count? Are the main points of the paper clear and convincing, with solid arguments and proper referencing to the literature?

♦Language, spelling and grammar: has the paper been proof-read? Are there spelling mistakes? Do sentences make sense? Are there any grammatical errors? Is it easy to establish what the writer is trying to say?

♦Quality of analysis: how well has the topic being researched? How clearly does it establish the important points and arguments. Are the references appropriate and adequate?

♦Original contribution: what does the paper contribute to the topic beyond just listing opinions or work done by others? How original is the paper?

Due date:

Week 6, Friday, 5pm

Remarks:

Please note that it is important to correctly attribute material that is not your own. Your paper will contain a bibliography, listing the work of others that you have consulted. The number of references you consult is up to you, as a rough guide most papers of this size will have somewhere between 6 - 20 references. Do not 'bulk up' your bibliography with unnecessary references or ones that you have not actually read.

Consider the authority and origin of your research sources. Favour books, journals and conference proceedings that are peer reviewed and from reputable publishers over web pages, for example.

At least 80% of your references should originate from sources other than the Internet (electronic versions of journal or conference papers can count towards this quota).

- **Assessment task 3**

Title:

Problem Solving and Programming Exercise

Description:

Problem solving and programming exercise on combinatorial problems, computational complexity and search paradigms. The assessment questions will be available from Week 7.

Weighting:

30%

Criteria for assessment:

♦Correctness and accuracy of the solution
♦Efficiency of the algorithm
♦Complexity analysis
♦Use of appropriate programming practices

Due date:

Week 9, Friday, 5pm

- **Assessment task 4**

Title:

Research Proposal

Description:

Formulate a research proposal on one of the topics covered during the last 6 weeks of the unit (Weeks 7 - 12).

Assessment Requirements

Weighting:
20%
Criteria for assessment:

♦ Critical awareness of relevant literature
♦ Strength of argument
♦ Use of information and literature to sustain argument
♦ Awareness of strengths and weaknesses of approach
♦ Appropriate and accurate use of language

Due date:
Week 12, Friday, 5pm

Learning resources

Reading list

Sean Luke (2009): "Essentials of Metaheuristics", Lulu, Available for free download at:
http://www.cs.gmu.edu/~sean/book/metaheuristics/

A.E. Eiben and J.E. Smith (2007): "Introduction to Evolutionary Computing", (2nd
Edition) Springer, Natural Computing Series

Stochastic Local Search, Foundations and Applications, by Holger H. Hoos and Thomas Stützle,
http://www.sls-book.net/

How to Solve It: Modern Heuristics, by Zbigniew Michalewicz and David B.
Fogel, http://www.amazon.com/How-Solve-It-Modern-Heuristics/dp/3540224947

Monash Library Unit Reading List
http://readinglists.lib.monash.edu/index.html

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

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.monash.edu.au/exams/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.

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). Please note that it is your
responsibility to retain copies of your assessments.

Online submission

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

Recommended Resources

Access to a C, C++ or Java compiler and IDE environment. These are available in University computer
labs.

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: www.policy.monash.edu.au/policy-bank/academic/education/index.html

Key educational policies include:

- Aademic integrity;
  http://www.policy.monash.edu/policy-bank/academic/education/conduct/student-academic-integrity-policy.h
- Assessment in Coursework Programs;
  http://www.policy.monash.edu/policy-bank/academic/education/assessment/assessment-in-coursework-po
- Special Consideration;
  http://www.policy.monash.edu/policy-bank/academic/education/assessment/special-consideration-policy.ht
- 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/dates/
- Orientation and Transition; http://intranet.monash.edu.au/infotech/resources/students/orientation/
- Academic and Administrative Complaints and Grievances Policy;
  http://www.policy.monash.edu/policy-bank/academic/education/management/complaints-grievance-policy.h
- Code of Practice for Teaching and Learning;
  http://www.policy.monash.edu.au/policy-bank/academic/education/conduct/suppdocs/code-of-practice-tea

Graduate Attributes Policy

http://www.policy.monash.edu/policy-bank/academic/education/management/monash-graduate-attributes-policy.ht

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 http://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/.

Monash University Library

The Monash University Library provides a range of services, resources and programs that enable you to save time and be more effective in your learning and research. Go to 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/.

Disability Liaison Unit

Students who have a disability or medical condition are welcome to contact the Disability Liaison Unit to discuss academic support services. Disability Liaison Officers (DLOs) visit all Victorian campuses on a regular basis.

Website: http://www.monash.edu/equity-diversity/disability/index.htmlTelephone: 03 9905 5704 to book an appointment with a DLO; or contact the Student Advisor, Student Commuity Services at 03 55146018 at SunwayEmail: dlu@monash.eduDrop In: Equity and Diversity Centre, Level 1, Building 55, Clayton Campus, or Student Community Services Department, Level 2, Building 2, Monash University, Sunway Campus

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 the Student Evaluation of Teaching and Units (SETU) survey. 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, see:

www.monash.edu.au/about/monash-directions and on student evaluations, see: www.policy.monash.edu/policy-bank/academic/education/quality/student-evaluation-policy.html

Previous Student Evaluations of this Unit

Student feedback has shown the unit is structured well. To make sure materials are current lecture notes have been updated and new visual references have been added.

If you wish to view how previous students rated this unit, please go to https://emuapps.monash.edu.au/unitevaluations/index.jsp