FIT4012
Advanced topics in computational science

Unit Guide

Semester 2, 2014

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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)

Workload Requirements

Minimum total expected workload equals 12 hours per week comprising:

(a.) Contact hours for on-campus students:

- Two hours of lectures

(b.) Additional requirements (all students):

- A minimum of 10 hours independent study per week for completing lab and project work, private study and revision.

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

Dr Aldeida Aleti

Campus Lecturer

Clayton

Aldeida Aleti

Julian Garcia

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

Academic Overview

Learning Outcomes

At the completion of this unit students should be able to:

- explain the role of computational methods in the chosen field of specialisation and their relation to complimentary and related approaches;
- solve non-trivial problems using the algorithms specific to the chosen field of specialisation;
- compare and evaluate alternative computational approaches in the chosen domain in terms of performance and suitability to a specific problem;
- critically evaluate the limits and capabilities of these methods;
- select, design and test computer programs in the domain;
- use standard computational packages in the chosen domain effectively for practical problem solving where appropriate.

Unit Schedule

Week	Activities	Assessment
0	Review recommended reading	No formal assessment or activities are undertaken in week 0
1	Evolutionary Computation for Optimisation and Simulation	
2	Combinatorial Problems and Computational Complexity	
3	Systematic, Local and Stochastic Search	
4	Fitness Landscape Analysis	
5	Parameter Control for Evolutionary Algorithms	
6	Constrained Problems and Constraint-Handling Techniques	Problem Set 1 due Week 6, Friday, 5pm
7	Co-evolution, Co-evolutionary algorithms, Evolutionary Models	
8	Fundamentals of Game Theory	
9	Evolutionary dynamics I	
10	Evolutionary dynamics II	
11	Agent-based models of evolution and applications	
12	Project presentations	Research Project due Week 12; Problem Set 2 due Week 14, 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.

Teaching Approach

Research activities

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

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
Problem Set 1	40%	Week 6, Friday,

Unit Schedule

		5pm
Problem Set 2	40%	Week 14, Friday, 5pm
Research Project	20%	Week 12

Assessment Requirements

Assessment Policy

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

Academic Integrity - Please see resources and tutorials at
http://www.monash.edu/library/skills/resources/tutorials/academic-integrity/

Assessment Tasks

Participation

- **Assessment task 1**

  Title:
  > Problem Set 1

  Description:
  > Problem solving and programming exercises on combinatorial problems, computational complexity and search paradigms. The assessment questions will be available from Week 1.

  Weighting:
  > 40%

  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 6, Friday, 5pm

- **Assessment task 2**

  Title:
  > Problem Set 2

  Description:
  > Problem solving and programming exercise on Evolutionary Simulation. The assessment questions will be available from Week 7.

  Weighting:
  > 40%

  Criteria for assessment:

  - ♦ Correctness and accuracy of the solution
  - ♦ Efficiency of the algorithm
  - ♦ Complexity analysis

♦Use of appropriate programming practices

Due date:

Week 14, Friday, 5pm

- **Assessment task 3**

Title:

Research Project

Description:

Prepare a research proposal or presentation on a research topic. 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 proposal or presentation well structured? 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 12

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).

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

M.A Nowak (2006): "Evolutionary dynamics: exploring the equations of life". Havard University Press. http://www.hup.harvard.edu/catalog.php?isbn=9780674023383

Monash Library Unit Reading List (if applicable to the unit) http://readinglists.lib.monash.edu/index.html

Faculty of Information Technology Style Guide

Feedback to you

Examination/other end-of-semester assessment feedback may take the form of feedback classes, provision of sample answers or other group feedback after official results have been published. Please check with your lecturer on the feedback provided and take advantage of this prior to requesting individual consultations with staff. If your unit has an examination, you may request to view your examination script booklet, see http://intranet.monash.edu.au/infotech/resources/students/procedures/request-to-view-exam-scripts.html

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/student-academic-integrity-managing-pla
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:

- Student Academic Integrity Policy and Student Academic Integrity: Managing Plagiarism and Collusion Procedures ;
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

Faculty resources and policies

Important student resources including Faculty policies are located at
http://intranet.monash.edu.au/infotech/resources/students/

Graduate Attributes Policy

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

Student Charter

www.opq.monash.edu.au/ep/student-charter/monash-university-student-charter.html

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 Malaysia 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 Malaysia, 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.html
- Telephone: 03 9905 5704 to book an appointment with a DLO; or contact the Student Advisor, Student Commuity Services at 03 55146018 at Malaysia
- Email: dlu@monash.edu
- Drop In: Equity and Diversity Centre, Level 1, Building 55, Clayton Campus, or Student Community Services Department, Level 2, Building 2, Monash University, Malaysia Campus