MONASH University
Information Technology

FIT4012
Advanced topics in computational science

Unit Guide

Semester 2, 2010

Last updated: 14 Jul 2010

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FIT4012 Advanced topics in computational science - Semester 2, 2010

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Introduction

Welcome to FIT4012. This is an honours-level unit for students enrolled in BCS or BSE honours. The unit looks at evolutionary processes and how these may be used in computer science for the purposes of problem-solving, optimisation, simulation and synthesis. The unit also examines biologically-inspired computational processes and their implementation in the form of simulations and for computer graphics or procedural animation.

Unit synopsis

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.

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.

Contact hours

2 hrs lectures/wk

Workload

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.

Teaching and learning method

Teaching approach

Teaching consists of a weekly 2-hour lecture. Course lecturers are available for individual consultation hours as advertised in the unit MUSO page.

Timetable information

For information on timetabling for on-campus classes please refer to MUTTS, http://mutts.monash.edu.au/MUTTS/

Tutorial allocation

On-campus students should register for tutorials/laboratories using the Allocate+ system: http://allocate.its.monash.edu.au/

Unit Schedule

Week	Date*	Topic	Key dates
1	19/07/10	Introduction to Procedural Modelling, Animation & Artificial Life	
2	26/07/10	Plant Models	
3	02/08/10	Flocks, Herds, Swarms & Schools: Distributed Models of Behaviour	
4	09/08/10	Animals: Form & Function	
5	16/08/10	Cells & Pix-cells	
6	23/08/10	Artificial (Virtual) Ecosystems	Programming Exercise due
7	30/08/10	Evolution & Evolutionary Algorithms	
8	06/09/10	Genetic Algorithms, Evolutionary Strategies	Programming Exercise due
9	13/09/10	Evolutionary and Genetic Programming	
10	20/09/10	Adaptive Intelligence, Learning Classifier Systems	Programming Exercise due
Mid semester break			
11	04/10/10	Multimodal Problems, Spatial Distribution	
12	11/10/10	Developmental Models	
13	18/10/10	Special Forms of Evolution, Advanced Applications	Written assignment due

*Please note that these dates may only apply to Australian campuses of Monash University. Off-shore students need to check the dates with their unit leader.

Improvements to this unit

Updated lecture notes with current material.

Added new visual references.

Unit Resources

Prescribed text(s) and readings

The unit focuses on current research and the particular methods addressed may change. Up-to-date literature (books, journals papers, conference articles, standards, etc) will be referenced throughout the unit and will be made available to the students.

Text books are available from the Monash University Book Shops. Availability from other suppliers cannot be assured. The Bookshop orders texts in specifically for this unit. You are advised to purchase your text book early.

Recommended text(s) and readings

The unit focuses on current research and the particular methods addressed may change. Up-to-date literature (books, journals papers, conference articles, standards, etc) will be referenced throughout the unit and will be made available to the students.

For Weeks 1-6...

Recommended reading:

Eiben, A.E. and J.E. Smith, *Introduction to Evolutionary Computing*, Springer, Berlin 2003.

Other reading:

Mitchell, M., *An Introduction to Genetic Algorithms,* MIT Press, Boston, Mass. 2002.

Engelbrecht, A.P., *Computational Intelligence: an introduction,* John Wiley & Sons, Chichester, England 2002

Dawkins, R., *The Selfish Gene*, Oxford UP, 2nd ed., 1990

Maynard Smith, J. and E. Szathmáry, *The major transitions in evolution*. Oxford ; New York, W.H. Freeman Spektrum, 1995

For weeks 7 -13... (some introductory texts on Artificial Life)

Terzopoulos, D., (1999), Artificial Life For Computer Graphics, in *Communications of the ACM*, Vol 42, No. 8, p32-42

Levy, S.,"Artificial Life - The Quest For A New Creation" Jonathan Cape 1992

Required software and/or hardware

UNIX or UNIX-like operating system with standard gnu development tools (gcc, gdb, Make).

Equipment and consumables required or provided

Students studying off-campus are required to have the minimum system configuration specified by the Faculty as a condition of accepting admission, and regular Internet access. On-campus students, and those studying at supported study locations may use the facilities available in the computing labs. Information about computer use for students is available from the ITS Student Resource Guide in the Monash University Handbook. You will need to allocate up to **n** hours per week for use of a computer, including time for newsgroups/discussion groups.

Study resources

Study resources we will provide for your study are:

Lecture notes

Visual and Audio examples

Assignment specifications

This Unit Guide outlining the administrative information for the unit;

The unit web site on MUSO, where resources outlined above will be made available.

Assessment

Overview

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. This variability is designed to give flexibility to the lecturer to decided the most appropriate form of examination for a given choice of topics.

Faculty assessment policy

To pass a unit which includes an examination as part of the assessment a student must obtain:

- 40% or more in the unit's examination, and
- 40% or more in the unit's total non-examination assessment, and
- an overall unit mark of 50% or more.

If a student does not achieve 40% or more in the unit examination or the unit non-examination total assessment, and the total mark for the unit is greater than 50% then a mark of no greater than 49-N will be recorded for the unit.

To pass this unit, a student must obtain:

- 40% or more in the first assignment (50% weight)
- 40% or more in the programming exercises and written assignment
- an overall unit mark of 50% or more

Assignment tasks

Assignment coversheets

Assignment coversheets are available via "Student Forms" on the Faculty website:
http://www.infotech.monash.edu.au/resources/student/forms/
You MUST submit a completed coversheet with all assignments, ensuring that the plagiarism declaration section is signed.

Assignment submission and return procedures, and assessment criteria will be specified with each assignment.

Assignment submission and preparation requirements will be detailed in each assignment specification. 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.

- **Assignment task 1**

  Title:
  Programming Exercises
  Description:
  Short programming exercises on evolutionary simulation
  Weighting:
  Criteria for assessment:

Correctness; accuracy; efficency; quality of documentation; quality of results; evidence of testing; statistical analysis; coding use; inventivness of solutions.

Due date:

Weeks 3 and 5

- **Assignment task 2**

Title:

Written Essay

Description:

Write a short academic paper on a topic in evolutionary simulation and synthesis.

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?

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.

Do not rely solely on the Internet for your information. Favour books, journals and conference proceedings over web pages. At least 80% of your references should originate from sources other than the Internet.

Due date:

Week 7

- **Assignment task 3**

Title:

Procedural Modelling and Visualisation Programming Exercise

Description:

Write a software simulation and visualisation demonstrating the principles discussed during lectures. Further details will be published along with the unit materials.

Weighting:

50%

Criteria for assessment:

Due date:

Week 13

Due dates and extensions

Please make every effort to submit work by the due dates. It is your responsibility to structure your study program around assignment deadlines, family, work and other commitments. Factors such as normal work pressures, vacations, etc. are not regarded as appropriate reasons for granting extensions. Students are advised to NOT assume that granting of an extension is a matter of course.

Students requesting an extension for any assessment during semester (eg. Assignments, tests or presentations) are required to submit a Special Consideration application form (in-semester exam/assessment task), along with original copies of supporting documentation, directly to their lecturer within two working days before the assessment submission deadline. Lecturers will provide specific outcomes directly to students via email within 2 working days. The lecturer reserves the right to refuse late applications.

A copy of the email or other written communication of an extension must be attached to the assignment submission.

Refer to the Faculty Special consideration webpage or further details and to access application forms: http://www.infotech.monash.edu.au/resources/student/equity/special-consideration.html

Late assignment

For weeks 7-13:

Late assignments will incur mark penalties according to the Fibonacci sequence multiplied by a lecturer-determined scaling factor (e.g. 0.5, 1 or 100). An assignment that is one day late will receive a one mark penalty multiplied by the scaling factor. Assignments two days late will receive a 2 mark penalty, three days late, 3 marks, each multiplied by the factor. The sequence is [1],1,2,3,5,8,13,21... (times the factor). This applies for all days including public holidays and weekends so please submit your assignments punctually!

For weeks 1-6:

Assignments received after the due date will be subject to a penalty of 5% per day, including weekends. Assignments received later than one week (seven days) after the due date will not normally be accepted. In some cases, this period may be shorter if there is a need to release sample solutions.

This policy is strict because comments or guidance will be given on assignments as they are returned, and sample solutions may also be published and distributed, after assignment marking or with the returned assignment.

Return dates

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

Appendix

Please visit the following URL: http://www.infotech.monash.edu.au/units/appendix.html for further information about:

- Continuous improvement
- Unit evaluations
- Communication, participation and feedback
- Library access
- Monash University Studies Online (MUSO)
- Plagiarism, cheating and collusion
- Register of counselling about plagiarism
- Non-discriminatory language
- Students with disability
- End of semester special consideration / deferred exams