MONASH University
Information Technology

FIT5167
Natural computation for intelligent systems

Unit Guide

Semester 1, 2010

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FIT5167 Natural computation for intelligent systems - Semester 1, 2010

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Introduction

This unit is one unit in the Intelligent Systems specialisation in the MIT courses. The unit has been design to provide you with an understanding of the fundamentals of neural networks and its applications.

Unit synopsis

This unit looks at the development and application of biologically inspired models of computation. We study: basic components of a natural neural systems: synapses, dendrites and neurons and their computational models; fundamental concepts of data and signal encoding and processing; neural network architectures: pattern association networks, auto associative networks, feedforward networks, competitive networks, self organizing networks and recurrent networks; plasticity and learning. Hebb rule, supervised learning, reinforced learning, error-correcting learning, unsupervised learning, competitive learning, self-organization.

Learning outcomes

At the completion of this unit students will:

- understand basic computational principles underlying the operations of biological neural systems;
- have knowledge of computational methods of simulating biological and artificial neural systems;
- have knowledge of supervised, unsupervised and self-organising neuronal learning systems;
- be able to use computer software to simulate behaviour of neurons and neural networks.

Contact hours

2 hrs lectures/wk, 2 hrs laboratories/wk

Further unit information

Sound basic knowledge of vectors and matrices is required to study in this unit. Specialised mathematical concepts will be introduced.

Workload

two-hour lecture and two-hour tutorial (or laboratory) (requiring advance preparation)a minimum of 2-3 hours of personal study per one hour of contact time in order to satisfy the reading and assignment expectations. You will need to allocate up to 5 hours per week in some weeks, for use of a computer, including time for newsgroups/discussion groups.

Unit relationships

Prohibitions

CSE5301

Teaching and learning method

Teaching approach

The approach to teaching and learning include a weekly two-hour lecture and a two-hour (tutorial/laboratory). Additionally, each student should spend a minimum of 8 to 12 hours for personal study every week and should allocate up to 5 hours per week in some weeks for use of a computer, including time for newsgroup and discussion.

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	References/Readings	Key dates
1	01/03/10	Introduction		
2	08/03/10	Artificial Neural Networks: an Overview	Haykin Ch 1, Dreyfus Ch.1 & Bishop Ch.1	
3	15/03/10	Perceptron for Linear Pattern Classification	Samarasinghe, Ch.2 & Haykin Ch 2	
4	22/03/10	Neural Networks for Non-linear Pattern Recognition 1	Samarasinghe, Ch.3-4 & Haykin Ch 4	
5	29/03/10	Neural Networks for Non-linear Pattern Recognition 2	as above	
Mid semester break				
6	12/04/10	Data Exploration, Dimensionality Reduction and Feature Extraction	Samarasinghe, Ch.7 & Bishop Ch.10	
7	19/04/10	Uncertainty Assessment of Neural Network Models	Samarasinghe, Ch.7 & Bishop Ch.10	
8	26/04/10	Unit Test (in the lecture time slot - tute still on)		
9	03/05/10	Unsupervised Classification with Self-Organising Maps	Samarasinghe, Ch.8 & Deyfus Ch.7	
10	10/05/10	Recurrent Networks	Samarasinghe, Ch.9 & Haykin Ch 15	
11	17/05/10	Radial Basis Function Networks	Bishop Ch.5	
12	24/05/10	Hopfield Networks	Beale Ch.7 & Haykin Ch.13	Assignment due (at the start of the lecture)
13	31/05/10	Revision and Exam Preparation		

*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

This unit is offered for the first time in Semester 1 2010.

Unit Resources

Prescribed text(s) and readings

None.

Recommended text(s) and readings

- S. Samarasinghe, *Neural Networks for Applied Sciences and Engineering: From Fundamentals to Complex Pattern Recognition*, Auerbach Publications, 2007 (e-book from Monash Library)
- G. Dreyfus, *Neural Networks: Methodology and Applications*, Springer-Verlag Berlin Heidelberg, 2005 (e-book)
- R. Beale, *Neural Computing: an Introduction*, Institute of Physics Pub., Bristol, 1991 (e-book)

- S. Haykin, *Neural Networks and Learning Machines*, 3rd edition, Prentice Education , Inc., New Jersey, 2009
- C. Bishop, *Neural Networks for Pattern Recognition*, Oxford University Press, 2005
- J. Freeman and D. Skapura, *Neural Networks: Algorithms, Applications, and Programming Techniques*, Addison-Wesley, Massachussets, 1991

Required software and/or hardware

You will need access to a Neural Network tool such as:

- Matlab 2009a with Neural Network Toolbox
- Emergent (available free from http://grey.colorado.edu/emergent/index.php/Main_Page)
- SNNS (available free from www.ra.cs.uni-tuebingen.de/SNNS)

All the above softwares are available in the 24 hour labs B3.45, B3.46, B3.46b at the Caulfield Campus. Submit an online IT request to gain access to these labs at http://www1.infotech.monash.edu.au/webservices/servicedesk/requestform/

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:

- Weekly detailed lecture notes outlining the learning objectives, discussion of the content, required readings and exercises
- Weekly tutorial or laboratory tasks and exercises with sample solutions provided one to two weeks later;
- Assignment specifications.
- Other resources available in the unit website on Moodle

Assessment

Overview

Examination (3 hours): 60%; In-semester assessment: 40%

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.

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 task 1**

  Title:
  Unit Test
  Description:
  Closed book
  Weighting:
  20%
  Due date:
  Week 8 lecture
  Remarks:
  The unit test will be conducted during Week 8 lecture time slot. Week 8 tutorials will still run as per normal.

- **Assignment task 2**

  Title:
  Applications of Neural Networks Algorithms
  Description:
  Students are to build neural network models for a given data set and provide analysis thereof.
  Weighting:

20%

Due date:

25 May 2010 at 6 pm

Remarks:

The assignment is to be submitted at the start of Week 12 lecture. Penalty for late submission applies.

Examination

- **Weighting:** 60 %
  Length: 3 hours
  Type (open/closed book): Closed book

See Appendix for End of semester special consideration / deferred exams process.

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

Assignments received after the due date and time will be subject to a penalty of 10% per day. Assignments received later than one week after the due date will not normally be accepted.

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