MCT621
Artificial Intelligence
Module Handbook

IT Online programmes:
Master of Science in Software Engineering &
Database Technologies (MScSED)
Postgraduate Diploma in Software Engineering
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1 Module Details

1.1 Module Description

Artificial Intelligence (MCT621) is an introduction to some of the fundamental concepts and techniques in Artificial Intelligence (AI). The module begins by examining the concept of AI and as well highlighting some important real-world applications of AI. It then presents search strategies currently employed in AI research. This is developed further by the examination of the functional programming language Prolog. The second half of the module looks at Knowledge Representation and Machine Learning. It also deals with the topic of uncertainty in AI. Finally, the module finishes by examining future directions of AI research and associated philosophical dilemmas.

1.2 Prerequisites

MCT609 (Fundamentals of Programming) or equivalent, i.e. good working knowledge of a procedural language such as C.

1.3 Module Aims

This module will cover:

- Definitions of Artificial Intelligence
- Various search techniques, particularly the advantages and disadvantages of each
- Programming in Prolog
- Representations (e.g. demonstrate how to represent objects, actions, events and situations; discuss how to reason about knowledge; and justify the selection of appropriate representations for a given application)
- The relevance of uncertainty to AI and alternative approaches to handling uncertainty
- Machine Learning techniques appropriate for a range of different applications
- The various applications of AI, their strengths and limitations, and their position in relation to current research
- The philosophical underpinnings of AI

1.4 Required Text


1.5 Module Assignments

Details of module assignments and a sample final examination are detailed fully in the *MCT621 Facilitator Guide*. Student assessment will take the form of:

- Participation in the weekly discussion forum
- Weekly assignments
- Lab exercises
- A final exam

1.6 Module Grading

The following table shows the breakdown of marks for this module:

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight</th>
<th>Workshop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forum participation</td>
<td>20%</td>
<td>1 to 8</td>
</tr>
<tr>
<td>Labs</td>
<td>0%</td>
<td>3, 4, 5</td>
</tr>
<tr>
<td>Weekly assignments</td>
<td>50%</td>
<td>1 to 7</td>
</tr>
<tr>
<td>Final exam</td>
<td>30%</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
</tr>
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## 2 Module Outline

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1: Introduction</td>
<td>Introducing Artificial Intelligence</td>
</tr>
<tr>
<td></td>
<td>Propositional Logic and Predicate Calculus</td>
</tr>
<tr>
<td>2: Search Strategies</td>
<td>Introduction to AI Search Techniques</td>
</tr>
<tr>
<td>3: Introduction to Prolog</td>
<td>Introducing Prolog</td>
</tr>
<tr>
<td></td>
<td>Prolog: Recursion and Lists</td>
</tr>
<tr>
<td>4: Knowledge Representation</td>
<td>Introduction to Knowledge Representation</td>
</tr>
<tr>
<td></td>
<td>Ontologies and categories</td>
</tr>
<tr>
<td></td>
<td>Situation &amp; event calculus</td>
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<tr>
<td></td>
<td>Semantic networks</td>
</tr>
<tr>
<td>5: Machine Learning Week 1</td>
<td>Introduction to Machine Learning</td>
</tr>
<tr>
<td>6: Machine Learning Week 2</td>
<td>Artificial Neural Networks</td>
</tr>
<tr>
<td></td>
<td>Reinforcement Learning</td>
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<tr>
<td>7: Uncertainty in AI</td>
<td>Uncertainty in AI</td>
</tr>
<tr>
<td></td>
<td>Reasoning with Probabilities</td>
</tr>
<tr>
<td>8: Philosophy of AI</td>
<td>Philosophy of AI</td>
</tr>
<tr>
<td></td>
<td>Artificial Intelligence Review</td>
</tr>
</tbody>
</table>
3 Module Syllabus

3.1 Workshop One (Introduction)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:

- Describe the various definitions of AI
- Outline the history of AI
- Identify the broad range of AI applications
- Construct propositional statements using connectives
- Analyse the truth value of propositional statements using truth tables
- Explain the motivation for the use of Predicate Calculus
- Construct sentences in predicate calculus using universal and existential quantifiers

3.2 Workshop Two (Search Strategies)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:

- Distinguish between AI search and conventional search.
- Explain the characteristics of uninformed search.
- Analyse breadth-first search, depth-first search and iterative deepening search.
- Explain the characteristics of informed search.
- Demonstrate how a heuristic can be used to reduce the search space.
- Devise heuristics for problems.
- Explain the operation of a Hill Climbing Search Algorithm.
- Describe the operation of Genetic Algorithms.

3.3 Workshop Three (Introduction to Prolog)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:

- Define the terms: fact, rule, goal and question
- Construct simple Prolog programs
• Define the closed-world assumption and understand its implication for Prolog
• Describe how Prolog programs are executed
• Demonstrate the use of recursion in Prolog
• Utilise lists in a Prolog program.
• Construct a search algorithm using Prolog

3.4 Workshop Four (Knowledge Representation)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:
• Utilise an ontology to represent knowledge.
• Describe the concept of a category.
• Describe the basic categories of objects, substances and measures.
• Describe situation calculus and demonstrate its use.
• Explain what event calculus is and demonstrate its use.
• Explain the concept of semantic networks and demonstrate their use.
• Define the concepts of truth maintenance and belief revision and demonstrate approaches to truth maintenance.

3.5 Workshop Five (Machine Learning - week 1)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:
• Describe the concept of Machine Learning
• Distinguish between different categories of machine learning algorithms
• Describe in detail an algorithm for decision tree induction
• Evaluate basic performance of machine learning algorithms
• Describe Instance Based Learning
• Describe the operation of Nearest Neighbour classifier and illustrate its operation on sample data sets
3.6 Workshop Six (Machine Learning - week 2)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:
- Describe the concept of an Artificial Neural Network.
- Demonstrate the operation of a neuron for both hard and soft thresholding.
- Demonstrate how to train a neural network using the Back-Propagation Algorithm
- Explore the concept of a Markov Property, Markov Chain and Markov Decision Process
- Apply the Bellman Equation and Value Iteration
- Demonstrate the operation of an Active and Passive Reinforcement Learning Algorithm.

3.7 Workshop Seven (Uncertainty in AI)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:
- Describe the sources of uncertainty
- Describe the area of probability and the typical notation used
- Demonstrate how to solve basic probability problems by applying probability formulae
- Describe Bayes’ Rule and apply it to solve appropriate probability problems
- The operation of Naïve Bayes Classifier and apply it to classification problems
- Describe the concept of Bayesian Networks as a means of representing probabilistic relationships

3.8 Workshop Eight (Philosophy of AI)

Learning Outcomes
Upon completion of this workshop, students are expected to be able to:
- Differentiate between the Weak AI Hypothesis and Strong AI Hypothesis
- Distinguish between functionalism and biological naturalism
- Discuss the ethical concerns associated with AI
- Outline the content that has been covered over the last seven weeks
- Summarise the keys points from each of the workshops