Abertay University

School of Design and Informatics

Session 2023/24

MAT501: Applied Mathematics & Artificial Intelligence

Module Tutor: Dr. Kean Lee Kang

Unit 1 of Module Assessment – 100%

Learning Outcomes Assessed by this Assessment:

LO1: Comprehend the underpinning mathematics of the AI techniques e.g. simple mathematical models of reinforcement, supervised and unsupervised learning machines.

LO2: Develop a critical understanding of AI techniques and technologies.

LO3: Evaluate the use of AI technologies and techniques in a computer game.

Date of Issue: 2nd October 2023

Submission Date: Tuesday 19th December 2023 (last submission 12 noon)

Grade Release and Feedback date: 16th January 2024

Assessment Overview

During this module you will be investigating various intelligent systems, techniques and algorithms that can be used to support various processes in Computing. For this assessment you can either choose **two different non-learning** Artificial Intelligence (AI) techniques and compare them (Rule Based Systems, Finite State Machines, Fuzzy Logic, Tree Searches, etc.), or look in depth at a **single learning** technique (Genetic Algorithms, Reinforcement Learning, Machine Learning, etc.).

The assessment is divided into two main artefacts, an application allowing you to develop and demonstrate your chosen technique(s), and a report describing the design process and implementation of said technique(s). An understanding of the AI's mathematics will also need to be demonstrated in the report, through critical analysis of the mathematical models of the algorithms and/or explanation of the calculations undertaken by the algorithm.

The Application

You should develop an application and use it to compare and contrast two different AI systems or look a single AI technique in depth. You should consider which domain would be most appropriate to test the AI algorithms that you have chosen. But, remember, whatever application you choose you will have to have enough data to enable you to create a reasonably sophisticated AI system. You may develop this application in any language and on any platform you wish but you must submit a standalone executable that can run on a Windows 10 system.

Some Ideas

You have a completely free choice as to what your AI system will do, but here are some possible ideas to get you started.

- You could use an AI that makes a racing car follow the racing line.
- You could have a decision making system to create believable interactions with game characters.
- You could try a planning system to create strategies in a Real Time Strategy (RTS) game.
- You could try using AI techniques to automatically generate game content.
- You could use evolutionary (or other) algorithms to 'evolve' opponents in games in order to balance the challenge of the game to the skills of the player (Dynamic Difficulty Adjustment (DDA)).
- You could use Affective Computing techniques to detect emotions in the player, which will change the game play.

- You could use emotional modelling to create ‘realistic’ behaviours in the NPCs.
- You could think of a specific issue that you have come across in games and come up with an AI solution.

You are free to apply any AI technique to any problem you wish. It is recommended that your check your idea with a member of teaching staff before proceeding with the coursework. Time will be allocated for this during the semester.

The Report

Your report should describe fully the design process for the application, giving specific details of the AI techniques implemented. You should give some general background to AI and its uses in the domain which you have chosen and you should give full rationale for your choice of AI techniques. I.e. why you chose them and why they are suited for your particular application. If comparing two techniques, the report should include the properly tabulated results of testing the two approaches using graphs or other illustrations to make them clear, and explain what differences there were between them. If focusing on a single AI technique, testing should focus on performance of the algorithm, using graphs and other illustrations to explain how effective the approach is. You should also compare the techniques in terms of computational efficiency and ease of coding.

Grading the Assessment

The report (70% weighting)

Should be well written and structured in a style suitable for a technical report (Introduction and literature review, methodology, results and conclusions with appropriate headings etc. and references). Any references used should be appropriately cited. There should be a full set of test data and results as well as suitable conclusions drawn and discussion on the advantages and disadvantages of each AI technique.

The application (30% weighting)

The application should be coded efficiently and properly documented. You will need to create a video, no more than 10 minutes long, demonstrating the application with an appropriate commentary detailing how you created the methods and how the application compares them.

Submission

You must submit your written report and video separately, along with all application files in a ZIP file, using the link provided on the MAT501 module page in MyLearning Space.

All submissions must be uploaded to the appropriate location within the MyLearningSpace system. The deadline for submissions is 12 noon and the system is likely to be busy at that time. **For this reason you are advised to leave plenty of time (at least an hour) to successfully complete the upload process.**

MAT501 – Coursework Grading Criteria

	Introduction and Literature Review (10%)	**Methodology (10%)**	**Results (10%)**	**Conclusions (10%)**	**References (5%)**	**Structure and Style (5%)**	**Mathematics (20%)**	**Application (30%)**
A	Excellent introduction which gives an appropriate overview of the project and outline of the solutions in the literature for the specific project problem.	Excellent description of the methods used including a complete explanation and rationale for the two techniques chosen.	Excellent results, clearly tabulated and relevant.	Excellent conclusions with a full analysis and summary of the project.	A good number of excellent references properly cited in Abertay Harvard style.	Excellent structure in a good, readable style with excellent spelling and grammar.	Excellent explanation of the mathematical formulae used in the AI and an excellent implementation of the AI algorithm in the application.	Excellent application which clearly shows how the programme is operating, efficiently coded with excellent documentation.
B	Very good introduction which gives an almost perfect overview of the project and outline of the solutions in the literature for the specific project problem.	Very good description of the methods used including a mostly complete explanation and rationale for the two techniques chosen.	Very good results, very well tabulated and mostly relevant.	Very good conclusions with a very good analysis and summary of the project.	A number of very good references mostly properly cited in Abertay Harvard style.	Very good structure in a readable style with very good spelling and grammar.	Very good explanation of the mathematical formulae used in the AI and a very good implementation of the AI algorithm in the application.	Very good application which clearly shows how the programme is operating, mostly efficiently coded with very good documentation.

C	A good introduction which gives a more than adequate overview of the project and outline of the solutions in the literature for the specific project problem.	A good description of the methods used including an explanation and rationale for the two techniques chosen with some omissions.	Good results, reasonably well tabulated and relevant.	Good conclusions with a good analysis and summary of the project.	A reasonable number of good references mostly cited in Abertay Harvard style.	Good structure in a fairly readable style with good spelling and grammar.	Good explanation of the mathematical formulae used in the AI and a good implementation of the AI algorithm in the application.	Good application which mostly shows how the programme is operating, well coded with good documentation.
D	A brief introduction which gives an adequate overview of the project and outline of the solutions in the literature for the specific project problem.	An adequate description of some of the methods used including an incomplete explanation and rationale for the two techniques chosen..	Adequate results, with some tabulation and relevance.	Adequate conclusions with an adequate analysis and summary of the project.	A few adequate references properly cited in Abertay Harvard style.	Adequate structure in a just readable style with passable spelling and grammar.	Adequate explanation of the mathematical formulae used in the AI and an adequate implementation of the AI algorithm in the application.	Adequate application which just shows how the programme is operating, adequately coded with some documentation.
MF	A very brief introduction which just fails to give an adequate overview of the project and outline of the solutions in the literature for the specific project problem.	A not quite adequate description of the methods used with an incomplete explanation and rationale the two techniques chosen with many omissions.	A few results, with little tabulation and relevance.	Inadequate conclusions with inadequate analysis and summary of the project.	Some references inadequately cited.	Some structure, readable in places with inadequate standards of spelling and grammar.	Inadequate explanation of the mathematical formulae used in the AI and a weak implementation of the AI algorithm in the application.	Inadequate application which does not show how the programme is operating clearly enough, inadequately coded with insufficient documentation.

F	Too brief and completely fails to give a sufficient overview of the project and outline of the solutions in the literature for the specific project problem.	Totally inadequate description of the methods used with very little explanation and rationale for the two techniques chosen..	Inadequate results, not properly tabulated and barely relevant.	Scant conclusions with barely any analysis or summary of the project.	Barely any references cited, or poorly cited.	Poorly structured, not easy read with poor spelling and grammar.	Very poor explanation of the mathematical formulae used in the AI and a very weak implementation of the AI algorithm in the application.	Very poor application which barely shows how the programme is operating, poorly coded with little documentation.

Please note that the percentage weightings for each criterion are approximate.

Marking scheme

Literal Grade	Grade Point	Evaluative Descriptor
A+	4.5	Excellent overall. Demonstrates an excellent grasp of the subject matter. Excellent capacity for original and creative enquiry. Excellent ability to critically evaluate, analyse, synthesise and integrate complex information. Excellent communication skills. In addition, exceptional in at least one of the above.
A	4	Excellent overall. Demonstrates an excellent grasp of the subject matter. Excellent capacity for original and creative enquiry. Excellent ability to critically evaluate, analyse, synthesise and integrate complex information. Excellent communication skills.
B+	3.5	Very good overall. Demonstrates a very good grasp of the subject matter. Very good capacity for original and creative enquiry. Very good ability to critically evaluate, analyse, synthesise and integrate complex information. Very good communication skills. In addition, excellent in at least one of the above but overall performance deemed to be very good.
B	3	Very good overall. Demonstrates a very good grasp of the subject matter. Very good capacity for original and creative enquiry. Very good ability to critically evaluate, analyse, synthesise and integrate complex information. Very good communication skills.
C+	2.5	Good overall. Demonstrates a good grasp of the subject matter. Good capacity for original and creative enquiry.

		Good ability to critically evaluate, analyse, synthesise and integrate complex information. Good communication skills In addition, very good in at least one of the above but overall performance deemed to be good.
C	2	Good overall. Demonstrates a good grasp of the subject matter. Good capacity for original and creative enquiry. Good ability to critically evaluate, analyse, synthesise and integrate complex information. Good communication skills
D+	1.5	Satisfactory overall. Demonstrates a satisfactory grasp of the subject matter but limited grasp in some areas Satisfactory capacity for original and creative enquiry. Satisfactory ability to critically evaluate, analyse, synthesise and integrate information. Satisfactory communication skills.
D	1	Adequate. Achievement of all threshold standards but grasp of some subject areas and graduate attribute development may be more limited.
MF	0.5	Marginal fail. Performance just below the threshold standard. A reasonable expectation that a pass is achievable by reassessment without the need to repeat the module.
F	0.0	Fail. Performance well below the threshold level. Some limited evidence of achievement of the outcomes.
NS		NS No assessments submitted.