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**Department of Computer & Information Sciences**

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| **ASSESSMENT BRIEF - Report** | |
| **Module Title:** | **Artificial Intelligence and Robotics** |
| **Module Code:** | KF6007 |
| **Academic Year / Semester:** | 2023-24 / Semester 2 |
| **Module Tutor / Email (all queries):** | Alan Godfrey  alan.godfrey@northumbria.ac.uk |
| **% Weighting (to overall module):** | 40% |
| **Assessment Title:** | An Intelligent Interactive System |
| **Date of Handout to Students:** | Week 1, week beginning 29th January 2024 |
| **Mechanism for Handout:** | Module Blackboard Site |
| **Deadline for Attempt Submission by Students:** | Wednesday 15th May 2024 12:00 (noon) GMT |
| **Mechanism for Submission:** | Document upload to Module Blackboard Site |
| **Submission Format / Word Count** | Document upload to Module Blackboard Site  (2000-word report ±10%) |
| **Date by which Work, Feedback and Marks will be returned:** | 31st May 2024 |
| **Mechanism for return of Feedback and Marks:** | The mark and individual written feedback sheet will be uploaded to the Module Site on Blackboard. |

**LEARNING OUTCOMES**

The learning outcomes (LOs) for this module are:-

**LO1**. Demonstrate knowledge and understanding of artificial intelligence techniques and robotics applications and identify state-of-the-art developments in the field.

**LO2**. Appraise machine learning and robotics applications and intelligent processes using appropriate methods.  
**LO3**. Design and implement advanced artificial intelligence, robotics, and machine learning applications.

**LO4**. Evaluate the effectiveness of implemented artificial intelligence applications, including using student developed methodologies where appropriate.   
**LO5**. Practise research skills in the construction of project reports and presentation of the products.

**This assessment addresses leaning outcomes:** LO1, LO2, LO3, LO4, and LO5

**Total assignment brief**

The module will be assessed by a product (60%) and a report (40%).

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| Part 1 | Product | 60 marks |
| Part 2 | Report | 40 marks |
| Total |  | 100 marks |

**Additional Instructions to students:**

This is an individual assignment and must be your own unaided work.

**Referencing Style:**

Either Harvard or British Standard as long as the reference style is consistent.

**Expected size of the submission:**

2000-word report + appropriate software

**Academic Integrity Statement:** You must adhere to the university regulations on academic conduct. Formal inquiry proceedings will be instigated if there is any suspicion of plagiarism or any other form of misconduct in your work. Refer to the University’s Assessment Regulations for Northumbria Awards if you are unclear as to the meaning of these terms. The latest copy is available on the University website.

**Failure to submit:** Note that failure to submit work or submission of work after the required deadline without an authorised late approval will result in a record of incomplete (IC) for the assessment component. Referral in that component will then be required even when the module is passed overall.

# 1. General description

You are required to develop an interactive intelligent system in an application domain of your choice. You have learned several approaches for decision making that can be used in robotics, computer vision, games, and general Artificial Intelligence (AI) applications. For this assessment, you will be required to practise your skills in AI, robotics, and affective computing by producing a product that will include the following:

**1.1 An interactive user interface:**

* You are required to develop an interactive user interface. You may use any GUI development environment as the basic platform for your work e.g., PyQt5, TKinter or gaming engines such as Unity or Slick2D. If you have problems developing a sophisticated GUI, then a text or console-based user interface is also acceptable as long as you justify the development decisions made and it follows good UI design principles.

**1.2 A core AI component**

* To provide at least one AI agent that it is capable of learning from an environment and making decisions.
* To develop an autonomous agent behaviour that augments the decision making of other agents or a human user (e.g. in e-learning or healthcare applications), or in the case of a gaming an agent that opposes a human player effectively.

**1.3 Suggested extra AI features that may enhance your development**

* Employ two machine learning approaches for decision-making. The chosen approaches should be able to effectively cooperate with each other to make decisions.
* Implement a complex rule-based inference or other probability-based decision-making component for robotics, affective computing, vision, bioinformatics or game applications.
* Provide an advanced speech or gesture-based interaction.

**1.4 Approaches to choose from for your implementation:**

* Rule-based Inference using expert systems,
* Fuzzy logic,
* Reinforcement Learning,
* Decision tree learning,
* Naive Bayes classifier,
* Neural networks (ANN’s, CNN’s).

From the list you should choose at least one machine learning method combined with an AI decision making method. Note: If you develop a basic rule-based expert system with a basic decision-making AI component, this will be considered a basic product and you should expect a passing mark (Please see the marking criteria in section 3).

**2. Assessment allocation**

Report (40%): The individual written report product should be of sound academic quality. To ensure a well written report please attend the workshop at the beginning of the semester, start detailing it soon after and constantly refine throughout the semester. Ensure you liaise with the teaching staff to ask questions about content, structure and overall narrative. The report should mainly be suitably referenced with sound academic references (use of a referencing manager like EndNote is recommended). It is important you critically evaluate your own report throughout the semester prior to submission.

**3. Marking criteria**

**3.1 The individual report (40%)**

The individual report will be marked based on the following components:

* 1. **A brief introduction and literature review of related existing studies (15%)**

The Introduction section should include a brief background of the problem, an introduction of the proposed system and any key AI methods adopted, as well as an overview the rest of the report. The literature review section should include a comprehensive review of AI techniques and existing studies in the chosen research area. Strengths and limitations of existing studies/techniques should be addressed.

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| **Marks** | **Description of quality** |
| 14-15 | Very well written - critically discussed to a high standard and shows insight. Comprehensive review and in-depth analysis of existing studies. Strong supporting evidence. Exceptional overall. Difficult to fault. |
| 12-13 | Very well written - critically discussed to a high standard and shows insight. Comprehensive review and in-depth analysis of existing studies. Strong supporting evidence. Any criticisms / areas for improvement are very minor. Outstanding overall. |
| 10-11 | Very well written - critically discussed to a high standard and shows insight. Comprehensive review and in-depth analysis of existing studies. Strong supporting evidence. Any criticisms / areas for improvement are minor. Excellent overall. |
| 9 | Well written, all elements considered and largely critical in tone but lacking insight. Substantial review of existing studies. Claims evidenced well. A good to very good review of existing studies. |
| 8 | Slightly lacking critical discussion and/or is not well written or presented. Review of existing studies lacks both consideration and evidence. A satisfactory review of existing studies. |
| 7 | Poorly written - lacking critical discussion, not entirely descriptive. Limited understanding or review of existing studies, missing some elements with poor evidence. A weak but satisfactory review of existing studies. |
| 5-6 | Poorly written, descriptive, many elements missed, weak or absent evidence. Lacking in review of existing studies. Overall unsatisfactory. |
| 1-4 | A very limited attempt, lacking thought and/or relevant research and or evidence. May be very descriptive. Very lacking in review of existing studies. Very poor. |
| 0 | Not meaningfully addressed. A minimal attempt or the task has been seriously misunderstood. |

* 1. **Novel AI techniques and approaches of the work developed (15%)**

This section should address any advantages or any novel aspects of the proposed work against the existing studies. This may include the adoption of existing methods for solving new problems in a new application domain, the proposal of any new decision-making models, the combination of a variety of techniques to address a challenging problem, the employment of unstructured large-scale data sets, as well as the deployment of AI methods to smartphones, IoT devices or robotic platforms. The discussion in this section can be flexible in accordance with different application scenarios.

* 1. **Three product development stages** 
     1. **Methodology (15%),**
     2. **Design (15%) and**
     3. **Implementation (15%).**

The methodology section should include a more comprehensive introduction of the proposed work and each decision-making component. The theoretical introduction of the selected AI methods and/or their adaptation to the problem domains should also be provided. Any proposed algorithms should be well discussed.

The design section needs to address the background and rationale for your design choice. This may include the design choice of user interface, selected AI methods, programming tools/platforms, as well as preparation of the adopted data sets. UML modelling and system architectures can be taken into account to assist the design process.

The implementation section should discuss the implementation details of the system interface and each key function or AI method. Pseudo-codes of the proposed decision-making components or the selected AI methods should be included. Example system outputs and screenshots, model structures and hyper-parameters as well as experimental settings (e.g., the numbers of training steps and epochs) should be introduced if applicable. The implementation section should provide sufficient details for others to repeat your experiments.

Both items 2-3 follow the following marking criteria.

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| **Marks** | **Description of quality** |
| 14-15 | Very well written - critically discussed to a high standard and shows insight. Comprehensive discussion on techniques and AI methods developed. Claims well supported by evidence from the project and the wider literature. Overall exceptional. Difficult to fault. |
| 12-13 | Very well written - critically discussed to a high standard and shows insight. Comprehensive discussion on techniques and AI methods developed. Claims well supported by evidence from the project and the wider literature. Overall outstanding. Any criticisms or areas for improvement are very minor. |
| 10-11 | Very well written - critically discussed to a high standard and shows insight. Comprehensive discussion on techniques and AI methods developed. Claims well supported by evidence from the project and the wider literature. Excellent overall. Any criticisms or areas for improvement are minor. |
| 9 | Well written, all elements considered and largely critical in tone but lacking insight. Substantial discussion of techniques and AI methods developed. Evidenced appropriately from the project and wider literature. There may be issues with the quality of some of the supplied supporting evidence. Overall good to very good. |
| 8 | Slightly lacking critical discussion and/or has limitation in how it is written or presented. Discussions of techniques and AI methods developed is lacking in consideration and tendency to be descriptive. May not make as much use of evidence. Overall satisfactory. |
| 7 | Poorly written - lacking critical discussion, not entirely descriptive. Limited discussion of techniques and AI methods developed. Overall poor but satisfactory. |
| 5-6 | Poorly written, descriptive, many elements missed. Little discussion of techniques and AI methods developed, weak evidence provided. Not satisfactory. |
| 1-4 | A very limited attempt, lacking thought and/or relevant research and or evidence. May be very descriptive. Very lacking in discussion of techniques and AI methods developed. Very poor. |
| 0 | Not meaningfully addressed. A minimal attempt or the task has been seriously misunderstood. |

* 1. Critical evaluation (15%)

The critical evaluation section should discuss a variety of evaluation strategies (e.g. black-box and white-box testing, unit and integration testing and any other evaluation strategies) adopted for the evaluation of the proposed work. The training and testing data sets, and system performance such as accuracy or error rates should be reported if applicable. Strengths and limitations of the delivered product and chosen AI methods should be identified. Future directions should be acknowledged.

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| **Marks** | **Description of quality** |
| 14-15 | Very well written - critically evaluates to a high standard and shows insight. Comprehensive reflection on tools and AI techniques used. Claims well supported by evidence from the project and the wider literature. Overall exceptional. Difficult to fault. |
| 12-13 | Very well written - critically evaluates to a high standard and shows insight. Comprehensive reflection on tools and AI techniques used. Claims well supported by evidence from the project and the wider literature. Overall outstanding. Any criticisms or areas for improvement are very minor. |
| 10-11 | Very well written - critically evaluates to a high standard and shows insight. Comprehensive reflection on tools and AI techniques used. Claims well supported by evidence from the project and the wider literature. Excellent overall. Any criticisms or areas for improvement are minor. |
| 9 | Well written, all elements considered and largely critical in tone but lacking insight. Substantial review of AI techniques and/or tools used. Evidenced appropriately from the project and wider literature. There may be issues with the quality of some of the supplied supporting evidence. Overall good to very good. |
| 8 | Slightly lacking critical evaluation and/or has limitation in how it is written or presented. Reflection of AI techniques and/or tools used is lacking in consideration and tendency to be descriptive. May not make as much use of evidence. Overall satisfactory. |
| 7 | Poorly written - lacking critical evaluation, not entirely descriptive. Weak reflection regarding tools and AI techniques used. Overall poor but satisfactory. |
| 5-6 | Poorly written, descriptive, many elements missed. Little reflection, weak evidence provided. Not satisfactory. |
| 1-4 | A very limited attempt, lacking thought and/or relevant research and or evidence. May be very descriptive. Very lacking in evaluation. Very poor. |
| 0 | Not meaningfully addressed. A minimal attempt or the task has been seriously misunderstood. |

* 1. The overall presentation of the work (10%)

The report should be thoroughly proof-read to avoid any spelling and grammatical errors. The proposed work should be clearly presented. Each decision-making component should be discussed precisely. The overall report should be consistent with the coding provided for the product.

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| **Marks** | **Description of quality** |
| 9-10 | Exceptional discussion of all aspects. Very well written - critically discusses the techniques and AI methods used, evaluates to a high standard and shows insight. Claims well supported by evidence from the project and the wider literature. Overall exceptional. Difficult to fault. |
| 8 | Exceptional discussion of all aspects. Very well written - critically discusses the techniques and AI methods used, evaluates to a high standard and shows insight. Claims well supported by evidence from the project and the wider literature. Overall outstanding. Any criticisms or areas for improvement are very minor. |
| 7 | Exceptional discussion of all aspects. Very well written - critically discusses the techniques and AI methods used, evaluates to a high standard and shows insight. Claims well supported by evidence from the project and the wider literature. Overall excellent. Any criticisms or areas for improvement are minor. |
| 6 | Well written and largely critical discussion of the related existing studies, AI techniques developed and evaluation conducted but lacking insight. Evidenced appropriately from the project and wider literature. There may be issues with the quality of some of the supplied supporting evidence. Overall good to very good. There are areas of improvement that prevent the answer from being excellent. |
| 5 | Slightly lacking in technical details, critical evaluation and/or has limitation in how it is written or presented. Reflection of issue involved is lacking in consideration and tendency to be descriptive. May not make as much use of evidence. Overall satisfactory. |
| 4 | Poorly written - lacking critical discussion on many key aspects. Some evidence provided but not entirely descriptive. Overall poor but satisfactory (just) |
| 3 | Poorly written, descriptive, many elements missed. Little reflection. Weak evidence provided. Not satisfactory. |
| 1-2 | A very limited attempt, lacking thought and/or evidence. May be very descriptive. Very lacking in all key elements. Very poor. |
| 0 | Not meaningfully addressed. A minimal attempt or the task has been seriously misunderstood. |