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Calculators may be used in this examination provided they are not capable of being used to store alphabetical information other than hexadecimal numbers

UNIVERSITY OF BIRMINGHAM

School of Computer Science

Third Year Undergraduate

06-37809

LH Intelligent Interactive Systems

Main Summer Examinations 2025

Time allowed: 2 hours

[Answer all questions]

Turn Over

Note

Answer ALL questions.

Question 1

(a) Consider a chatbot designed for providing advice on the relative benefits and risks of medical treatment. How might Prospect Theory be used to shape the behaviour of the chatbot. In your answer introduce and define the following terms: loss aversion and reference dependence. Illustrate your answer with specific examples of how the chatbot could influence user decisions based on the framing of its advice. Please ensure that you provide an example of both a positively framed message and a negatively framed message. **[10 marks]**

(b) Most chatbots now make use of a Large Language Model (LLM) in order to generate appropriate responses. Discuss briefly the issues of bias in the context of training the LLM and what methods could be used to mitigate any possible risks. **[5 marks]**

(c) How can risk aversion, as described in prospect theory, be leveraged in chatbot design to influence user decision-making? **[5 marks]**

(d) Discuss the ethical implications of using Prospect Theory-based framing in medical AI chatbots. Should chatbots be designed to nudge users toward certain medical decisions, or should they remain strictly neutral? Justify your answer. **[10 marks]**

Question 2

(a) Consider an AI system which is used to pre-filter job applications prior to short listing for (human) interview. In order to mitigate potential issues of fairness and bias, the developer proposes to provide mechanisms for transparency and explainabiity. Comment on whether this is sufficient to address potential concerns. As part of your answer, distinguish the concepts of fairness and bias, transparency and explainabiity. **[10 marks]**

(b) Consider a Computer Vision system developed for the purpose of public safety, specifically for identifying individuals engaging in criminal activity in real-time through surveillance cameras across a city. This system uses advanced facial recognition technologies and machine learning algorithms to analyse video feeds and alert authorities to potential crimes in progress. Critically analyze the ethical implications of deploying such a Computer Vision system for public safety. **[10 marks]**

(c) In an era where computer vision can infer sensitive attributes like emotions, health conditions, or even political affiliations from images, discuss how should policymakers regulate its use to prevent discrimination and mass surveillance while still enabling innovation? **[10 marks]**

Question 3

(a) Give the Bellman equation and explain the meaning of each term in the equation. Briefly describe how it is used. **[5 marks]**

(b) Consider an e-learning platform that aims to personalize the learning experience for its users. The platform wants to implement a Reinforcement Learning (RL) agent to adaptively select and recommend learning materials (videos, articles, exercises) based on each learner's progress, preferences, and engagement levels. The goal of the RL agent is to maximize the learner's understanding and retention of the taught material. Describe a reinforcement learning model for this e-learning platform. Describe how you would evaluate the system and further optimise performance as part of your answer.

[10 marks]

(c) Reflect on the ethical implications of using Reinforcement Learning in e-learning. Discuss concerns related to data privacy, learner autonomy, and potential biases in learning recommendations. How can the system be designed to respect ethical principles and promote equitable learning opportunities?

[10 marks]

(d) AI-powered personalized learning systems are increasingly used in education to improve student performance by analyzing learning behaviors, predicting difficulties, and adapting content accordingly. However, these systems raise ethical concerns related to privacy, bias, and fairness.

Critically analyze the ethical implications of using AI in personalized learning. In your response, discuss:

- The privacy risks associated with collecting and analyzing student data.
- How algorithmic bias might affect students' learning opportunities.
- Whether AI-based personalization could reinforce or reduce educational inequalities.
- The balance between student autonomy and institutional control over AI-driven recommendations.
- Possible solutions or guidelines to ensure AI is used responsibly in education.

Your response should demonstrate clear argumentation, ethical reasoning, and real-world examples where applicable.

[15 marks]

Do not complete the attendance slip, fill in the front of the answer book or turn over the question paper until you are told to do so

Important Reminders

- Coats/outwear should be placed in the designated area.
- Unauthorised materials (e.g. notes or Tippex) must be placed in the designated area.
- Check that you do not have any unauthorised materials with you (e.g. in your pockets, pencil case).
- Mobile phones and smart watches **must** be switched off and placed in the designated area or under your desk. They must not be left on your person or in your pockets.
- You are not permitted to use a mobile phone as a clock. If you have difficulty seeing a clock, please alert an Invigilator.
- You are not permitted to have writing on your hand, arm or other body part.
- Check that you do not have writing on your hand, arm or other body part – if you do, you must inform an Invigilator immediately
- Alert an Invigilator immediately if you find any unauthorised item upon you during the examination.

Any students found with non-permitted items upon their person during the examination, or who fail to comply with Examination rules may be subject to Student Conduct procedures.