

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

Intelligent Interactive Systems

Main Summer Examinations 2024

Time allowed: 2 hours

[Answer all questions]

Note

Answer ALL questions. Each question will be marked out of 20. The paper will be marked out of 60, which will be rescaled to a mark out of 100.

Question 1

- (a) Consider an AI chatbot which provides medical advice on a particular disease. The probability that a person has the disease is 1%. If a person has the disease then the standard test for detecting the disease is correct 80% of the time. If a person does not have the disease, then the probability that they nevertheless test positive is 9% (false-positive rate). A patient tests positive and seeks advice from the chatbot. Briefly discuss what advice the chatbot should give and justify your answer.

[10 marks]

- (b) Now consider a chatbot designed for financial advising, where users are presented with choices about investments with varying levels of risk and potential returns. 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.

[10 marks]

Question 2

- (a) What is the Bellman equation? Explain the meaning of each term in the equation.

[5 marks]

- (b) Discuss the challenges one might face while implementing Q-learning in a chatbot designed for handling customer service for an online retailer. Consider aspects such as state space size, defining rewards, and ensuring the chatbot can handle a wide range of customer interactions effectively. How can these challenges impact the learning process and the quality of the chatbot's responses?

[10 marks]

- (c) Consider the issues regarding chatbots handling user data to ensure privacy? What ethical considerations should be taken into account when storing and processing user interactions?

[5 marks]

Question 3

- (a) Consider an autonomous robot which is used to deliver cooked food in a busy city. The robot has to navigate and interact with other road users – for example, in knowing when to give way to or proceed when encountering a pedestrian. Provide a game theoretic analysis of what should be the appropriate policy of the robot. As part of your answer, provide a payoff matrix and comment briefly on whether your game theoretic analysis adequately captures the relevant issues. **[10 marks]**
- (b) Consider a Movie Recommender System which uses Latent Dirichlet Allocation (LDA). What is meant by calling LDA a generative method? Explain how LDA can be applied to analyze the movie descriptions and reviews to discover latent topics. As part of your answer, describe how the topics discovered by LDA could be used to generate personalized movie recommendations for users. **[10 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.