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 80, which will be rescaled to a mark out of 100. We have given you FOUR questions. The real exam will have just THREE questions.

Question 1

Social housing is the provision of rental housing provided by local government (or non-profit organisations) to families who may struggle to afford rents available from the private market. A social housing company wishes to use AI to improve its service provision and ensure costs are kept as low as possible.

(a) Consider the use of a Large Language Model chatbot for dealing with customer queries and complaints. Propose a possible application for the chatbot for social housing. Discuss briefly if there are any risks in terms of bias. If any risks are identified – what steps could be taken to mitigate these?

[10 marks]

(b) Consider the use of Computer Vision to monitor the occupancy of the houses and thereby control energy usage. Discuss whether this is a good idea. What risks are there? For any risk – discuss whether there is a mitigation.

[10 marks]

Question 2

In the popular game called Rock, Paper, Scissors, each of the two players' objectives is to choose the option, out of rock, paper, and scissors, that beats his opponent's option, rock beating scissors, paper beating rock, and scissors beating paper.

(a) Draw a payoff matrix for playing Rock, Paper, Scissors. Identify any Nash equilibria which exist. If no Nash equilibria exists, briefly explain why not.

[5 marks]

Imagine a scenario where a cooperative AI, in the form of a chatbot, is designed to assist users in making investment decisions. The chatbot's algorithm integrates Prospect Theory to better predict and influence user decisions under uncertainty.

(b) Describe how the chatbot might utilize Prospect Theory to influence users' investment choices. Provide an example of how it could frame investment options to either minimize loss aversion or exploit it to guide users towards more rational long-term investment strategies. As part of your answer describe what is meant by loss aversion.

[10 marks]

(c) Evaluate the ethical considerations of implementing Prospect Theory within the AI's decision-making framework. Discuss the potential benefits and risks associated with this approach, especially in terms of user autonomy and decision-making quality. **[5 marks]**

Question 3

You are a part of a big social media company, and your task is to detect cyberbullying messages based on the text they contain. You have access to a large number of messages, which have been manually labelled as "OK" and "bullying".

(a) How can you apply a CNN classifier to the task and evaluate it? Describe the approach, including how you would estimate the model parameters. **[5 marks]**

(b) You decide to use precision and recall instead of accuracy as the evaluation metric for this task. Why does this decision make sense, and how are the metrics calculated? **[5 marks]**

(c) The company decided to hire more human annotators to re-label your training data. Why might this be a good idea, and do you think this would improve your classifier in any way? **[5 marks]**

(d) Due to repeated media coverage of cyberbullying, your company introduces a new policy stating that as many cyberbullying messages as possible are to be found and deleted, while still making sure the number of non-filtered messages remains high. Some additional manual labour is made available for this change. How does this affect your evaluation strategy, and how can you adapt the classifier to comply better with the new strategy? (Tip: a development corpus could be of use.) **[5 marks]**

Question 4

You work as AI researcher at an autonomous vehicle company, and your task is to develop a reinforcement learning algorithm for safe and efficient navigation of self-driving car. Your goal is to design an intelligent agent that has an ability to navigate through complex urban environments while following traffic rules and minimizing travel time.

(a) Discuss the components of the reinforcement learning problem in the context of autonomous driving and formulize the problem with the help of Markov Decision process. **[10 marks]**

(b) b) Outline the training process of the intelligent agent to learn optimal policy, and discuss how you will collect historical data, pre-process it and update the agent policy using a suitable reinforcement learning algorithm. As part of your answer, discuss the potential challenges during the training process. **[10 marks]**

End of Paper

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.