



**BSc EXAMINATION**

**COMPUTER SCIENCE**

**Artificial Intelligence**

**Release date:** Monday 7 March 2022 at 12:00 midday Greenwich Mean Time

**Submission date:** Tuesday 8 March 2022 by 12:00 midday Greenwich Mean Time

**Time allowed:** 24 hours to submit

**INSTRUCTIONS TO CANDIDATES:**

**Section A** of this assessment paper consists of a set of **TEN** Multiple Choice Questions (MCQs) which you will take separately from this paper. You should attempt to answer **ALL** the questions in Section A. The maximum mark for Section A is **40**.

Section A will be completed online on the VLE. You may choose to access the MCQs at any time following the release of the paper, but once you have accessed the MCQs you must submit your answers before the deadline or within **4 hours** of starting whichever occurs first.

**Section B** of this assessment paper is an online assessment to be completed within the same 24-hour window as Section A. We anticipate that approximately **1 hour** is sufficient for you to answer Section B. Candidates must answer **TWO** out of the **THREE** questions in Section B. The maximum mark for Section B is **60**.

Calculators are not permitted in this examination. Credit will only be given if all workings are shown.

You should complete **Section B** of this paper and submit your answers as **one document**, if possible, in Microsoft Word or a PDF to the appropriate area on the VLE. Each file uploaded must be accompanied by a coversheet containing your **candidate number**. In addition, your answers must have your candidate number written clearly at the top of the page before you upload your work. Do not write your name anywhere in your answers.

## **SECTION A**

Candidates should answer the **TEN** Multiple Choice Questions (MCQs) quiz, **Question 1** in Section A on the VLE.

## SECTION B

Candidates should answer any **TWO** questions from Section B.

### Question 2

- (a) What type of problems are Markov Decision Processes (MDPs) suitable for modelling? [3]
- (b) Choose a video game that is significantly different from the Breakout game seen in the course.
  - i. Name and briefly describe the game you have chosen. [1]
  - ii. What are the control inputs? [1]
  - iii. How can you gain points in the game? [1]
  - iv. How might an artificial intelligence system perceive the state of the game? Please do not use the example of screen pixels - think about the underlying state of the game. [2]
- (c) Name and describe THREE elements of a Markov Decision Process. For each element, say what it represents from your chosen video game. [9]
- (d) Do you think a Markov Decision Process is a suitable way to model playing your chosen game? Justify your answer. [3]
- (e) Reinforcement learning might be described as learning a Q-function. Deep learning might be described as seeking a minimal result from an error function. What does the Q-function represent in reinforcement learning and what does the error function represent in deep learning? Consider the inputs and outputs in your answer. [6]
- (f) What is Q-learning? Describe it in terms of the Markov Decision Process. [2]
- (g) If we are using Q-learning to learn how to play video games, state TWO aspects that make Q-learning difficult. [2]

### Question 3

- (a) Define the following types of model and state what their role can be in an artificial intelligence system which generates creative artefacts.
- i. Computational model [2]
  - ii. Pre-trained model [2]
  - iii. Auto-regressive model. [2]
- (b) Select an example of a creative activity which humans engage in and that one might attempt to model using artificial intelligence techniques.
- i. Name and briefly describe the activity you have chosen. [2]
  - ii. What would be an appropriate artificial intelligence technique (or set of techniques) to work in the domain you have described? Justify your answer. [6]
  - iii. Explain how you would go about evaluating the output of your putative 'creative' system. [4]
- (c) "Genetic algorithms employ a design process which is similar to the human design process". Provide TWO arguments against this statement and TWO arguments in support of this statement, using details of the design of genetic algorithms. [8]
- (d) Analyse a genetic algorithm system in terms of Colton's creative Tripod. [4]

#### Question 4

Nowadays AI systems are capable of making autonomous scientific discoveries. In this course, we considered several AI systems capable of making automated scientific discoveries, for example, the mobile robotic chemist, the automatic statistician, the robot scientists Adam and Eve. The research in automated scientific discovery is flourishing, and the target is to develop systems capable of making significant scientific discoveries.

- (a) What are the advantages of automated discovery systems? [10]
- (b) What are the current limitations of automated discovery systems? [10]
- (c) Describe the functionality of one of the key components of the robot scientist system, e.g. a hypotheses generator, a reasoning engine, an experiments planner, or data analysis component. What is required for the functioning of the selected component? What are its input and output? How does it interact with other components of the system? Outline the workings of the component. [10]

END OF PAPER