King's College London

This paper is part of an examination of the College counting towards the award of a degree. Examinations are governed by the College Regulations under the authority of the Academic Board.

Degree Programmes	BSc, MSci
Module Code	6CCS3AIN
Module Title	Artificial Intelligence
Examination Period	January 2019 (Period 1)
Time Allowed	Two hours
Rubric	ANSWER ALL QUESTIONS. Questions 1–15 carry FOUR marks each and have ONE or MORE correct choices. In order to obtain full marks you must select all correct choices and only those. **Marks will be deducted for incorrect choices selected in those questions.** Questions 16 and 17 each carry FIVE marks. Questions 18–20 each carry TEN marks. The answers to questions **1–15** need to be clearly made by pen on the appropriate grid on the **answer sheet** provided at the back of the exam paper. The answers to questions **16–20** need to be written by pen on the separate **answer book** provided.
Calculators	Calculators may be used. The following models are permitted: Casio fx83 / Casio fx85.
Notes	Books, notes or other written material may not be brought into this examination

PLEASE DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

Please answer Questions 16–20 on the separate answer book provided.

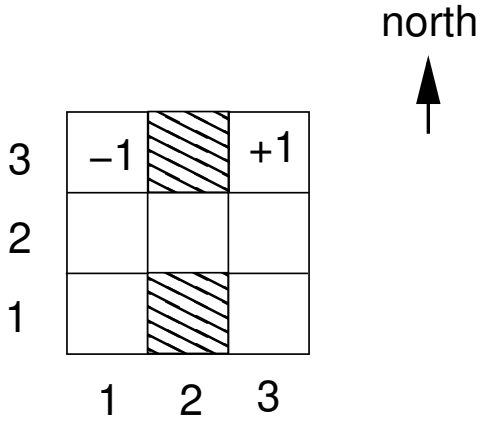
16. Explain what the K-means algorithm is and how it works.

[5 marks]

17. Imagine you are part of a government ethics committee whose role is to develop legislation that will govern the development and use of facial recognition technology for identification purposes. Identify *two* issues that you think the ethics committee should consider, explaining why those issues are relevant to the development and use of facial recognition technology.

[5 marks]

18. a. The following is a very simple world in which an agent operates:



The shaded squares represents obstacles. The reward for being in each state is -0.05 except for the states where the rewards are given in the figure. The agent can move north, south, east and west. The world is non-deterministic: when the agent makes a move, there is a probability of 0.9 that the move succeeds, and a probability of 0.1 that the agent does not move. All attempts to move into obstacles or into the boundaries of the world fail so that the agent will not move.

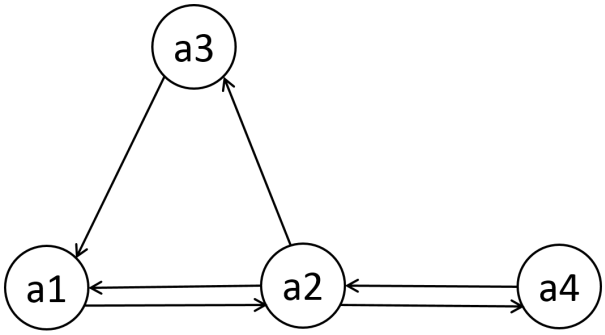
Write down a policy for this world.

[4 marks]

b. Briefly explain how policy iteration can be used to create a policy with reference to computing $\pi(1, 1)$.

[6 marks]

19. Consider the argumentation framework shown below.



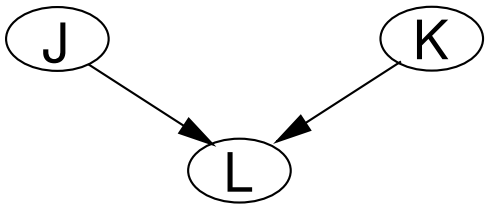
a. Following the equational approach, write down the set of equations that you can solve to determine the complete extensions of the argumentation framework above.

[4 marks]

b. Use the equational approach to find the complete extensions of the argumentation framework above. Make sure you show your workings.

[6 marks]

20. **a.** Use prior sampling to create an estimate of $P(j, \neg k, l)$ based on three samples from the following network:



where:

$$P(l|j,k) = 0.2 \qquad P(j) = 0.6$$
$$P(l|j,\neg k) = 0.6$$
$$P(l|\neg j|k) = 0.8 \qquad P(k) = 0.3$$
$$P(l|\neg j,\neg k) = 0.1$$

When generating samples, use the following list of random numbers picked from a uniform distribution between 0 and 1:

$$0.21, 0.8, 0.55, 0.76, 0.93, 0.42, 0.61, 0.34, 0.73, 0.11, 0.83, 0.29$$

[8 marks]

b. Why might prior sampling of the network in (a) be inefficient when computing conditional probabilities such as $P(k|l)$?

[2 marks]