SEMESTER 1 EXAMINATIONS 2014-2015

Intelligent Systems (COMP2208)

DURATION 120 MINS (2 Hours)

This paper contains 4 questions

Answer **only THREE** questions**.**

All answers must be in separate answer books

Each question carries 1/3 of the total marks for the exam paper and you should aim to spend about 40 minutes on each.

An outline marking scheme is shown in brackets to the right of each question.

Only University approved calculators may be used.

A foreign language translation dictionary (paper version) is permitted provided it contains no notes, additions or annotations.

TURN OVER

1. (i) Explain in detail the important trade-offs in choosing between depth-first and breadth-first search strategies, and explain what difference it makes whether the search tree has finite maximum depth or not? [16]

ii) a) What is heuristic search?

b) Describe a type of heuristic search that is guaranteed to return optimal solutions for the 8-puzzle

c) Describe a heuristic suitable for this search strategy on this problem.

d) Explain briefly why this is guaranteed to return optimal solutions. [17]

2. For each part below your answer should be around 50 to 150 words in length. There is no need to write a long essay: the important thing is to show your understanding by briefly summarizing the relevant concepts.

(i) Briefly describe the difference between supervised learning, unsupervised learning, and reinforcement learning. [6]

(ii) In creating a Q-learning policy:
a) Explain why it is necessary to balance exploration with exploitation.
b) Explain why in static environments policies with exploration (e.g. epsilon-greedy) perform sub-optimally in the long run? [6]

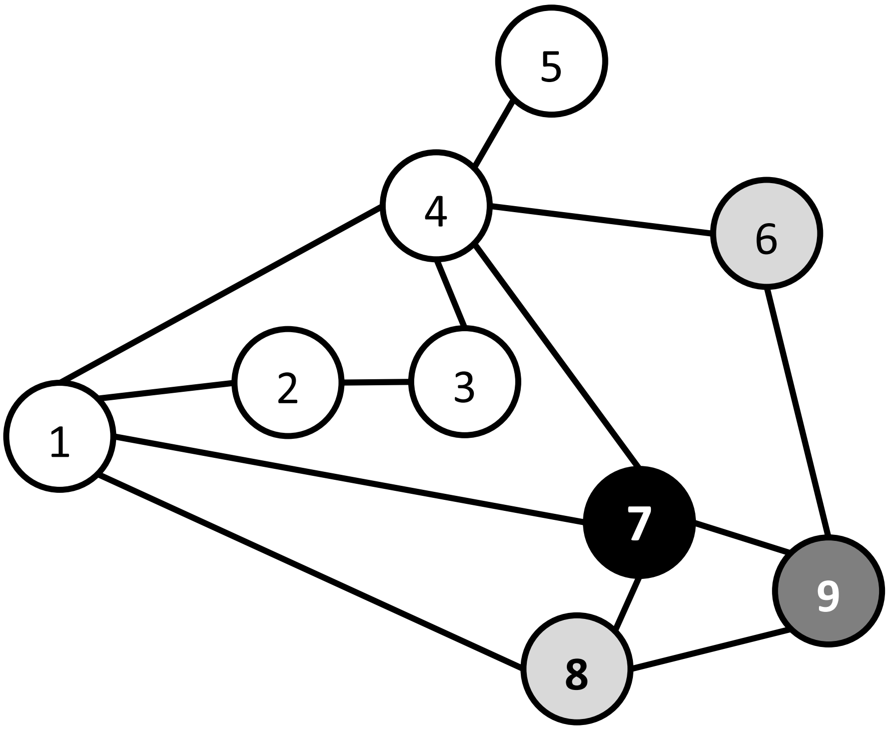
(iii) In working with classification methods (e.g. a decision tree):
a) Explain why is it inadequate to evaluate a classifier on the same data it was trained on, and
b) Describe the steps involved in an evaluation method that alleviates the key problem. [6]

(iv) Explain Valentino Braitenberg's "law of uphill analysis and downhill invention". With this law in mind, what does Braitenberg suggest we should do in order to better understand cognition? [6]

(v) Using points from the literature we have discussed in this module, including Turing and Searle, discuss the following statement: "There is no good way to test whether an AI system is intelligent" [9]

TURN OVER

3. (i) Consider the following graph representing the constraints of a graph-colouring problem. The four shaded nodes (6, 7, 8 and 9) have already been assigned colours. Which node should we choose to assign a colour to next? Explain.

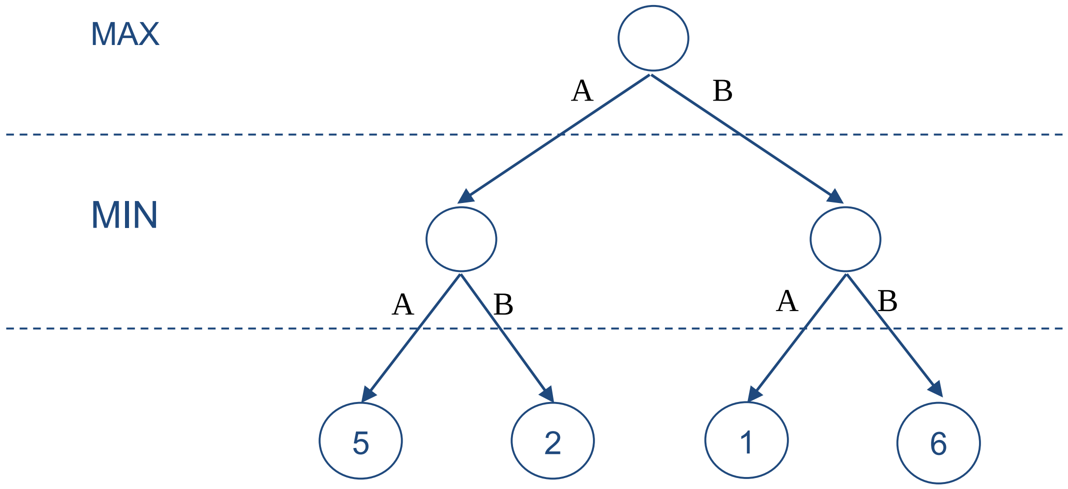


[10]

(ii) What are the advantages of searching the space of partially ordered plans rather than fully-ordered plans? [7]

QUESTION CONTINUES

(iii) Consider the game tree shown below. Assume the top node is a max node. The labels on the edges are the moves. The numbers in the bottom layer are the values of the different outcomes of the game to the max player. What is the value of the game to the max player? What is the first move the max player should make? Assuming that the max player makes that move, what is the best next move for the min player (assuming that this is the entire game tree)?



[7]

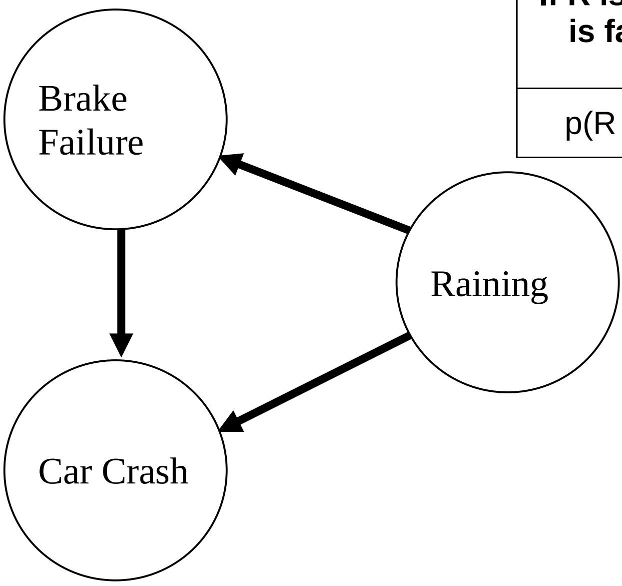
(iv) Consider the alpha-beta pruning algorithm applied to the game tree shown in part (iii). Assume the tree is traversed in the usual depth-first left-to-right order. What will the values of alpha and beta be after evaluating the first three leaf nodes? Explain why the value of the fourth leaf node does not matter in deciding what move to make. [9]

TURN OVER

4. Consider the Bayesian network below. It describes the relationship between it raining (R), a car's brakes failing (B), and the car crashing (C) on any particular journey. The rain is not dependent on the other two variables. Brakes are more likely to fail when it is raining. Whether or not the car crashes is dependent on both of the other variables.

If B is true, the brakes have failed. If B is false, they are working.	
p(B = True | R = True)	0.05
p(B = True | R = False)	0.001

If R is true, it is raining. If R is false, it is not raining.	
p(R = True)	0.2



If C is true, the car crashed. If C is false, the car did not crash.	
P(C = True | R = True, B = True)	0.5
P(C = True | R = True, B = False)	0.1
P(C = True | R = False, B = True)	0.2
P(C = True | R = False, B = False)	0.001

QUESTION CONTINUES

(i) Imagine that we observe this system over an infinitely large number of car journeys.

a) What proportion of journeys will the weather be rainy? [2]

b) What proportion of journeys will the brakes fail? [3]

(ii) We can use Monte Carlo simulation to study the behaviour of a Bayesian network. Assume that we generate random states by taking a random value from zero to one inclusive, and set a given state to True if the random value is **less than or equal to** the relevant probability of that state being True. We need three such random values to generate one set of state values for the network. Take these three random values and use them in sequence to generate a single random state of the network: [0.1, 0.7, 0.55]. [6]

(iii) In the form of a truth table, with an additional column showing the relevant probability, use the Bayesian network diagram to reconstruct the full joint probability distribution across the three Boolean state variables. [10]

(iv) Using Bayes' theorem, calculate the following conditional probabilities.

a) What is the probability that it is raining given that the car crashed? In other words, p(R=True | C=True)? [4]

b) What is the probability that the brakes failed given that the car did not crash? That is, p(B=True | C=False)? [4]

c) What is the probability that it is raining given that the brakes failed and car didn't crash? In other words, what is p(R=True | B=True, C=False)? [4]

END OF PAPER