SEMESTER 1 EXAMINATIONS 2018/19

INTELLIGENT SYSTEMS

Duration 120 mins (2 hours)

This paper contains 4 questions

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

Please start a new page for each question.

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 dictionary is permitted ONLY IF it is a paper version of a direct 'Word to Word' translation dictionary AND it contains no notes, additions or annotations.

7 page examination paper

***QUESTION 1*.**

a) In tree search, if the next node to be expanded from the fringe is taken from the front of a queue, which search strategy is defined by adding newly created nodes:

i) To the front of the queue. [3 marks]

ii) To the back of the queue. [3 marks]

iii) Into positions dependent on the estimated distance from the node to the goal. [3 marks]

iv) Into positions dependent on the estimated cost of a path from the start state, through that node, to the goal. [3 marks]

b) What are the advantages and disadvantages of iterative deepening search compared to depth first search? What circumstance can you think of where depth first would be preferable to iterative deepening search? Explain. [10 marks]

c) What are the advantages and disadvantages of graph search compared to tree search? [8 marks]

d) Is iterative deepening search optimal when applied to the map routing problem (e.g. Romania map)? Explain briefly. [3 marks]

QUESTION 2.

a) Briefly describe the following terms:

i) Supervised and unsupervised learning; [2 marks]

ii) Overfitting; [2 marks]

iii) Offline and online learning; [2 marks]

b) In nearest neighbour methods:

i) Briefly explain why it is useful to apply data normalisation on multi-dimensional data. [2 marks]

ii) Name two distance types between data points that are frequently used. [2 marks]

iii) Briefly explain what lazy learning is. [2 marks]

c) Explain why neural networks based technologies are significantly more efficient nowadays, compared to neural networks that were developed before the 2000s. [6 marks]

d) 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)?

(question continues)

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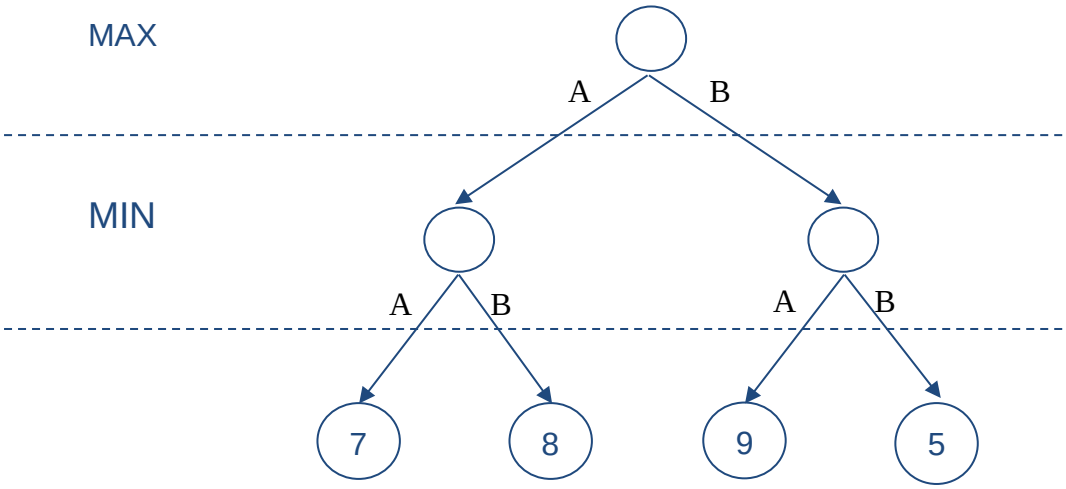
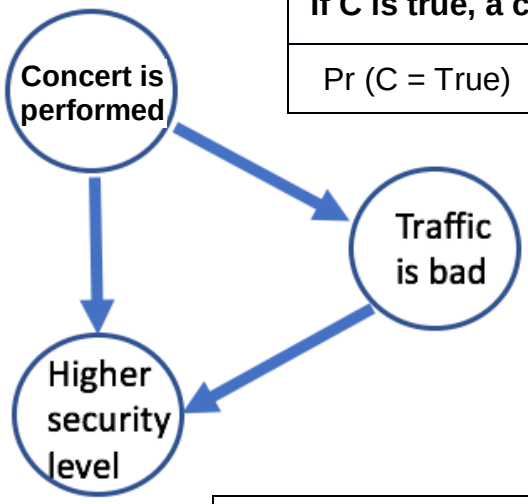


[6 marks]

e) Consider the alpha-beta pruning algorithm applied to the game tree shown in part (d). 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? Does the value of the fourth leaf node need to be considered in deciding what move to make? Explain? [9 marks]

QUESTION 3.

Consider the Bayesian network below, which describes the relationship between whether a concert is performed (C), traffic is bad (T), and a higher security level (H). The "concert is performed" does not depend on the other two variables. But, the traffic is more likely to be bad when there is a concert. Whether or not a higher-level security guard is needed depends on both of the other variables. The conditional probabilities are given in the tables.



If C is true, a concert is performed	
Pr (C = True)	0.9

If T is true, the traffic is bad	
Pr (T = True | C = True)	0.8
Pr (T = True | C = False)	0.4

If H is true, a higher-level security guard is needed	
Pr (H = True | C = True, T = True)	0.8
Pr (H = True | C = True, T = False)	0.5
Pr (H = True | C = False, T = True)	0.2
Pr (H = True | C = False, T = False)	0.1

a) What is the probability that the traffic will be bad? [4 marks]

b) 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

(question continues)

TURN OVER

three such random values to generate one set of state values for the network. Take these three random values and use them in sequence for the variables C, T and H, respectively, to generate a single random state of the network: [0.3, 0.9, 0.6] [4 marks]

c) 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 marks]

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

i) What is the probability that the concert was performed given that a higher-level security guard was needed? In other words, Pr (C=True | H=True)? [5 marks]

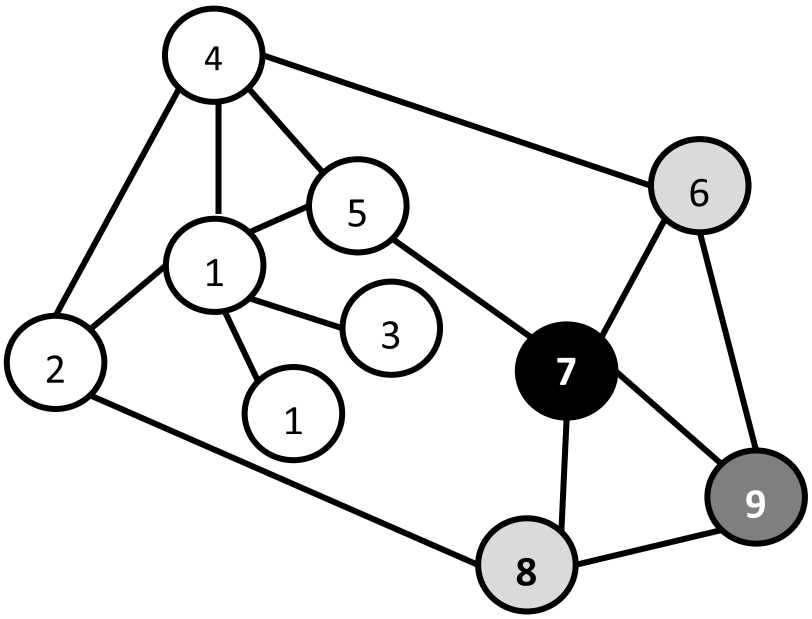
ii) What is the probability that the traffic was bad given that a higher-level security was not needed? That is, Pr (T=True | H=False)? [5 marks]

iii) What is the probability that the concert was performed given that the traffic was bad and a higher-level security guard was not needed? In other words, what is Pr(C=True | T=True, H=False)? [5 marks]

QUESTION 4.

a) Using points from the literature we have discussed in this module, including Turing and Searle, discuss the following statement: “The Turing Test is a good test of whether an AI system is intelligent” [9 marks]

b) 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.



[9 marks]

c) In bandit theory, briefly:

i) Explain why it is necessary to balance exploration with exploitation. [3 marks]

ii) Explain what regret is and why we use it to measure performance. [3 marks]

iii) Explain the concept of zero-regret algorithms [3 marks]

d) In plain language, briefly explain the concept of information gain within the context of decision trees, and how we can calculate it. [6 marks]

END OF PAPER

