SEMESTER 1 EXAMINATIONS 2015/16

INTELLIGENT SYSTEMS

Duration 120 mins (2 hours)

This paper contains 4 questions

Answer **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 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) What advantages are there in using breadth-first search compared to depth-first search? [7]

b) What is the main advantage of using depth-first search compared to breadth-first search? [3]

c) What is the main advantage of using iterative deepening search compared to breadth-first search? [3]

d) What are the advantages and disadvantages of A* search compared to iterative deepening search? [4]

e) What are the advantages and disadvantages of local search compared to A* search? [4]

f) Explain (e.g. provide a proof) why A* is optimal when using an admissible heuristic. [12]

Question 2.

For each part below, show your understanding by briefly summarizing the relevant concepts.

a) Briefly describe the differences between the following terms:

i) supervised and unsupervised learning; [2]

ii) offline and online learning; [2]

iii) MDP (Markov decision process) and PoMDP (partially observable MDP). [2]

b) In bandit theory:

i) Briefly explain why it is necessary to balance exploration with exploitation. [3]

ii) Briefly explain the concept of zero-regret algorithms. [3]

iii) In plain language, explain 3 advantages and 3 drawbacks of using the Bayesian approach in AI. [6]

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

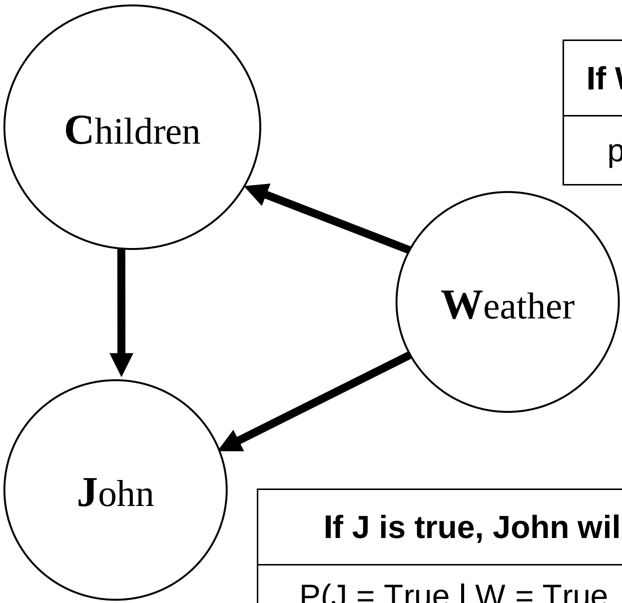
d) Using points from the literature we have discussed in this module, including Turing and Searle, discuss the following statements: “A machine could pass the Turing test without really understanding anything. And a machine might fail the Turing test even though it really was intelligent.” [9]

TURN OVER

Question 3.

Consider the Bayesian network below, which describes the relationship between whether the weather is nice (W), John's children want to stay at home (C), and that John will be able to finish writing his annual report (J). The weather being nice does not depend on the other two variables. But, the children are more likely to stay at home if the weather is bad. Whether or not John will be able to finish his report depends on both of the other variables. The conditional probabilities are given in the tables.

If C is true, the children will stay at home.	
p(C = True | W = True)	0.2
p(C = True | W = False)	0.7



If W is true, weather is nice	
p(W = True)	0.8

If J is true, John will finish his report.	
P(J = True | W = True, C = True)	0.5
P(J = True | W = True, C = False)	0.01
P(J = True | W = False, C = True)	0.7
P(J = True | W = False, C = False)	0.95

QUESTION CONTINUES

a) What is the probability that the children will stay at home? [4]

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 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 W, C and J, respectively, to generate a single random state of the network: [0.1, 0.7, 0.55]. [4]

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]

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

i) What is the probability that the weather was nice given that John finished writing his report? In other words, p(W=True **|** J=True)? [5]

ii) What is the probability that the children were staying at home given that John did not finish his report? That is, p(C=True **|** J=False)? [5]

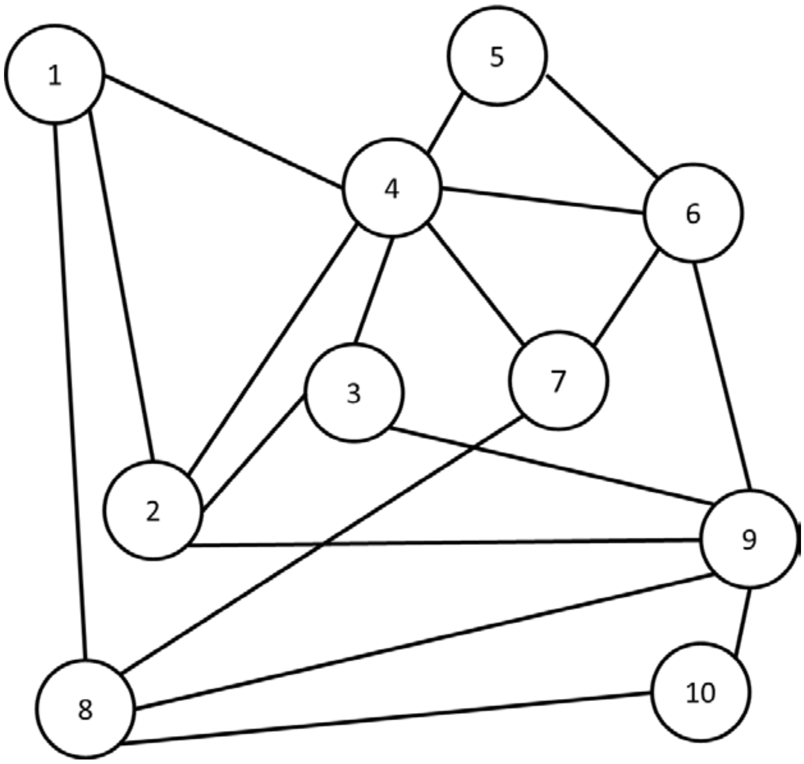
iii) What is the probability that the weather was nice given that the children stayed at home and John did not finish his report? In other words, what is p(W=True **|** C=True, J=False)? [5]

TURN OVER

Question 4.

a) Why is bi-directional search more efficient, when available, than single-directional search? [3]

b) Consider the following graph representing the constraints of a graph-colouring problem. None of the nodes have been assigned a colour yet.



i) Explain why node 4 is a good choice to assign a colour to first. [4]

ii) Which node should we choose to assign a colour to second (given that we have already assigned a colour to node 4)? Explain briefly. [5]

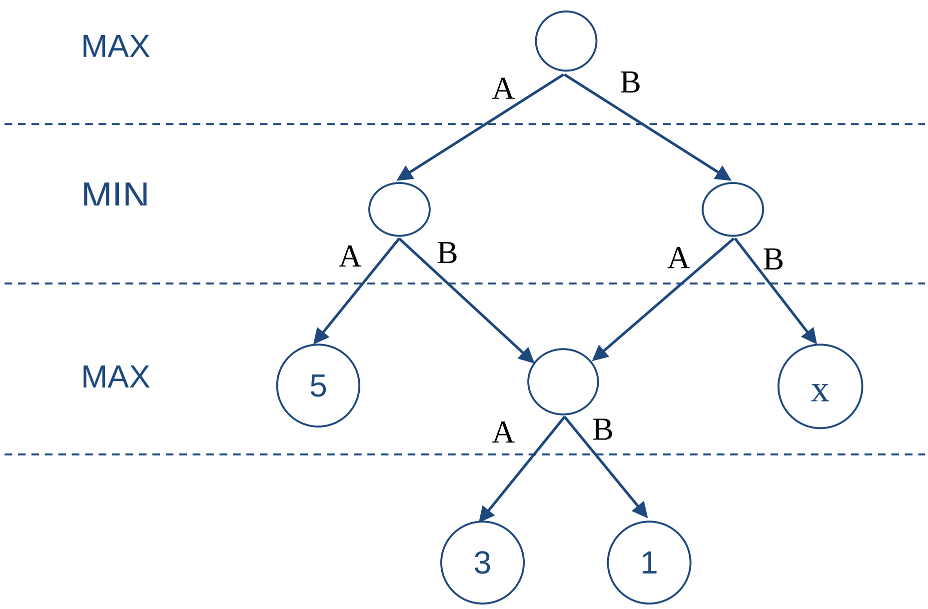
c) What advantages are there of searching the space of partially ordered plans rather than fully-ordered plans when a problem has semi-independent sub-goals? [7]

QUESTION CONTINUES

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 leaf nodes are the values of the different outcomes of the game to the max player.

i) Suppose that the node labelled "x" has value 2. 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)? [6]

ii) What value could node "x" take that would change the answer to part (i)? Explain. [8]



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