Cooperating Intelligent Systems – Written Exam April 2009

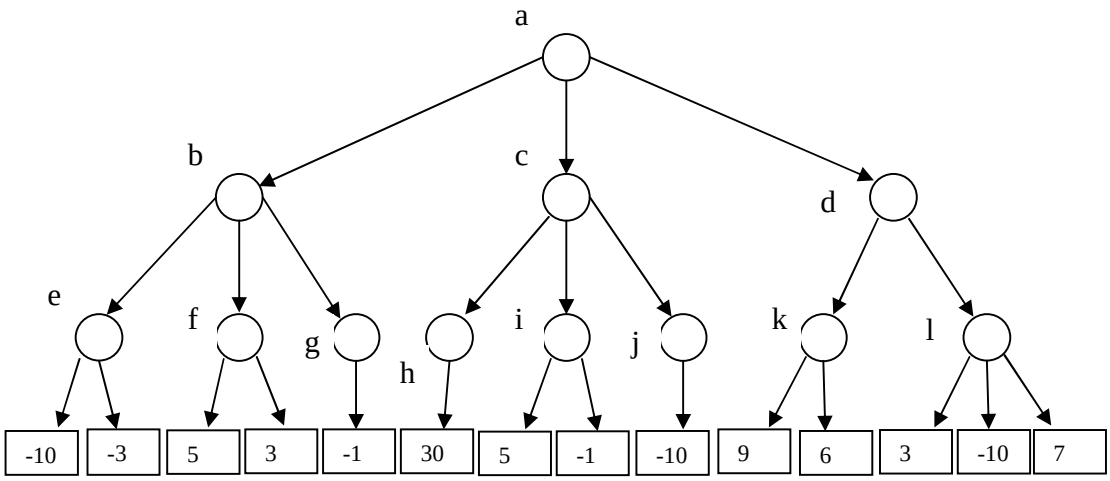
You must achieve at least 50% of the points on this written exam to continue to the oral exam.

The total number of points is 26.

No books, mobile phones or calculators are permitted during the exam.

1 Game playing

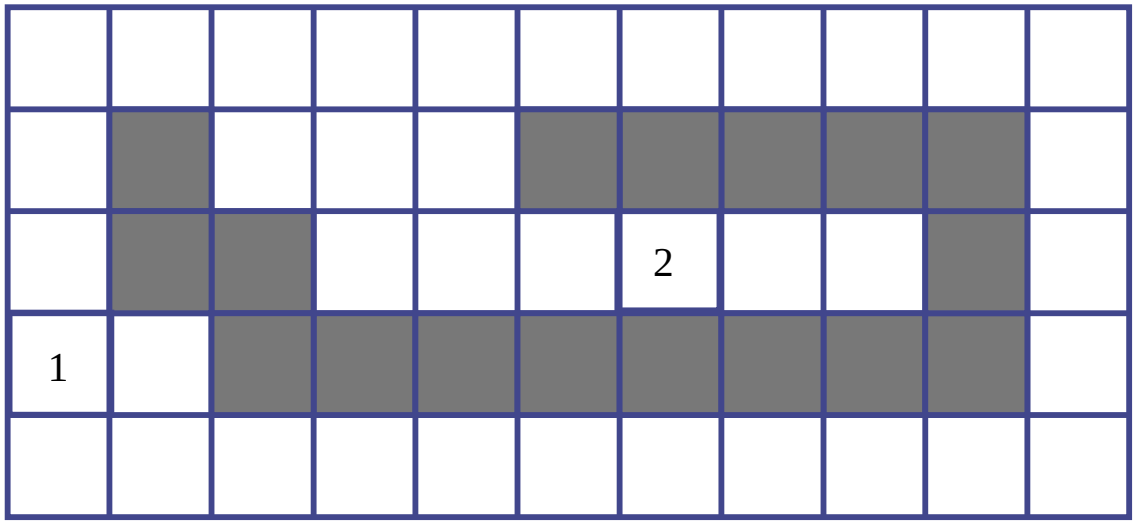
Consider the following game tree where the square boxes are goal states and their respective values. Assume that the first player to move is the maximizing player.



a. What is the optimum game path if the players follow the minimax rule? [1p]
b. With alpha-beta pruning and if the tree is expanded from left to right, which nodes will not be expanded? [2p]
c. If the tree is expanded from right to left, which nodes will not be expanded? [2p]

2 Informed search - **Robot navigation**

The task is to move a robot from the start square (marked with a ‘1’) to the goal square (marked with a ‘2’). The grey shaded areas are walls that cannot be passed. For the algorithms below, use the manhattan distance heuristic. Use necessary assumptions when necessary, e.g. assign a cost of ‘1’ for moving a single step.



a. Show how Greedy-best first search solves the task [3p]
b. Show how A* solves the task [4p]
c. Explain why there is a different result for the two algorithms [1p]
d. What is meant by an admissible heuristic? [1p]

3 Logic

Represent the following sentences in first-order logic

a. A salesman has some apples, oranges and bananas. [1p]
b. All salesmen have some apples, oranges and bananas. [1p]
c. At least one salesman has apples and oranges, but no bananas. [1p]
d. None of the salesmen have apples, oranges or bananas. [1p]
e. For each of the fruits, there is a salesman that has at least one. [1p]

4 Bayesian networks

Mary catches the bus every morning to the train station, where she catches a train to work. Some mornings the bus is late and sometimes the train is late. The bus is late more often than the train, but if either mode of transport should be late it does not necessarily mean that Mary is late for work.

a. Given the following tables of probabilities, draw the Bayesian network for the above scenario. [1p]

P(bus)	
Late	On time
0.3	0.7

P(train)	
Late	On time
0.1	0.9

P(Mary | Bus, Train)			
Bus	Train	Late	On time
On time	On time	0.01	0.99
On time	Late	0.90	0.10
Late	On time	0.20	0.80
Late	Late	0.90	0.10

b. Given that Mary is late, what is the probability of this being due to the late bus? [6p]