

Cooperating Intelligent Systems – Written Exam October 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 60.

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.

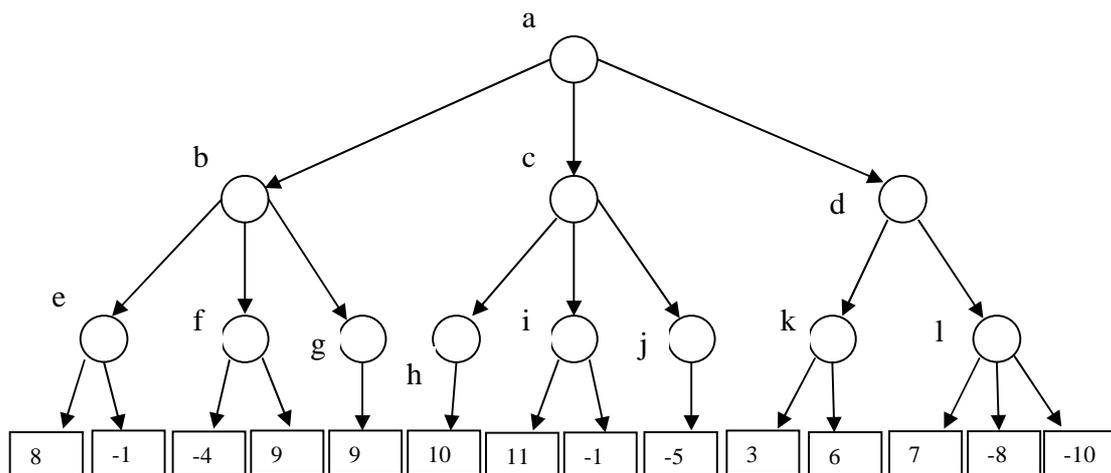


Figure 1. Game tree

- What is the optimum game path if the players follow the minimax rule? [1p]
- With alpha-beta pruning and if the tree is expanded from left to right, which nodes will not be expanded? [4p]
- If the tree is expanded from right to left, which nodes will not be expanded? [4p]

2 Search

Consider the 3-puzzle problem, which is a simpler version of the 15-puzzle where the board is 2 x 2 and there are three tiles, numbered 1, 2, and 3, and one blank. There are four operators, which move the blank up, down, left, and right. The start and goal states are given in figure 2. Show how the path to the goal can be found using:

- (a) Breadth first search [5p]
- (b) Depth first search [5p]
- (c) A* using a suitable heuristic [5p]

Assume that there is no possibility to remember states that have been visited earlier. Also, use the given operators in the given order unless the search method defines otherwise. Label each visited node with a number indicating the order in which they are visited. If a search method doesn't find a solution, explain why this happened.

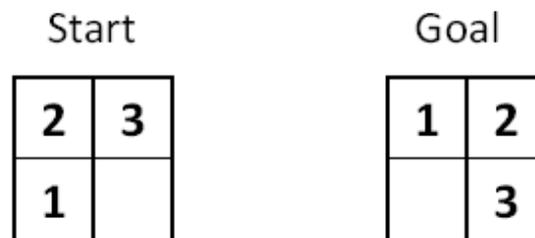


Figure 2. Start and goal states of the 3-puzzle

3 Logic

Italy, 13th April 2008. A journalist stops three friends (Mr. Rossi, Mr. Bianchi and Mr. Verdi) who just left the voting office. The journalist interviews them separately about their votes in the elections. Mr. Rossi declares: "If Bianchi voted for Berlusconi then also Verdi did". Mr. Bianchi declares: "If Rossi did not vote for Berlusconi, then also Verdi did not". Finally, Verdi declares: "Rossi voted for Berlusconi while Bianchi did not".

- (a) Are the declarations compatible? [2p]
- (b) If all three voted for Berlusconi, who is lying? [2p]
- (c) If all three voted against Berlusconi, who is lying? [2p]
- (d) If all three are telling the truth, who has voted for Berlusconi and who has voted against him? [2p]
- (e) If all three are lying, who has voted for Berlusconi and who has voted against him? [2p]
- (f) If the ones who voted for Berlusconi are telling the truth, and those who has voted against Berlusconi are lying, who has voted for him and who has voted against him? [2p]
- (g) If only one of the three is telling the truth, who is he and how did everybody vote? [3p]

Use e.g. truth-table! All answers must be motivated.

4 Bayesian networks

You go to the racetrack. A shady character comes to offer you a free tip (a tip is a piece of information): he says that the horse Belle did not eat her breakfast. Assume that:

- The probability that a horse will win is dependent on the horse's health and its speed.
- A horse's health and its speed are independent.
- A healthy horse has a higher probability of eating breakfast than does a sick horse.
- Your informant is known to be accurate 80% of the time.

(a) Draw a Bayesian network with 5 variables (T = you got this tip; B = Belle ate her breakfast; H = Belle is healthy; W = Belle will win; F = Belle is fast). The relationships between the variables should reflect the problem description. [3p]

(b) What is the probability that Belle will win? [6p]

(c) What is the probability that Belle will win given that you got the tip? [6p]

5 Machine learning

(a) Describe the simple perceptron learning rule. [3p]

(b) Describe two principally different ways of doing inductive learning with a decision tree. [3p]