COEN 266 Artificial Intelligence

Homework #3

Guideline: Please complete the following problems and submit the answers as a single PDF file to Camino.

Problem 1: Consider the following game tree in which the utility values (in parentheses at the leaf nodes) are all from the first player's point of view. Assume that the first player is the maximizing player.

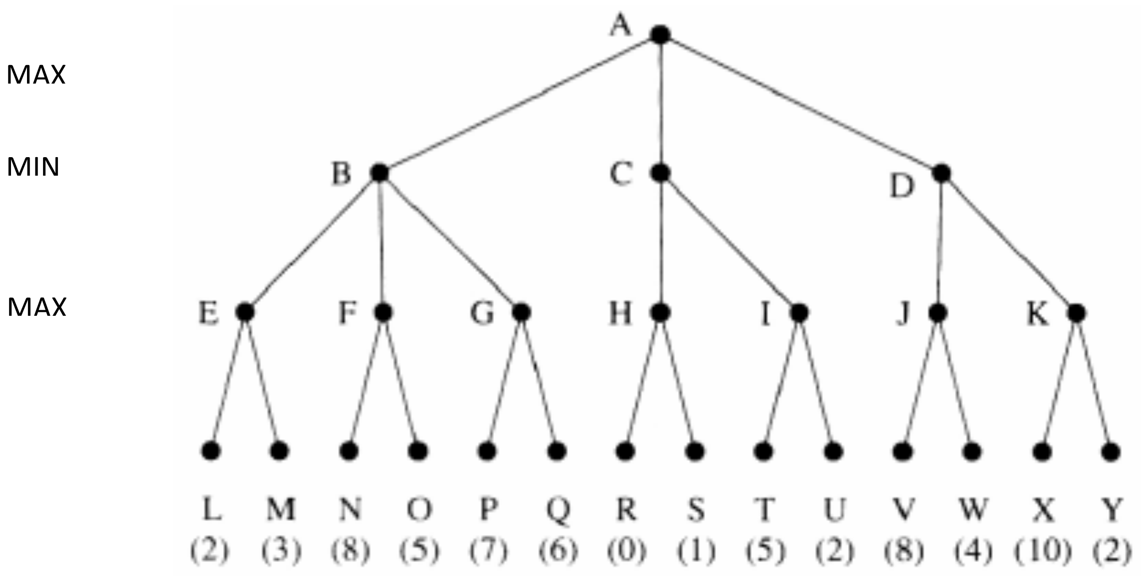

Figure 1.1

a. What leaf nodes (nodes at the bottom layer) would not need be examined using the alpha-beta pruning algorithm – assuming that the nodes are examined in left-to-right order? Show the derivation procedure on the graph.

b. What move should the first player (the root node) choose?

c. What's the final minimax value of the root node?

Problem 2: Consider the following search tree.

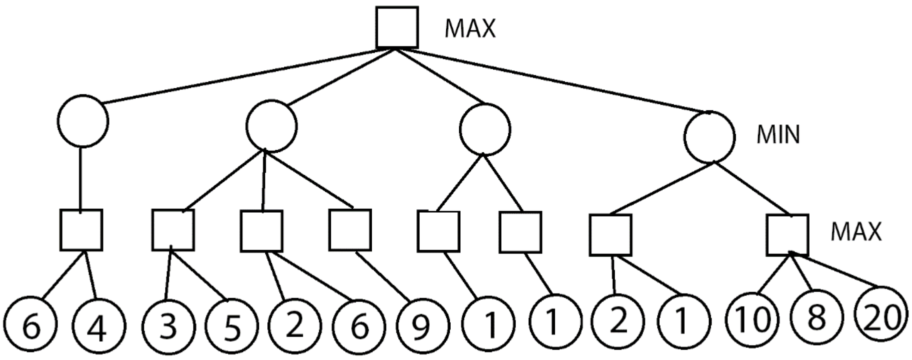

Figure 2.1

a. Fill in the squares and circles with the backed-up values resulting from a regular minimax search.

b. What leaf nodes (nodes at the bottom layer) would not need be examined using the alpha-beta pruning algorithm - assuming that the nodes are examined in left-to-right order? Show the derivation procedure on the graph.

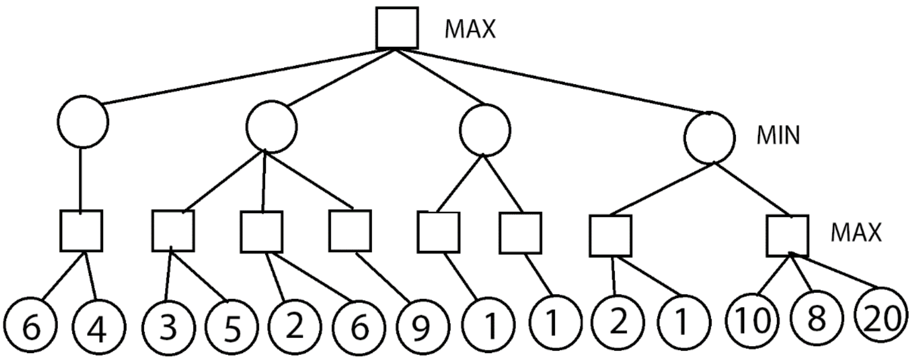

Figure 2.1

c. What is the minimax value of the root node?

Problem 3 Suppose two friends live in different cities on a map. They take turns to move. Each turn one person will move to a neighboring city. The amount of time needed to move from city i to neighbor j is equal to the road distance d(i, j) between the cities. Assume that one of the friends wants to avoid the other. The problem then becomes a two-player **pursuit-evasion** game. We assume that the players take turns moving. The game ends only when the players are on the same node; the terminal payoff to the pursuer is minus the total time taken. (The evader "wins" by never losing.) An example is shown in Figure 5.16.

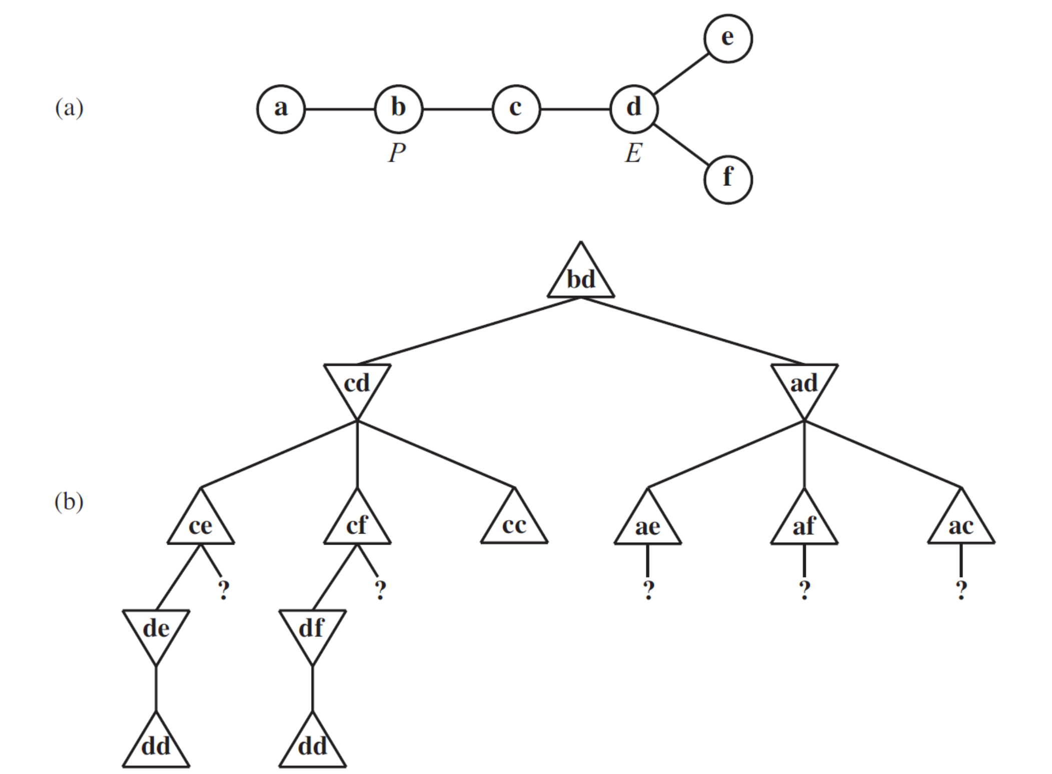

Figure 5.16 (a) A map where the cost of every edge is 1. Initially the pursuer P is at node **b** and the evader E is at node **d**. (b) A partial game tree for this map. Each node is labeled with the P, E positions. P moves first. Branches marked "?" have yet to be explored.

a. Copy the game tree and mark the values of the terminal nodes.

b. Beneath each question mark, write the name of the node reached by that branch.

c. Explain how a bound on the value of the nodes in (b) can be derived from consideration of shortest-path from each of these nodes to a terminal node, and derive such bounds for these nodes.

d. Next to each node, write the strongest fact you can infer about its value (a number, one or more inequalities such as "≥ 14", or a "?").

e. With the leaf bounds derived from the above questions, the tree is evaluated from left to right. Circle those leaf nodes that would *not* need to be expanded further, and cross out the leaf nodes that need not be considered at all.

Problem 4 This question considers pruning in games with chance nodes. Figure 5.19 shows the complete game tree for a trivial game. Assume that the leaf nodes are to be evaluated in left-to-right order, and that before a leaf node is evaluated, we know nothing about its value - the range of possible values is $-\infty$ to $+\infty$.

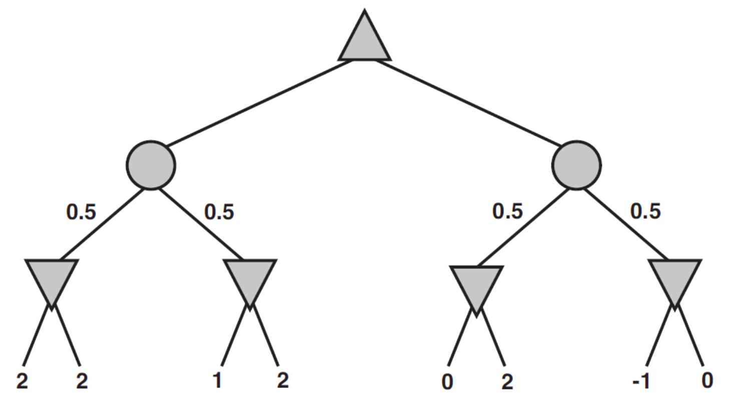

Figure 5.19 The complete game tree for a trivial game with chance nodes.

a. Copy the figure, mark the value of all the internal nodes, and indicate the best move at the root with an arrow.

b. Given the values of the first six leaves, do we need to evaluate the seventh and eighth leaves? Given the values of the first seven leaves, do we need to evaluate the eighth leaf? Explain your answers.

c. Suppose the leaf node values are known to lie between –2 and 2 inclusive. After the first two leaves are evaluated, what is the value range for the left-hand chance node?

d. Circle all the leaves that need not be evaluated under the assumption in question c.