CS 5100: Foundations of Artificial Intelligence (Spring 2022) Robert Platt
Student: Due October 3, 2022

Adversarial Search

1 Expectimax [3 points]

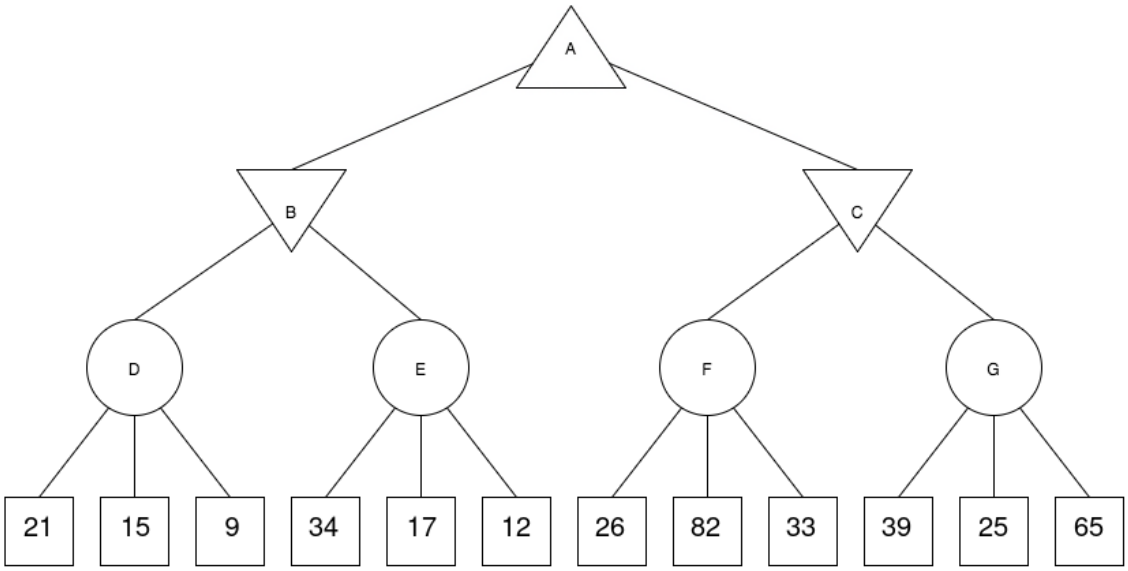
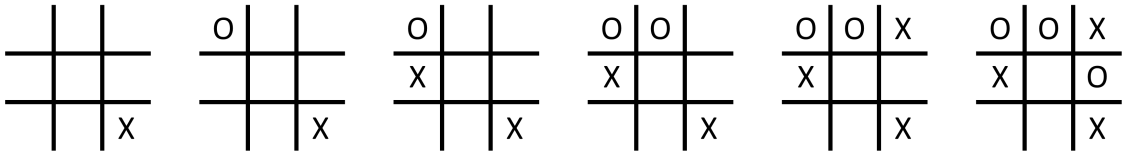


Figure 1: Expectimax

1. For the Expectimax tree above, what is the value of A,B,C,D,E,F,G? Upward triangles are max nodes, downward triangles are min nodes, circles are chance nodes, and squares are final state evaluations. (Assume uniform random probabilities)

2 Two-Player Game [3 points]



s_1 s_2 s_3 s_4 s_5 s_6

Figure 2: Partial game of tic-tac-toe (noughts and crosses).

The first six moves of a tic-tac-toe (noughts and crosses) game is shown above (left to right). It is now X's turn, starting at the right-most state.

1. Draw the game tree starting from the final position shown above. The game tree should include all terminal states as well. Apply minimax search to this tree, showing the backed-up value of each node (value the final game states as 1 point if X wins, -1 if O wins, and 0 for a tie).

2. Does X have a winning strategy at the current (right-most) state? What should X play next?

3 Pruning with Chance Nodes [4 points]

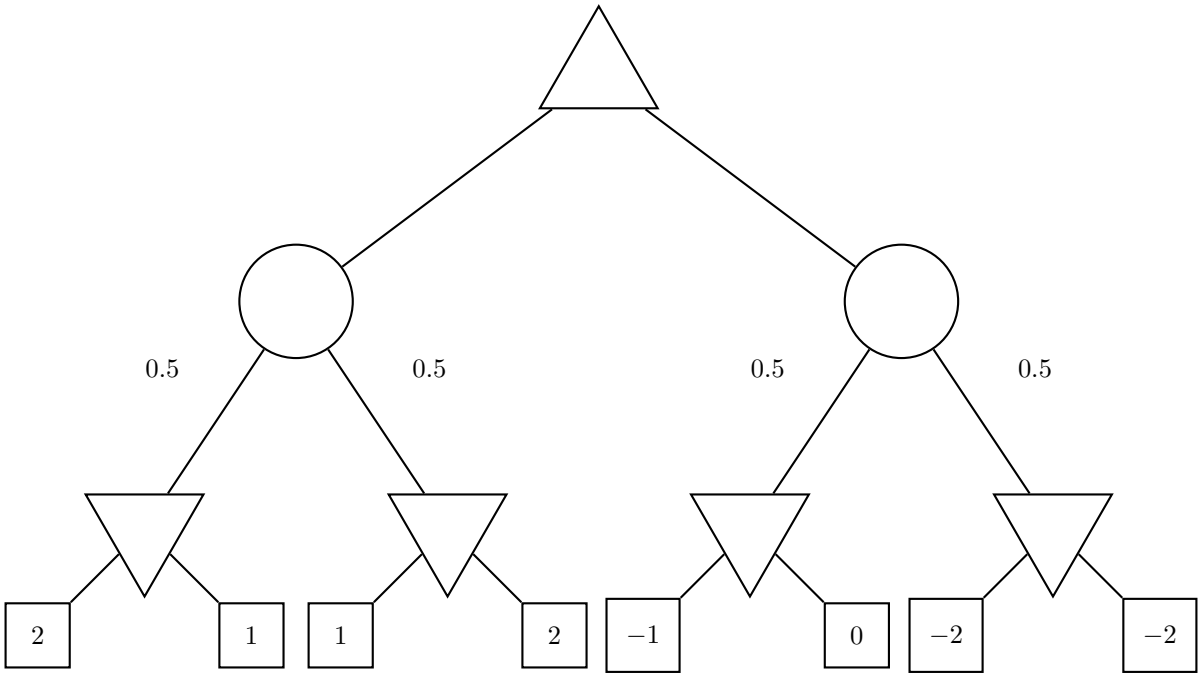


Figure 3: Pruning nodes with chance.

1. (Modified from AIMA 5.16) This question considers pruning in games with chance nodes. Figures **??** 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 ∞.

   (a) In 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 (c).