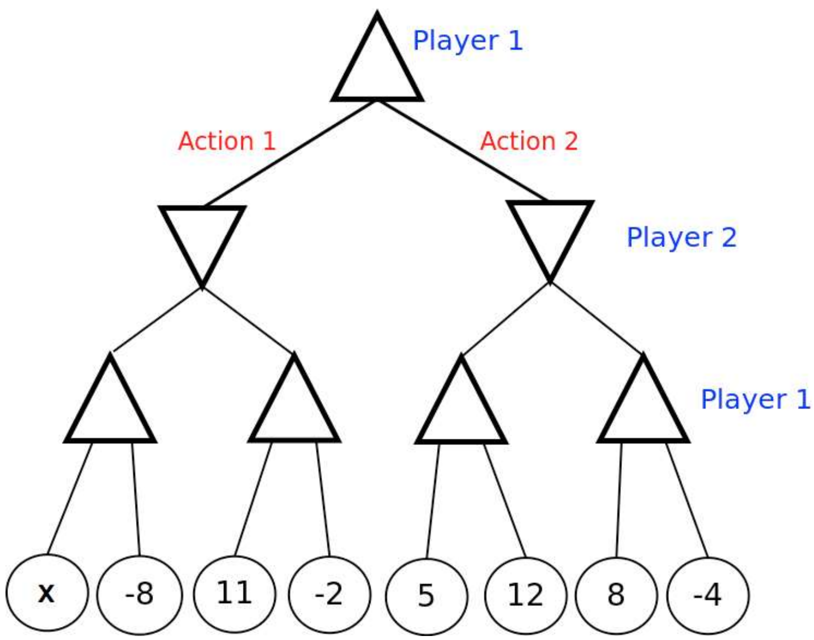
hw3_games_q3_unknown_leaf_value

Question 3: Unknown Leaf Value

0.0/8.0 points (graded)

Consider the following game tree, where one of the leaves has an unknown payoff, x. Player 1 moves first, and attempts to maximize the value of the game.



Each of the next 3 questions asks you to write a constraint on x specifying the set of values it can take. In your constraints, you can use the letter x, integers, and the symbols > and <. If x has no possible values, write 'None'. If x can take on all values, write 'All'. As an example, if you think x can take on all values larger than 16, you should enter x > 16.

Assume Player 2 is a minimizing agent (and Player 1 knows this). For what values of x is Player 1 *guaranteed* to choose Action 1?

X>8

Answer: $X > 8$

Assume Player 2 chooses actions at random with each action having equal probability (and Player 1 knows this). For what values of x is Player 1 *guaranteed* to choose Action 1?

X>9

Answer: $X > 9$

Denote the minimax value of the tree as the value of the root when Player 1 is the maximizer and Player 2 is the minimizer. Denote the expectimax value of the tree as the value of the root when Player 1 is the maximizer and Player 2 chooses actions at random (with equal probability). For what values of x is the minimax value of the tree worth more than the expectimax value of the tree?

Null

Answer: $None$

Is it possible to have a game, where the minimax value is strictly larger than the expectimax value?

- ○ Yes
- ◉ No ✔

Part 1:
Depending on the value of x, there can be three different values for taking Action 1:
If x < - 8, then Action 1 results in -8;
If -8 $\leq$ x $\leq$ 11 then Action 1 results in x;
If x > 11 then Action 1 results in 11.
Action 2 always results in a utility of 8
Hence Action 1 is optimal for Player 1 if x $\geq$ 8

Part 2:
Action 2 gives Player 1 a utility of 10, so the average of x and 11 must be greater than 10.
(x+11)/2 > 10 $\rightarrow$ x > 9

Part 3:
To satisfy this, you would need x such that max(min(x,11), 8) > max(x+11/2, 10).
For x $\leq$ 8: (x+11)/2 < 10, and 8$\not>$10.
For 8 < x $\leq$ 9: (x+11)/2 $\leq$ 10, and x$\not>$10.
For 9 < x $\leq$ 11: x $\not>$ (x+11)/2.
For 11 < x: 11 $\not>$ (x+11)/2.

Part 4:

The minimax value can never be strictly greater than the expectimax value for the same tree because in minimax Player 2 always chooses the worst possible move for Player 1, while in expectimax, those same nodes average that value with other higher values. Thus, the utility at a node under expectimax is always at least as high as the utility of the same node under minimax.

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