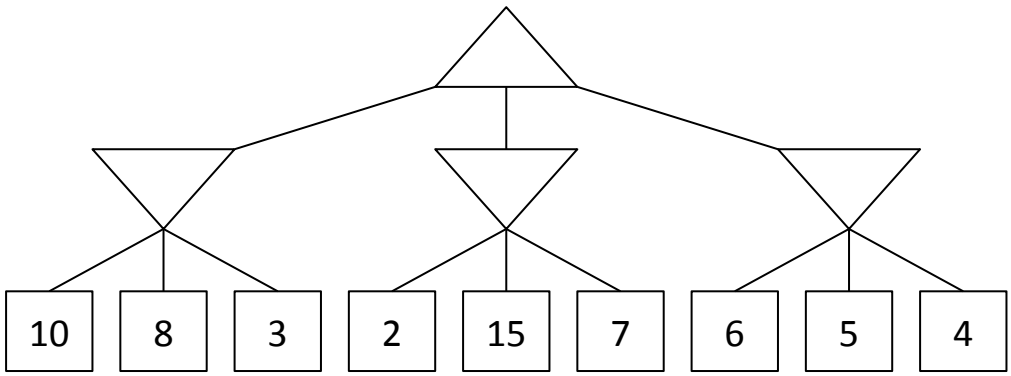
CS 188 Introduction to
Summer 2020 Artificial Intelligence

Section 2: Game Trees

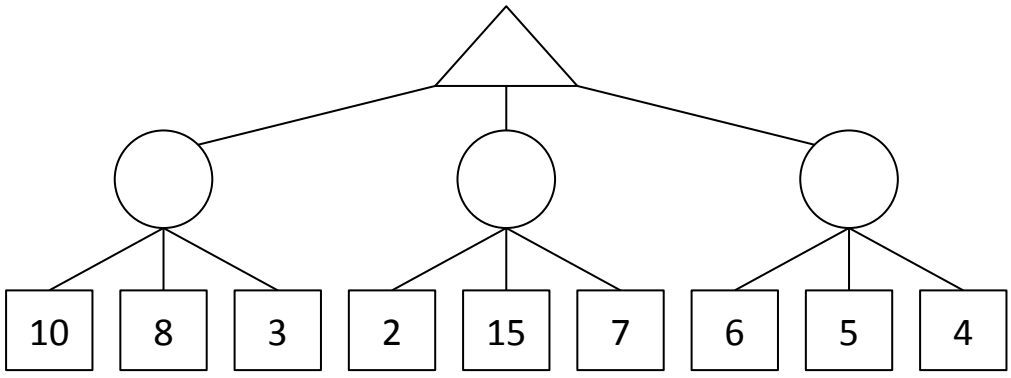
1 Games

1. Consider the zero-sum game tree shown below. Triangles that point up, such as at the top node (root), represent choices for the maximizing player; triangles that point down represent choices for the minimizing player. Assuming both players act optimally, fill in the minimax value of each node.



2. Which nodes can be pruned from the game tree above through alpha-beta pruning? If no nodes can be pruned, explain why not. Assume the search goes from left to right; when choosing which child to visit first, choose the left-most unvisited child.

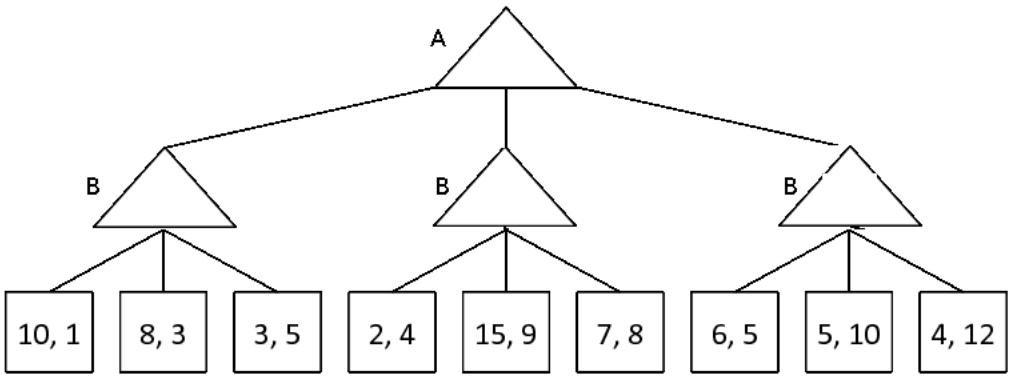
3. (optional) Again, consider the same zero-sum game tree, except that now, instead of a minimizing player, we have a chance node that will select one of the three values uniformly at random. Fill in the expectimax value of each node. The game tree is redrawn below for your convenience.



4. (optional) Which nodes can be pruned from the game tree above through alpha-beta pruning? If no nodes can be pruned, explain why not.

2 (Optional) Nonzero-sum Games

1. Let's look at a non-zero-sum version of a game. In this formulation, player A's utility will be represented as the first of the two leaf numbers, and player B's utility will be represented as the second of the two leaf numbers. Fill in this non-zero game tree assuming each player is acting optimally.



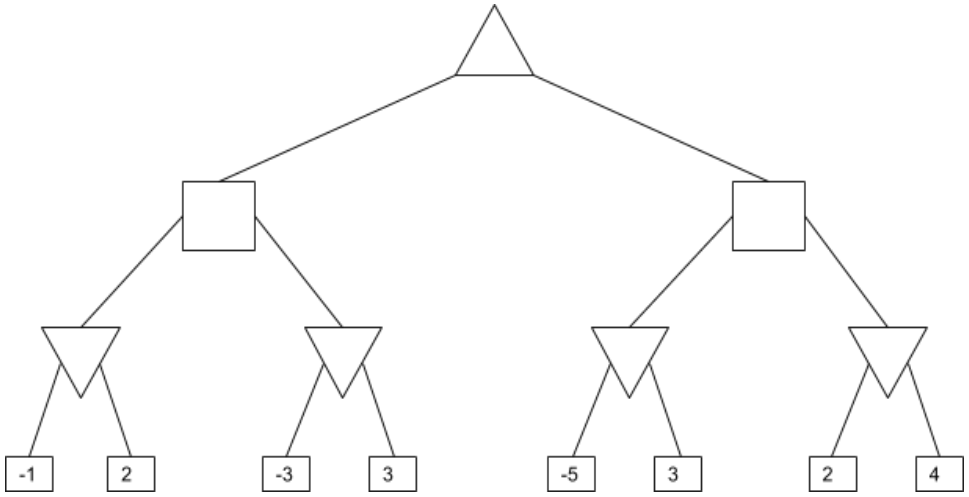
2. Which nodes can be pruned from the game tree above through alpha-beta pruning? If no nodes can be pruned, explain why not.

Q3. Fair Play

Consider a game tree with three agents: a maximizer, a minimizer, and an equalizer. The maximizer chooses the highest score, the minimizer chooses the lowest score, and the equalizer tries to *minimize the absolute value* (i.e. equalizer wants to make the game as close as possible, so it chooses whichever value is closest to zero).

We use an upward-facing triangle to represent a max node, a downward-facing triangle to represent a min node, and a square to represent an equalizer node. The values in the leaves are given from max's point of view.

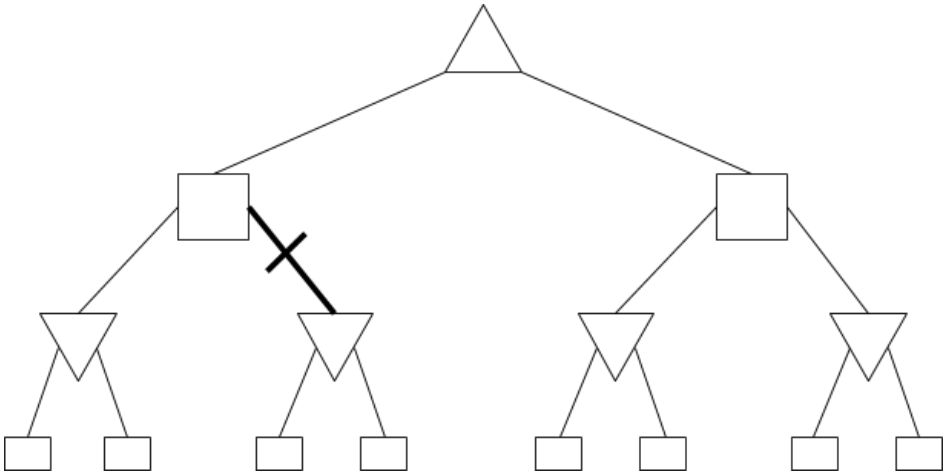
(a) Fill in all values in the game tree below:



(b) In the same game tree above, put an X on the line of all branches that can be pruned, or write "No pruning possible." Assume that branches are explored from left to right.

(c) For each of the following game trees, fill in values in the leaf nodes such that only the marked, bold branches can be pruned. Assume that branches are explored from left to right. If no values will allow the indicated nodes to be pruned, write "Not possible." **Be very clear**: if you write "Not possible," we will not look at the values you filled in.

(i) [Hint: what is the *best possible value* from the equalizer's viewpoint?]



(ii) Note that the order of the players has changed in the game tree below.