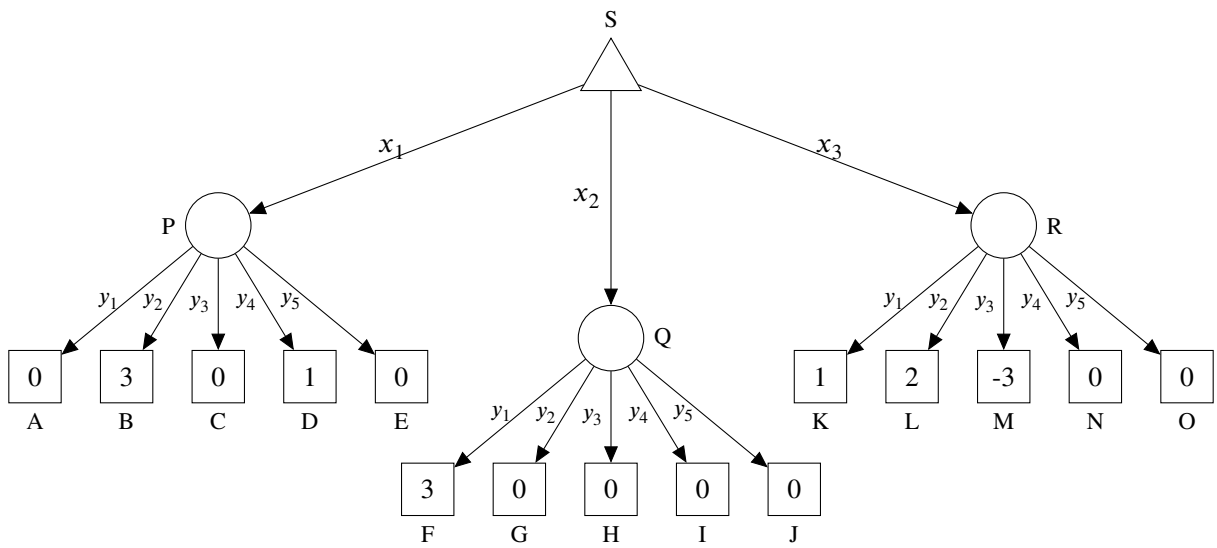
Q1. Expectimax

Alyssa P. Hacker and Ben Bitdiddle are bidding in an auction at Stanley University for a bike. Alyssa will either bid x_1, x_2, or x_3 for the bike. She knows that Ben will bid y_1, y_2, y_3, y_4, or y_5, but she does not know which.

1. Alyssa wants to maximize her payoff given by the expectimax tree below. The leaf nodes show Alyssa's payoff. The nodes are labeled by letters, and the edges are labeled by the bid values x_i and y_i. The maximization node S represents Alyssa, and the branches below it represent each of her bids: x_1, x_2, x_3. The chance nodes P, Q, R represent Ben, and the branches below them represent each of his bids: y_1, y_2, y_3, y_4, y_5.



(a) Suppose that Alyssa believes that Ben would bid any bid with equal probability. What are the values of the chance (circle) and maximization (triangle) nodes?

i. Node P _____

ii. Node Q _____

iii. Node R _____

iv. Node S _____

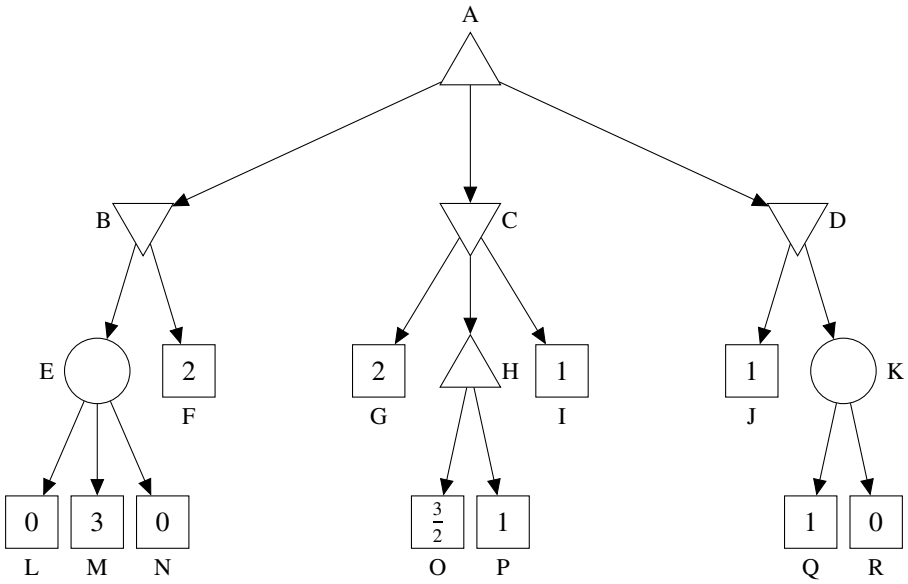
(b) Based on the information from the above tree, how much should Alyssa bid for the bike?

○ x_1 ○ x_2 ○ x_3

Q2. Adversarial Search

1. Answer the following questions about the search tree below. Triangle nodes pointing up are the maximizing nodes, triangle nodes pointing down are the minimizing nodes, circle nodes are the chance nodes, and square nodes are the evaluation nodes. Assume the following:

   - Pruning on equality (e.g., if $v \geq \beta$ at a maximizing node return v).
   - Uniform distribution over the chance nodes children.
   - Children are visited in left to right order.



   (a) How many actions (edges in the tree) will MiniMax search consider?

   (b) What value of node A would MiniMax search return?

   (c) How many actions (edges in the tree) will AlphaBeta search consider?

   (d) What value of node C does AlphaBeta search return?

   (e) What are the values of α and β at C after AlphaBeta search considers G?

α:	β:

(f) What range of values should node N have for AlphaBeta search to consider exactly one fewer action? Answer in interval notation, e.g. where $[3, 5)$ designates the interval $\{x|3 \leq x < 5\}$.

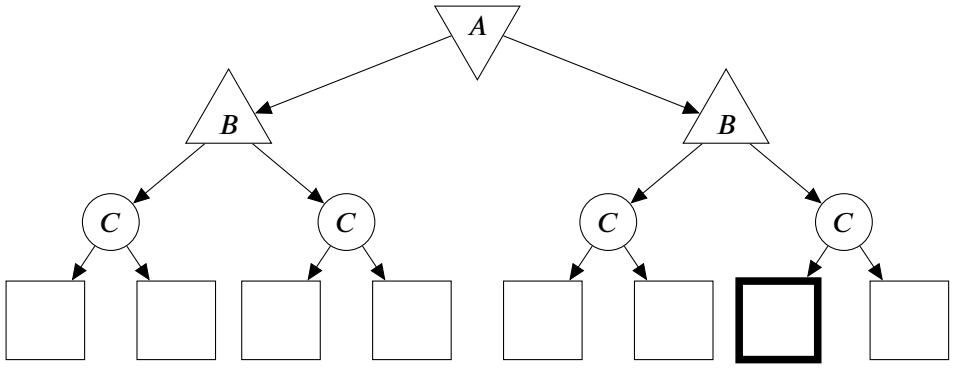
Q3. Alpha-Beta

In this question, player A is a minimizer, player B is a maximizer, and C represents a chance node. All children of a chance node are equally likely. In lecture, we considered how to prune a minimax game tree - in this question, you will consider how to prune an expinimax game tree (like a minimax game tree but with chance nodes). Assume that the children of a node are visited in left-to-right order.

For each of the following game trees, if there are terminal values of the leaf nodes such that the bolded node can be pruned (it doesn't matter if you prune more nodes), write "possible" and provide terminal node values that allow the node to pruned. If there are no such values, write "not possible".

Important: The α-β pruning algorithm does not deal with chance nodes. Instead, for a node n, consider all the values seen so far, and determine whether you can know, *without looking at the node*, that the value of the node will not affect the value at the top of the tree. If that is the case, then n can be pruned.

1.



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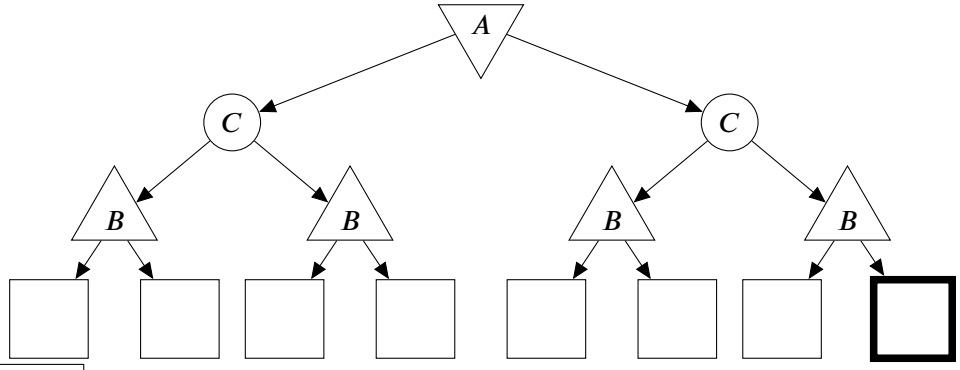

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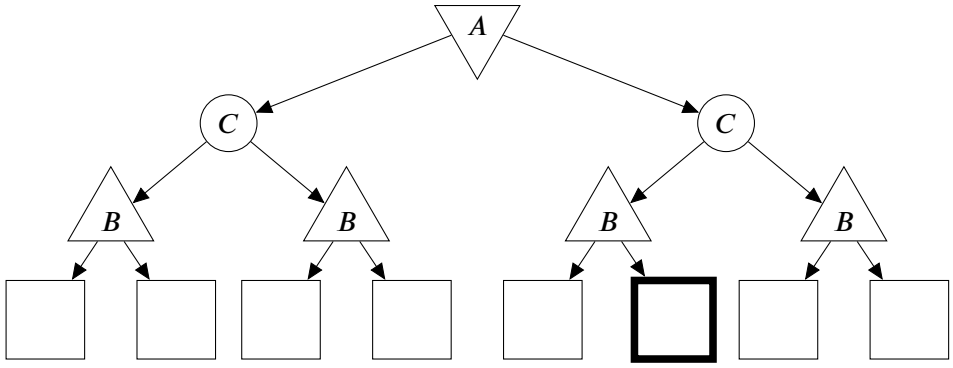

Q4. Hours Worked

(a) How many hours did you spend on this homework? Any reasonable answer (number greater than zero) will receive credit. This will not affect your score on any other problem.