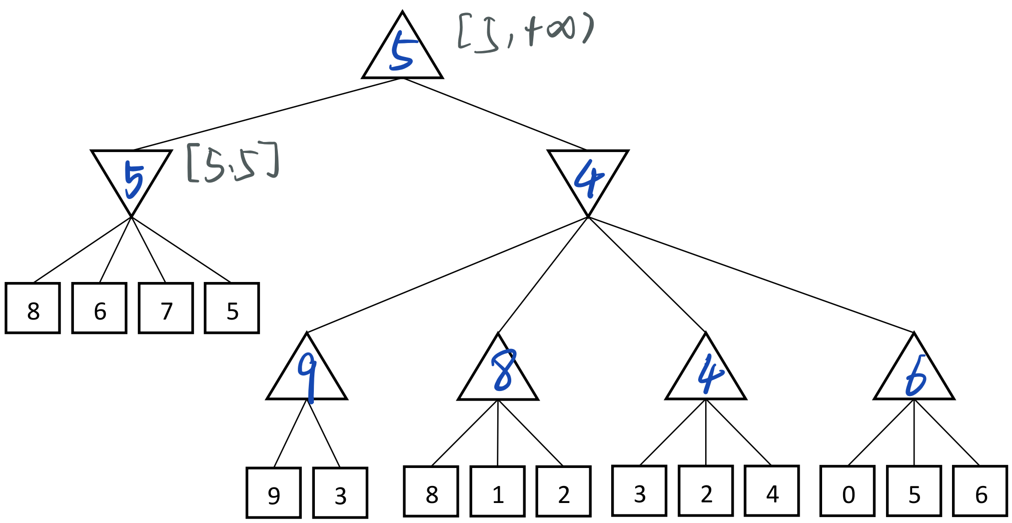
COMPSCI 402 Artificial Intelligence

Assignment 5 – Game tree   Total points: 8-point

Q1. Minimax. Upward triangle nodes are maximizer nodes and downward are minimizers.



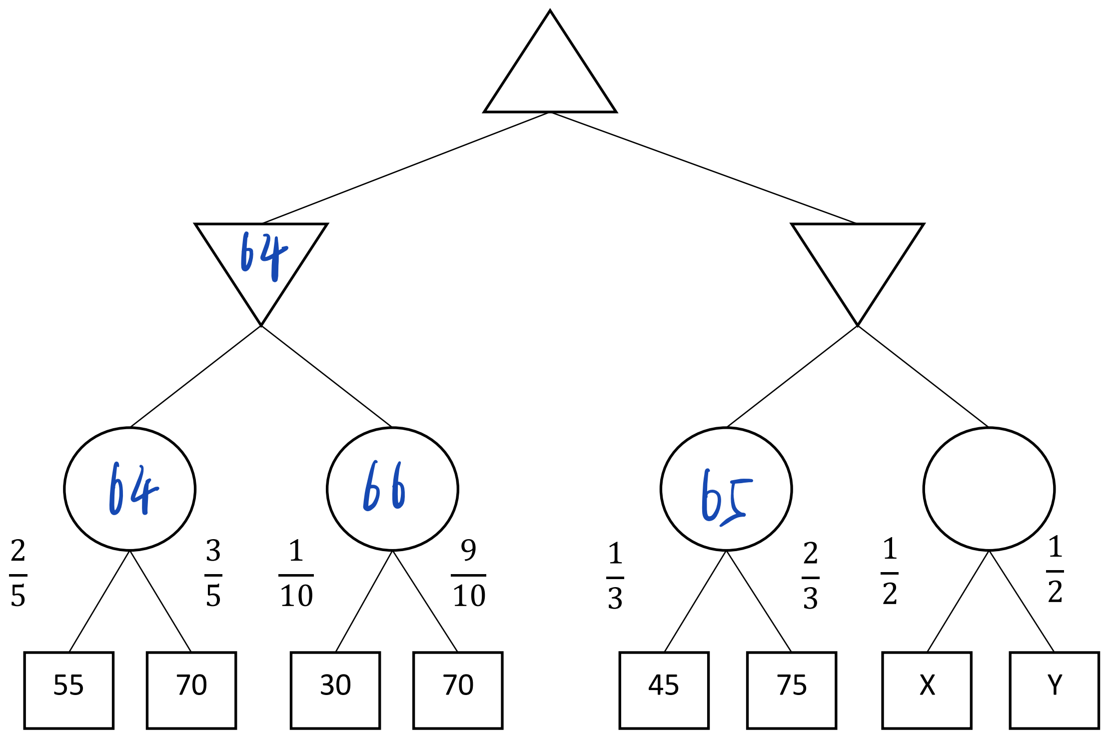
1) Complete the game tree shown above by filling in values on the maximizer and minimizer nodes. (0.5-point)
2) Indicate which nodes can be pruned by marking the edge above each node that can be pruned (you do not need to mark any edges below pruned nodes). In the case of ties, please prune any nodes that could not affect the root node's value. Fill in the bubble below if no nodes can be pruned. (1-point)

◯ No nodes can be pruned

4 - 6 、8 - 2 can be pruned

Q2. Pacman is playing a tricky game. There are 4 portals to food dimensions. But, these portals are guarded by a ghost. Furthermore, neither Pacman nor the ghost know for sure how many pellets are behind each portal, though they know what options and probabilities there are for all but the last portal.
Pacman moves first, either moving West or East. After which, the ghost can block 1 of the portals available.

You have the following game tree. The maximizer node is Pacman. The minimizer nodes are ghosts and the portals are chance nodes with the probabilities indicated on the edges to the food. In the event of a tie, the left action is taken. Assume Pacman and the ghosts play optimally.

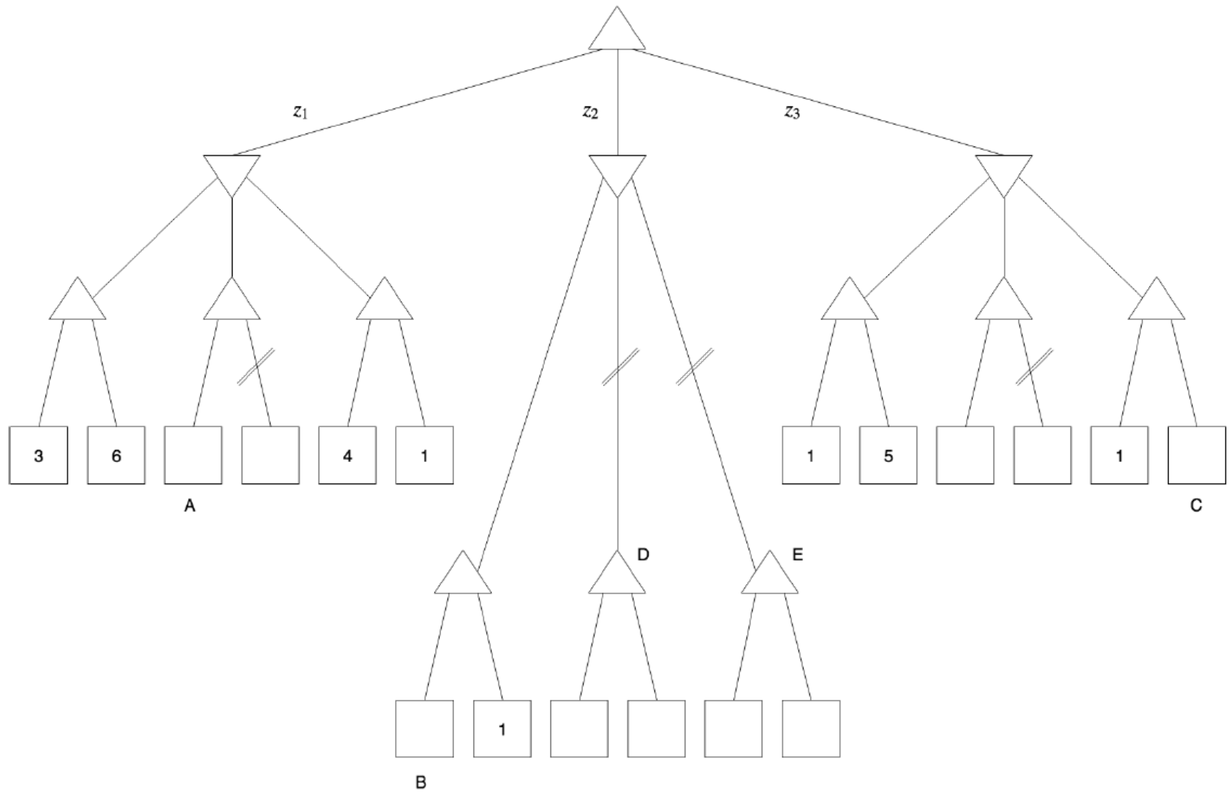


1) Fill in values for the nodes that do not depend on X and Y . (0.5-point)
2) What conditions must X and Y satisfy for Pacman to move East? What about to definitely reach the P4? Keep in mind that X and Y denote numbers of food pellets and must be whole numbers: $X, Y \in \{0,1,2,3,\cdots\}$ (1-point)

To move EAST: $X+Y > 128$

To reach P4: $X+Y = 129$

Q3. Consider the minimax tree below. whose leaves represent payoffs for the maximizer. The crossed-out edges show the edges that are pruned when doing naive alpha-beta pruning visiting children nodes from left to right. Assume that we prune on equalities (as in, we prune the rest of the children if the current child is $\leq \alpha$ (if the parent is a minimizer) or $\geq \beta$ (if the parent is a maximizer)).



1) Fill in the inequality expressions for the values of the labeled nodes A and B. Write ∞ and $-\infty$ if there is no upper or lower bound, respectively. (2-point)
   a. 6 $\leq A \leq$ ∞
   b. $-\infty$ $\leq B \leq$ 4

2) Suppose node B took on the largest value it could possibly take on and still be consistent with the pruning scheme above. After running the pruning algorithm, we find that the values of the left and center subtrees have the same minimax value, both 1 greater than the minimax value of the right subtree. Based on this information, what is the numerical value of node C? (1-point)

○1 ○2 ●3 ○4 ○5 ○6 ○7 ○8 ○9 ○10

3) For which values of nodes D and E would choosing to take action z_2 be guaranteed to yield the same payoff as action z_1? Write ∞ and $-\infty$ if there is no upper or lower bound, respectively (this would correspond to the case where nodes D and E can be any value). (2-point)
   a. 4 $\leq D \leq$ ∞
   b. 4 $\leq E \leq$ ∞