

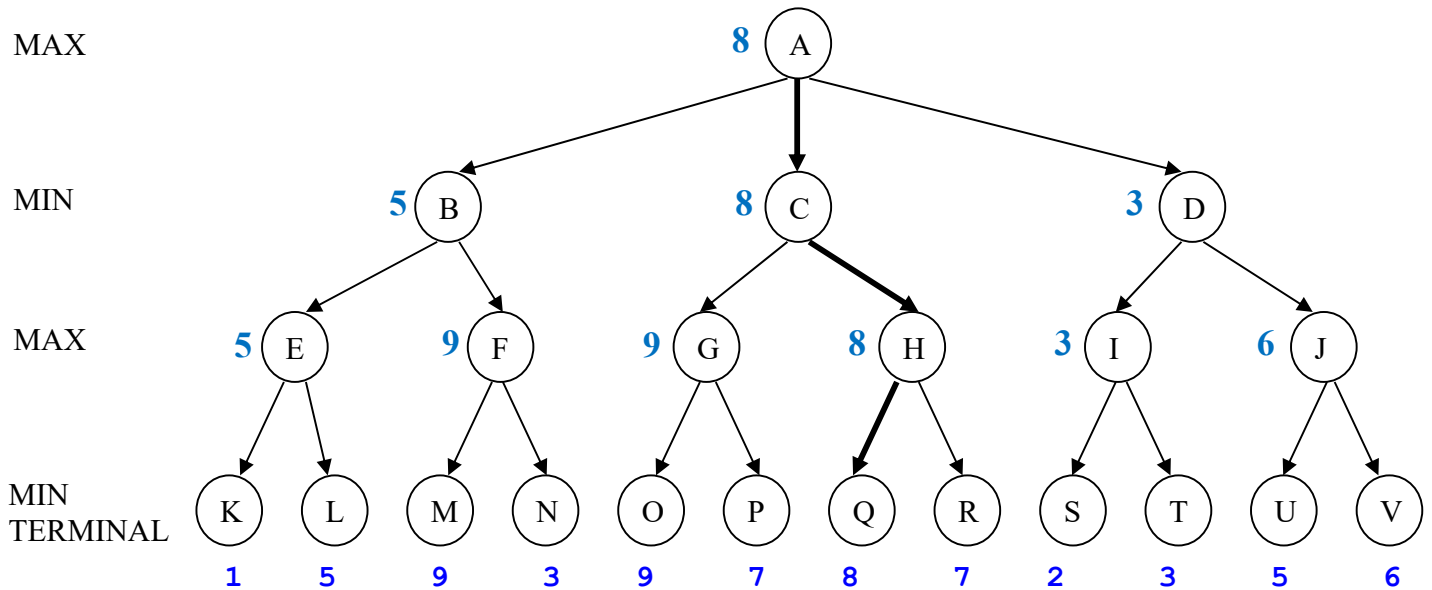
COS30019 - Introduction to Artificial Intelligence
Tutorial Problems Week 5

Task 1: For the following game tree:

(a) The first player (MAX) is trying to maximise the final score. Clearly indicate the max and min layers as part of your answer. Use minimax to determine the best move for MAX.

Path A->C->H->Q is the optimal one because in the worst case, the final utility is maximised

What if MIN does not play optimally? – The MAX's final utility can only increase!



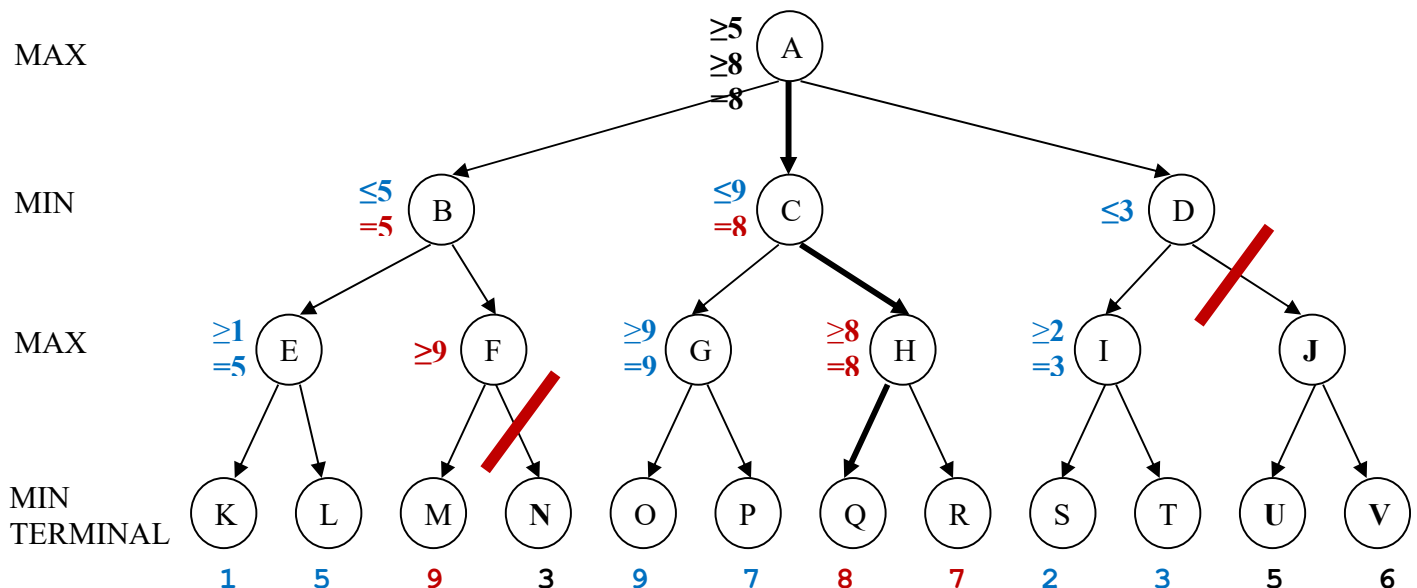
(b) Use minimax to determine the best move for MAX.

Path A->C->H->Q is the optimal one because in the worst case, the final utility is maximised

What if MIN does not play optimally? – The MAX's final utility can only increase!

(c) Which nodes will not be examined if the alpha-beta procedure is used? – N, J, U, V

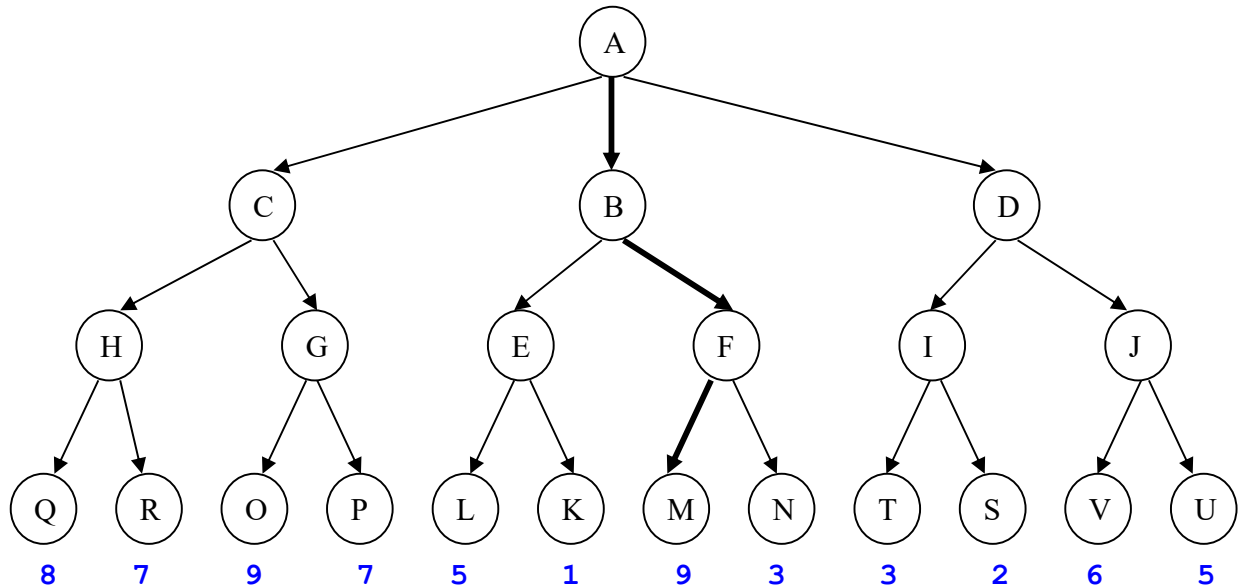
(d) In which order will the nodes be examined by the alpha-beta procedure? – DF search until the first leaf; after we backtrack verifying consistency. What if we change the order of nodes expansion?



(e) Did the alpha-beta procedure give the same best move (for MAX) as minimax?

Yes, both Alpha-beta and Minimax determine optimal solutions

(f) Draw a new game tree by re-ordering the children of each internal node, such that the new game tree is equivalent to the tree above, but alpha-beta pruning will prune as many nodes as possible. Which nodes will be pruned by the alpha-beta procedure in this case??

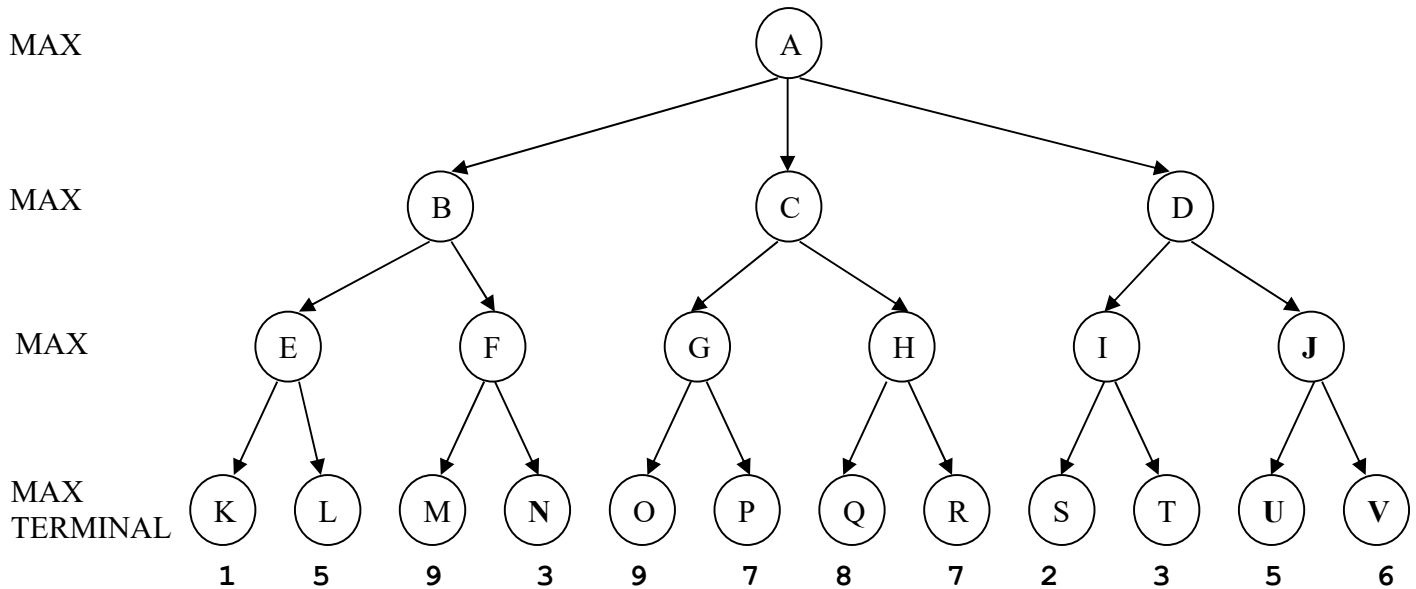


Exercises for you:

1. Find the nodes that will be pruned in the above tree.
2. For the original tree, if the question is changed into: "The first player (MIN) is trying to minimise the final score." Can you answer ALL the questions under this new assumption?

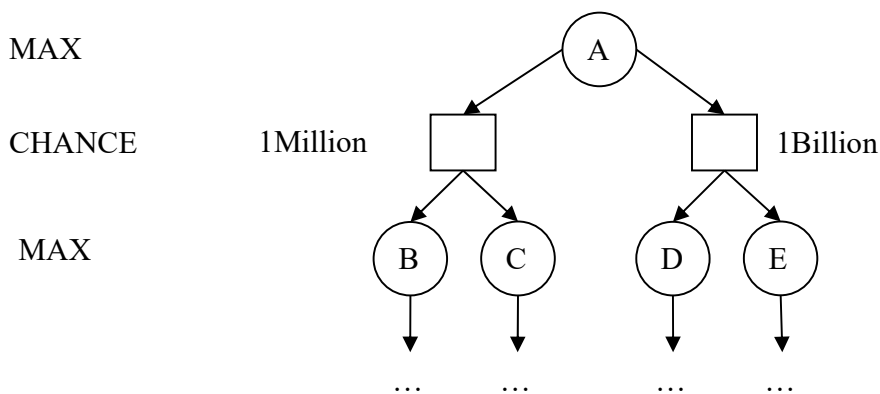
Task 2: In the following, a “max” tree consists only of max nodes, whereas an “expectimax” tree consists of a max node at the root with alternating layers of chance and max nodes. At chance nodes, all outcome probabilities are non-zero. The goal is to find the value of the root with a bounded-depth search.

- a) Assuming that leaf values are finite but unbounded, is pruning (as in alpha-beta) ever possible in a max tree? Give an example, or explain why not.



Leaf values are finite but unbounded means that the utility obtained in the final leaf can be any real number in a range $[-\infty, +\infty]$. In a MAX tree (there is no MIN opponent), the alpha-beta pruning would not prune any branch because the mechanism will always try to find the better MAX value and would expand all the nodes for this.

- b) Is pruning ever possible in an expectimax tree under the same conditions? Give an example, or explain why not.



Again, as leaf values are finite but unbounded means that the utility obtained in the final leaf node of the expectimax tree can be any real number in a range $[-\infty, +\infty]$, i.e potentially larger than any value at any other node (including both MAX nodes and CHANCE nodes). Thus, alpha-beta pruning would not

prune any branch because the mechanism will always try to find the better MAX value at the next branch (whether it is a MAX branch or a CHANCE branch) and would expand all the nodes for this. There is not much difference between MAX and EXPECTIMAX tree in this sense – only that CHANCE is the average value of the values in the nodes below.

Task 3: Take this as another exercise to help you get more practice with this. Alpha-beta pruning will prune Q and J. Did you get the right answer???