ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Εθνικόν και Καποδιστριακόν Πανεπιστήμιον Αθηνών

ΤΜΗΜΑ ΠΛΗΡΟΦΟΡΙΚΗΣ & ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ

Project 2

ARTIFICIAL INTELLIGENCE

Anna-Aikaterini Kavvada | NKUA | 01/12/2018

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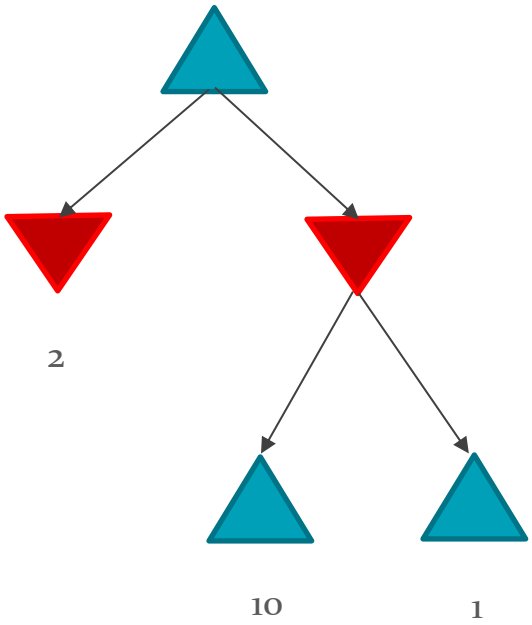
Problem 1

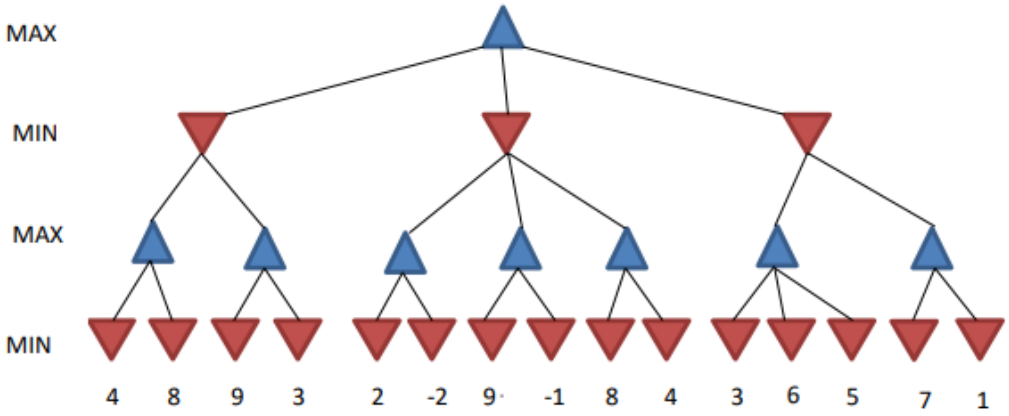
By definition, we know that a MIN player playing suboptimally means, that MIN selects a move with minimax utility greater than or equal to the move predicted by minimax. On the other hand, MAX player, maxes over these decisions. So, the minimax utility against a suboptimal is greater than or equal to the minimax utility against an optimal min decision.

e.g.



In the decision tree above, the optimal move for the MAX player is to select the move which leads to the leaf with utility value 2. But, in the case where MAX knows that player MIN is playing suboptimally, player MAX can select the right option. The utility value in this case is 1 against an optimal MAX and utility value 10 against a suboptimal MIN.

Problem 2.



a) As we see from the image above every node which is not a tree leaf will have the following values:

   MAX (rootNode): 8

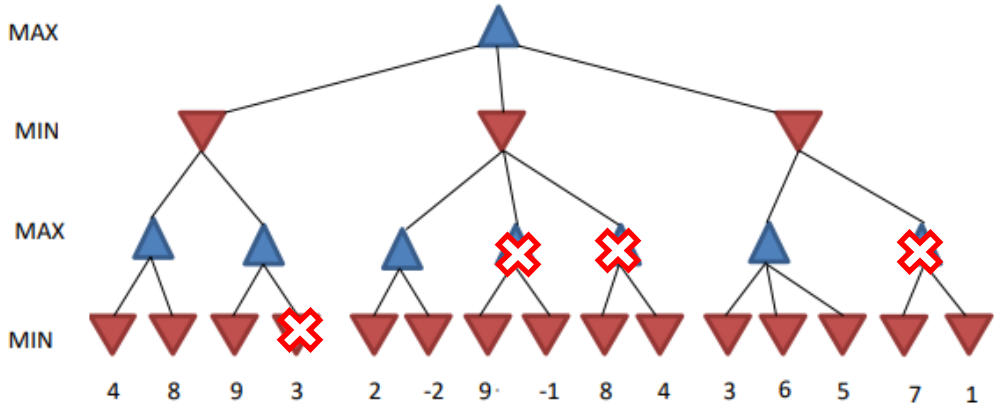
   MIN: 8, 2, 6

   MAX: 8, 9, 2, 9, 8, 6, 7

   MIN (tree leafs): 4, 8, 9, 3, 2, -2, 9, -1, 8, 4, 3, 6, 5, 7, 1

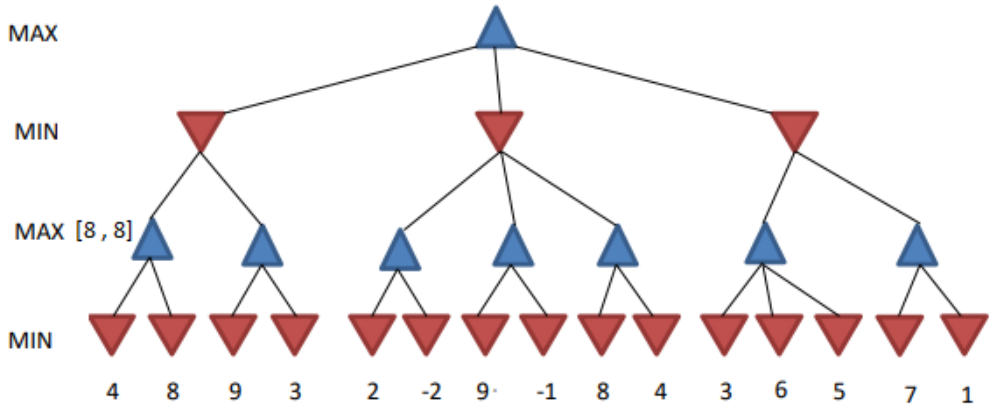
b) The rootNode as we have already seen in question (a) above is having the minimax decision 8.

c) While using the AB pruning algorithm, the nodes that are pruned are the following;

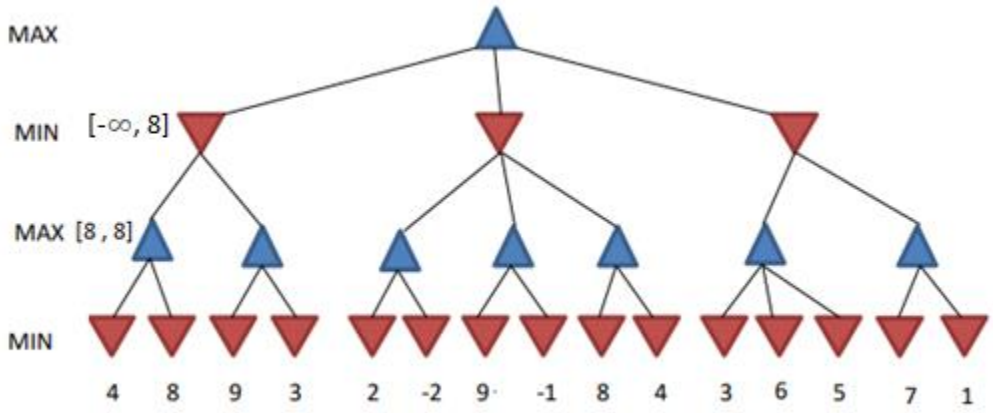


We get down the left bottom leaf of the above tree, as the AB pruning algorithm commands.

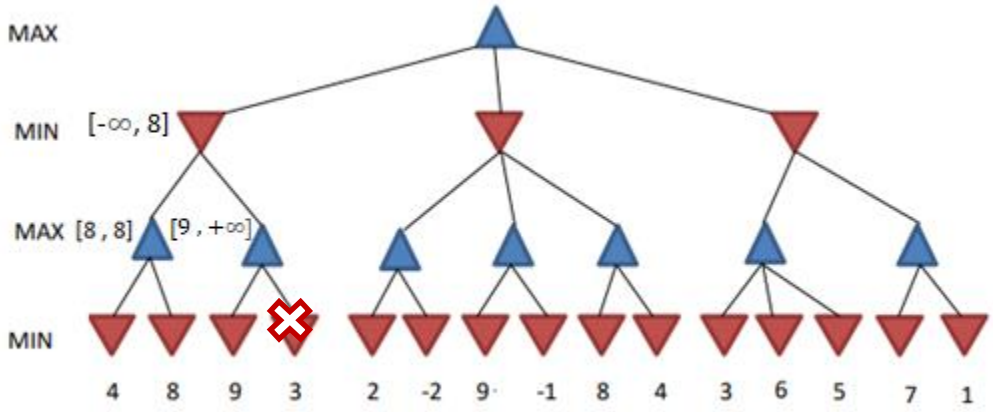
Step 1: value 8 is greater than 4 in the leafnodes, thus we choose value 8 for the MAX parent node (max(8 ,-∞) ➔ a = 8, b = +∞).



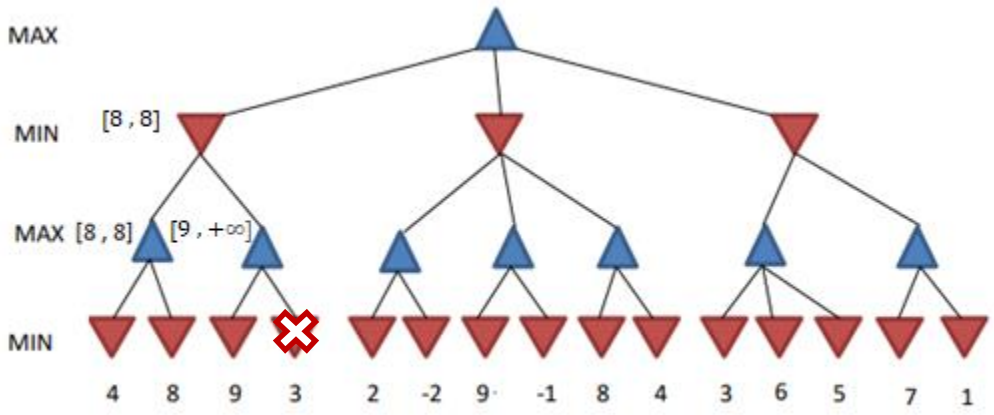
Step 2: The MIN parent node takes value 8. (a = -∞, min (8, +∞) ➔ b = 8)



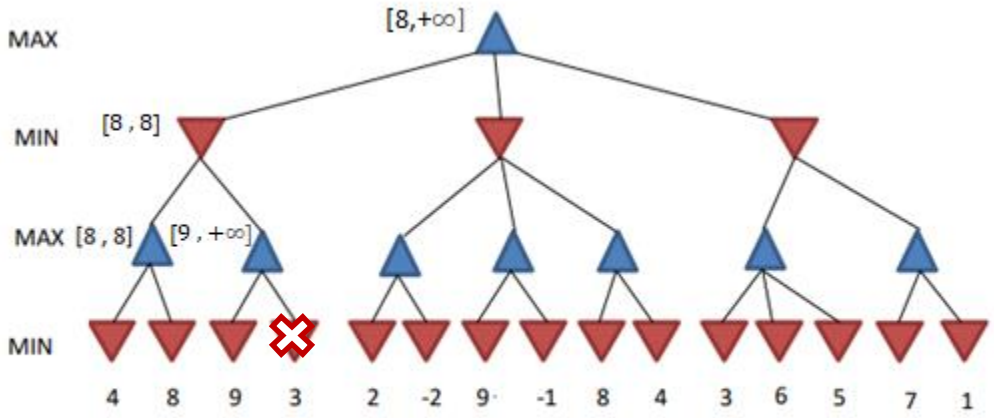
Step 3: We will keep searching the right branch where we find for the MAX node the value 9. Since 9 is the lesser value we can get from this node, we decide that there is no use to keep on searching. Thus, we prune the leaf with value 3.
(max (-∞,6) ➔ a = 6, min (8,9) ➔ b = 8)



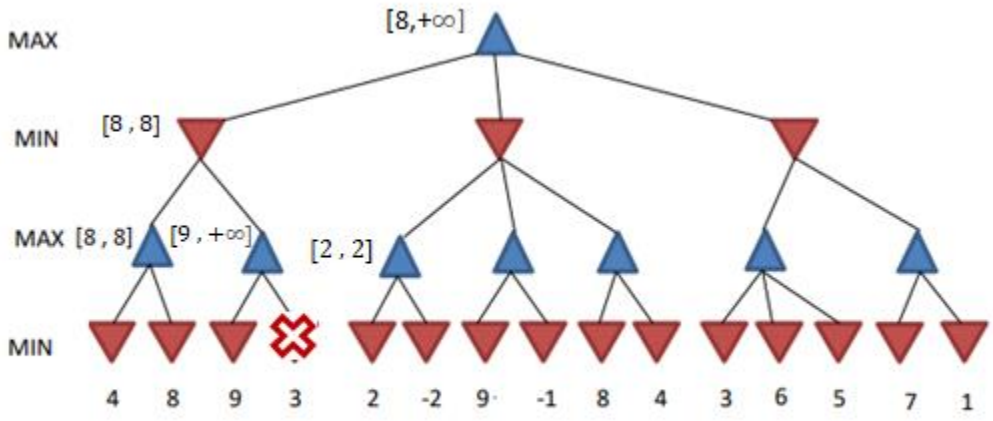
Step 4: The MIN parent node now is definite that gets the value 8.
(a = -∞, min (+∞,8) ➔ b = 8)



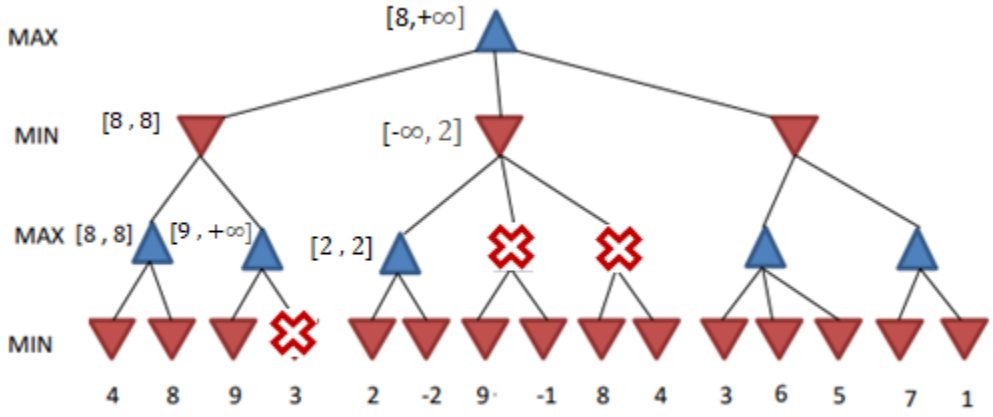
Step 5: The MIN node returns to the MAX rootNode the value 8
(max(-∞, 8) ➔ a = 8, b = +∞)



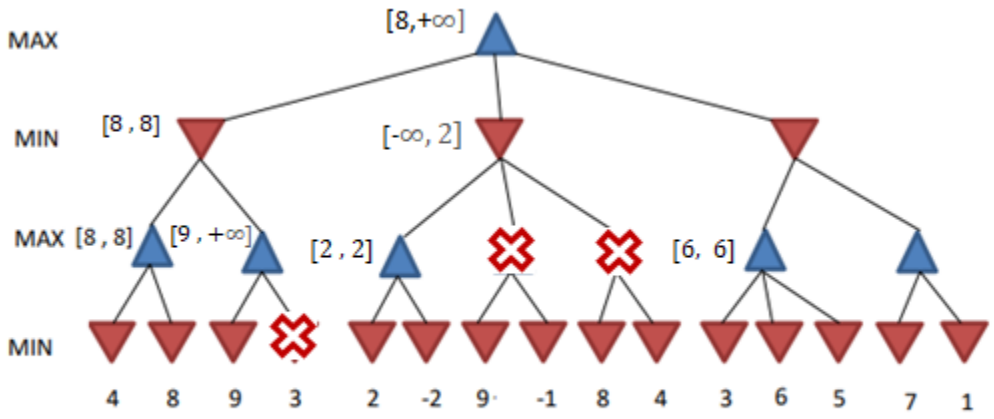
Step 6: Now the rootNode is guaranteed a value of 8 or greater. So, we keep searching for a greater value in the middle branch. In the lower MAX node, we pick value 2 (2 > -2). (max (2, 8) ➔ a = 8, b = +∞)



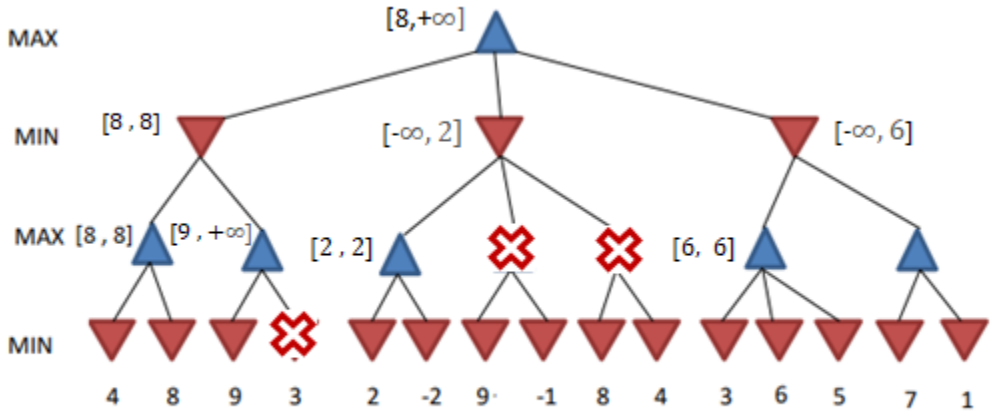
Step 7: Following the action in Step 6, the upper MIN node gets the value 2. (a = 8, min (2, +∞) ➔ b = 2). Since we have a >= b, there is no need to search any further this middle subtree. The value 2 returns to the MAX rootNode but 8 > 2, so we keep value 8 for the root. (a = 8, b = +∞))



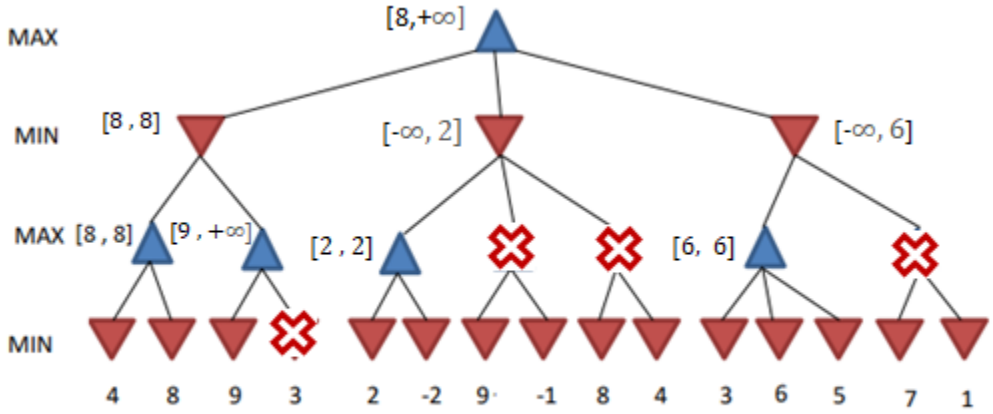
Step 8: The search keeps on going to the right most branch of our tree. From the left most leaf of this subtree we get the lower level MAX value of 6. (max (6, 8) ➔ a = 8, b = +∞)



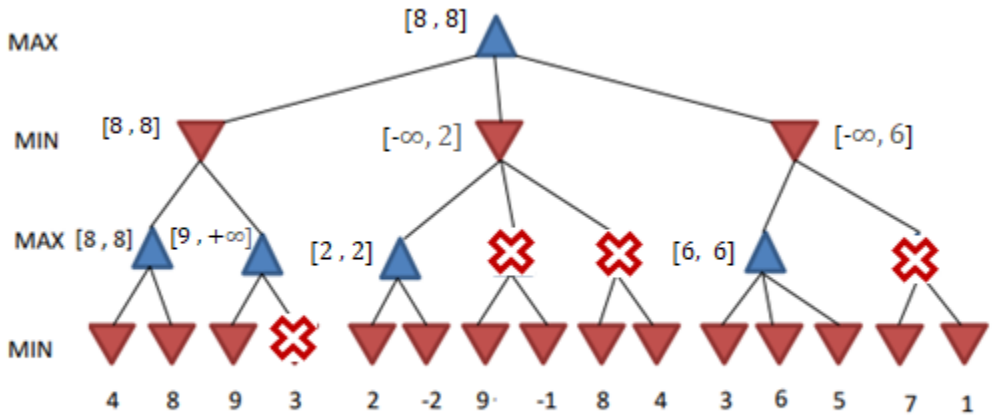
Step 9: The value 6 returns to the upper MIN parent node. (a = 8, min (6, +∞) ➔ b = 6)



Step 10: At this point, we decide whether we will keep on our search. But, a > = b. Thus, we won't search the right branch of this subtree.

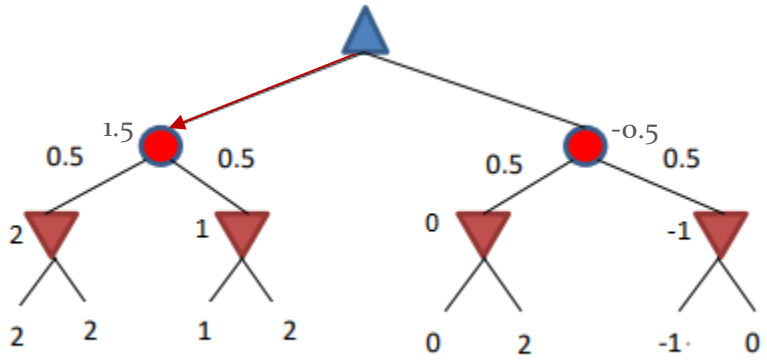


Step 11: The upper MIN node returns to the rootNode the value 6. Since the rootNode is a MAX node we get 8 > 6 and decide that the value of the rootNode is 8. (a = 8, b = +∞)



Problem 3

a)



b) The left branch is having the value 1.5. After checking the first six leaves, we still need to keep evaluating, since, in case the seventh and eighth leaf were both greater than 3, then we would prefer the right branch of the tree. Thus, we evaluate the seventh leaf and we find that the value of the right branch will at most be -0.5. So, we conclude, that there is no need for any further evaluation.

c) After the evaluation of the first two leaves, the value range of the left chance node shall be between [0 , 2]. (0 and 2 are included)

d) As we see on the image below, the three right most leaves (6th, 7th and 8th), do not need to be evaluated, since after the evaluation of the first five, we know that the right tree branch is between -2 and 1, thus, inferior to the left branch of the tree.