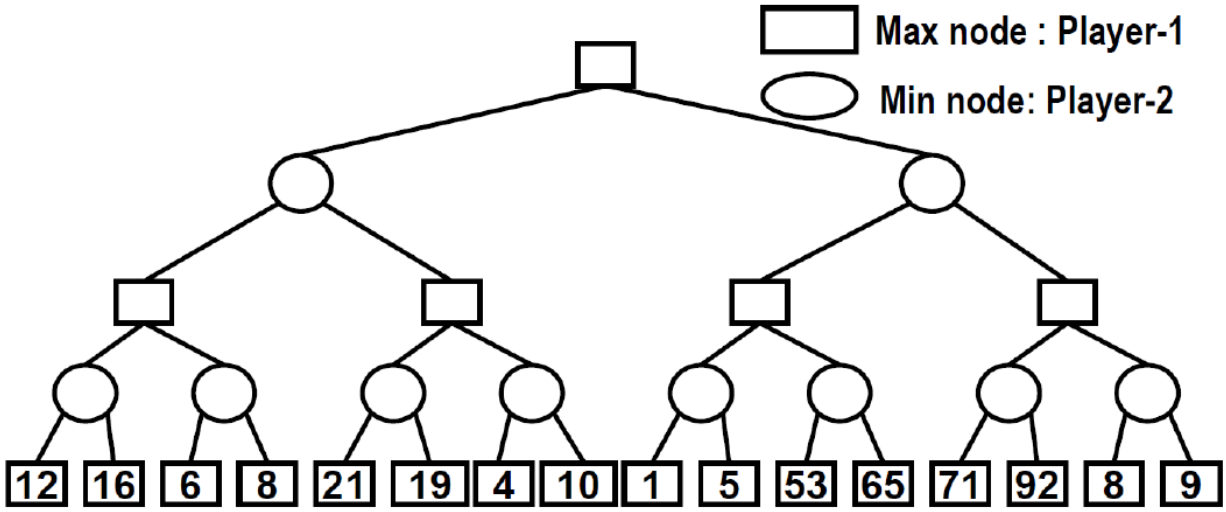
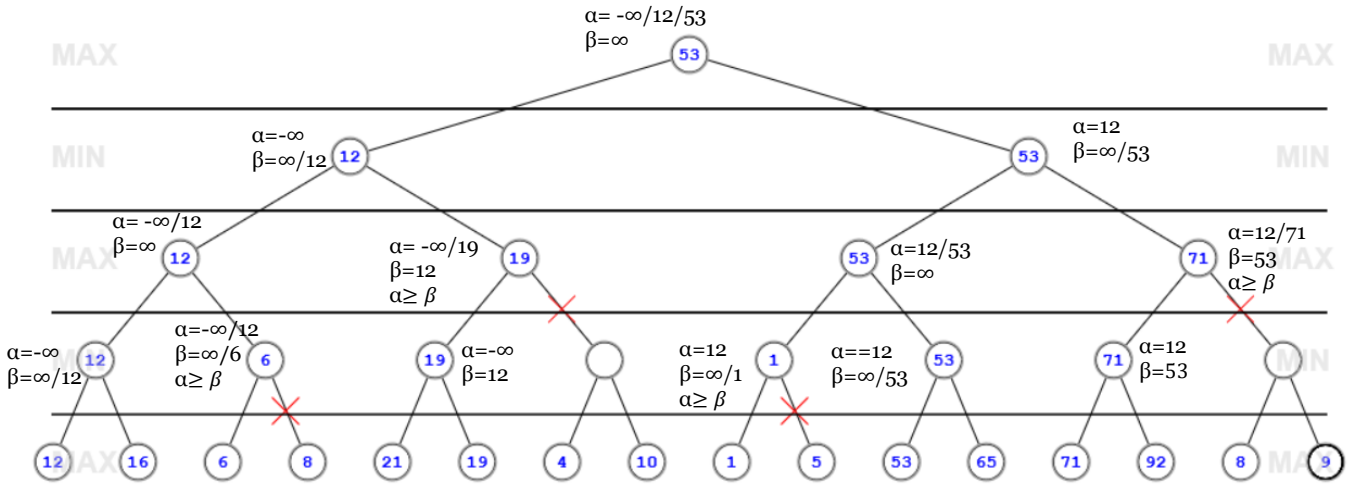
AIFA TUTORIALS: August 05 2022

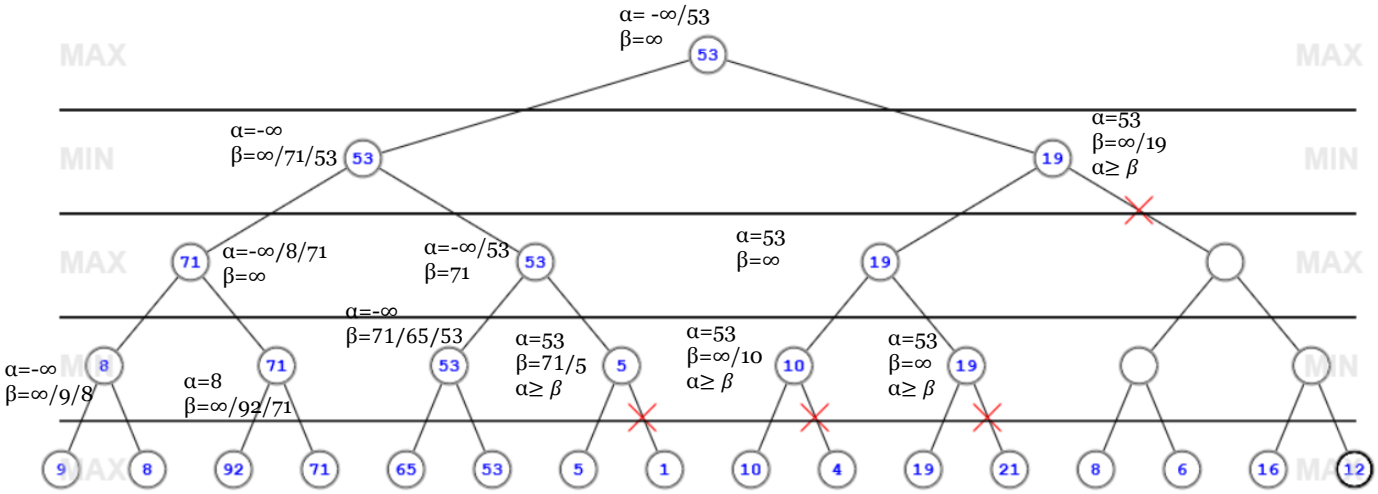
1. Consider the Game Tree given below



Present the working of the alpha-beta pruning algorithm under these situations:

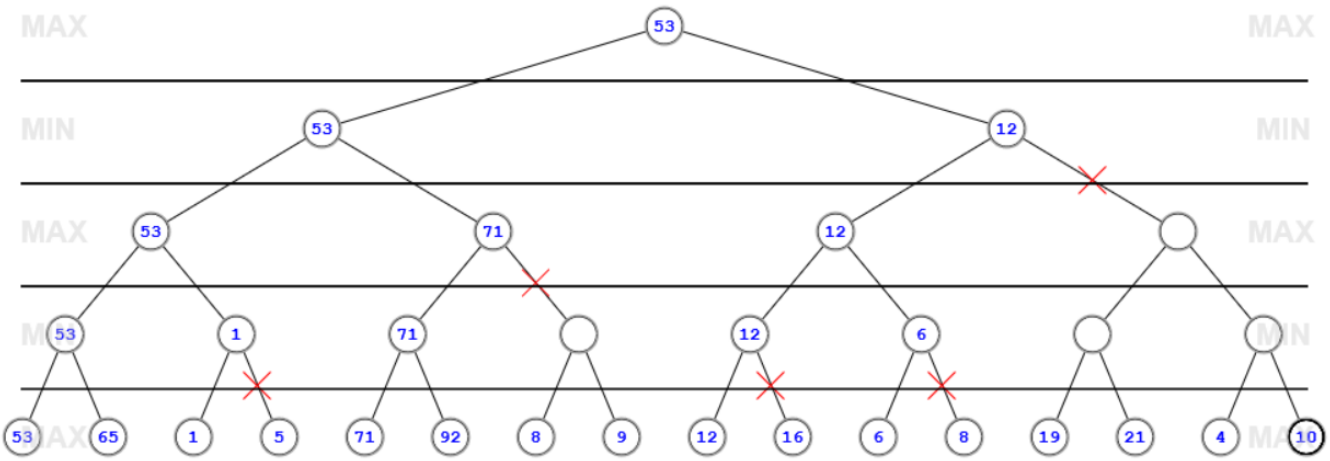
(a) When we see successors from left to right
(b) When we see successors from right to left.

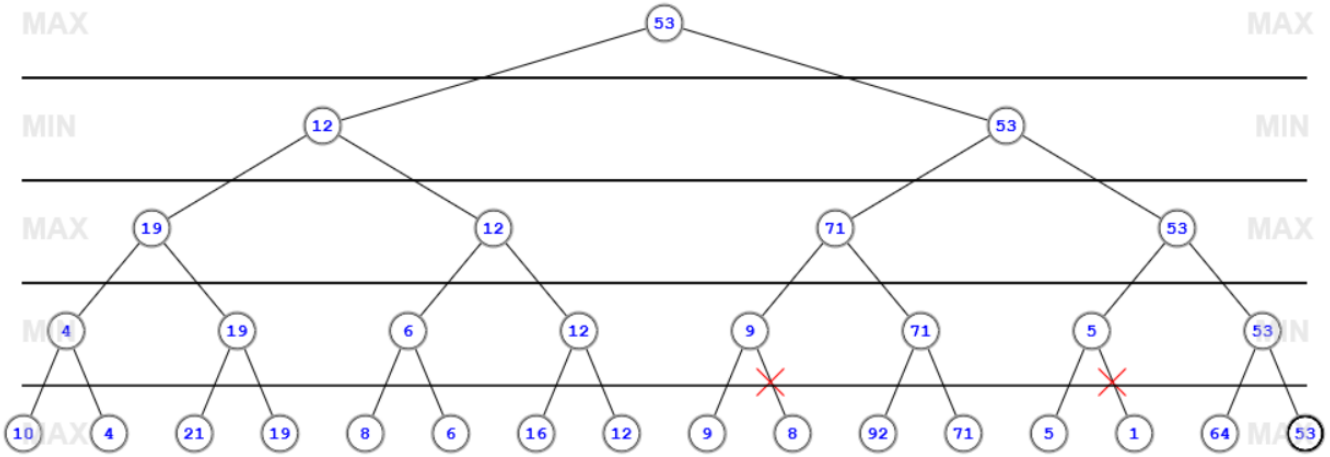




2. Given the above game tree what is the best leaf node ordering (leading to maximum pruning) or worst leaf node ordering (leading to minimum pruning) for alpha-beta? You have to keep node pairs in the leaf level together (e.g., [12,16], [6,8]), though you may change the order of values in the pair (e.g., [12,16] can be rearranged as [16,12]).

   To ensure best pruning, the MAX player should have the highest value at the leftmost branch and the MIN player should have the lowest value in the leftmost branch





3. Comment on the following statements with justification:
   (a) Alpha-beta pruning can alter the computed minmax value of the root of a game tree.
   (b) When doing alpha-beta pruning from left to right, the leftmost branch will never be pruned.

(a) FALSE. Alpha-beta only prunes some of the unnecessary min-max evaluation. But the min-max values remain the same.
(b) TRUE. The leaf on the extreme left is the one that is examined first, and we can't prune a branch before evaluating the leaf or we can say there is no alternative to pruning at the leftmost branch of the game tree.

4. In a town in Utopia, people from different religions live harmoniously. It has been a feature that neighbour families do not belong to same religion. Another interesting feature of this town is that it hosts families from every possible religion. Below are presented some facts about the town. Translate them into First-Order-Logic (FOL).
   (a) For each religion, there is at least one family with that religion in the town.

$$\forall_r \exists_f family(f) \wedge religion(f, r)$$

   (b) Neighbouring families do not have the same religion.

$$\forall_{f1} \forall_{f2} \forall_r \; neighbor(f1, f2) \wedge religion(f1, r) \Rightarrow \neg religion(f2, r)$$

   (c) The town contains only 2 Jewish families.

$$\exists_{f1} \exists_{f2} religion(f1, Jewish) \wedge religion(f2, Jewish) \wedge (f1 \neq f2) \wedge \forall_{f3} (f1 \neq f3) \wedge (f2 \neq f3) \Rightarrow \neg religion(f3, Jewish)$$

   (d) Starting from a Buddhist family one can reach a Bahai family within 4 steps.

$$\forall_f \; religion(f, Buddhist) \Rightarrow (\exists_{f1} neighbor(f, f1) \wedge religion(f1, Bahai)) \vee (\exists_{f1} \exists_{f2} \; neighbor(f, f1) \wedge neighbor(f1, f2) \wedge (f \neq f1 \neq f2) \wedge religion(f2, Bahai)) \vee (\exists_{f1} \exists_{f2} \exists_{f3} \ldots) \vee (\exists_{f1} \exists_{f2} \exists_{f3} \exists_{f4} \ldots)$$

5. Represent following statements in First-Order-Logic
   (a) Some students of AIFA course have got placed in Google and rest has been placed in Facebook

$$\exists_x \; student(x) \wedge taken(x, AIFA) \wedge placedIn(x, Google) \wedge \forall_y \; student(y) \wedge taken(y, AIFA) \wedge (x \neq y) \Rightarrow placedIn(x, Google)$$

   (b) Something that glitters is not always gold, whereas the gold always glitters.

$$\exists_x \; glitter(x) \wedge \neg gold(x) \wedge \forall_y \; gold(y) \Rightarrow glitter(y)$$

   (c) Only one student took Hieroglyphics in Autumn 2022.

$$\exists_x \; student(x) \wedge taken(x, Hieropglyphics) \wedge \forall_y \; student(y) \wedge taken(y, Hieroglyphics) \Rightarrow x = y$$

   (d) No student participated in Marathon but at least one student participated in Hackathon.

$$\neg\exists_x\big(student(x) \wedge \neg participated(x, Marathon)\big) \wedge \exists_y(student(y) \wedge participated(y, Hackathon))$$