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Minimax Algorithm with Alpha-beta Pruning

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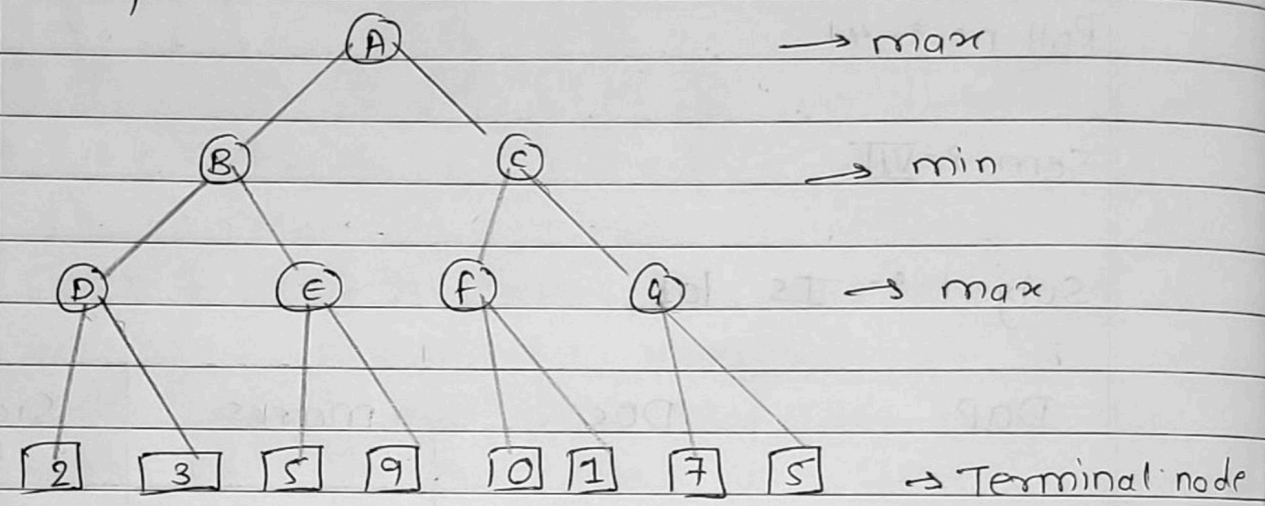
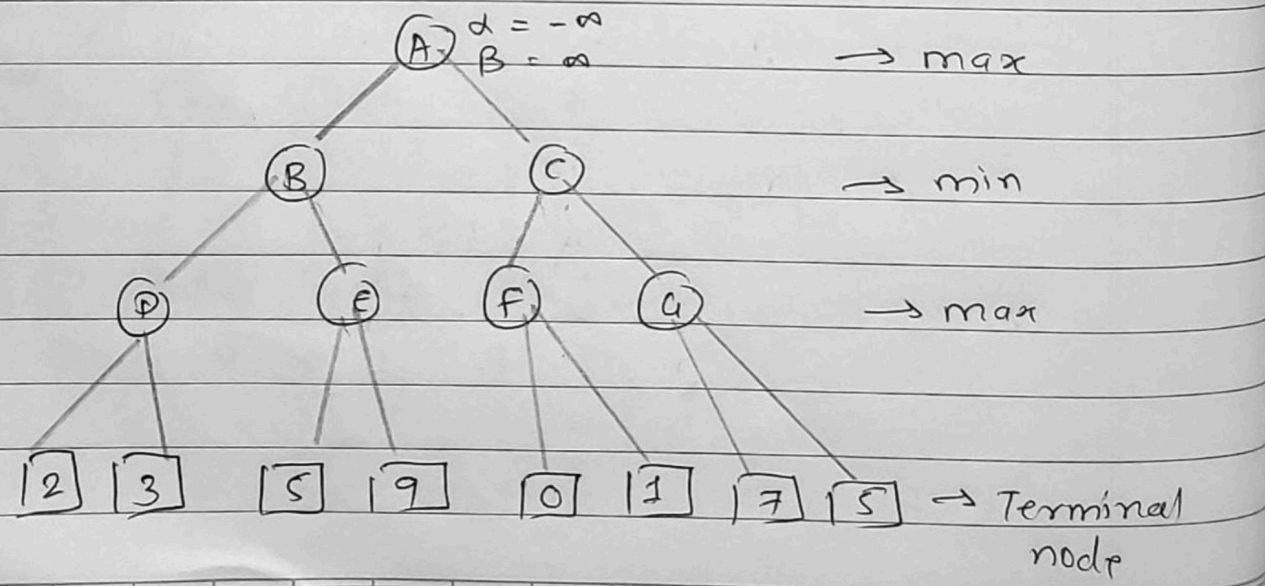
* Minimax Algorithm with Alpha-beta pruning
- Alpha beta pruning is a modified version of the minimax algorithm. It is an optimization technique for the minimax algorithm.

* example



Step 1 :- At the first step, the max player will start first move from node A where $\alpha = -\infty$ & $B = +\infty$ these value of alpha and beta passed down to node B where again $\alpha = -\infty$ and $B = +\infty$ and Node B passes the same value to its child D.



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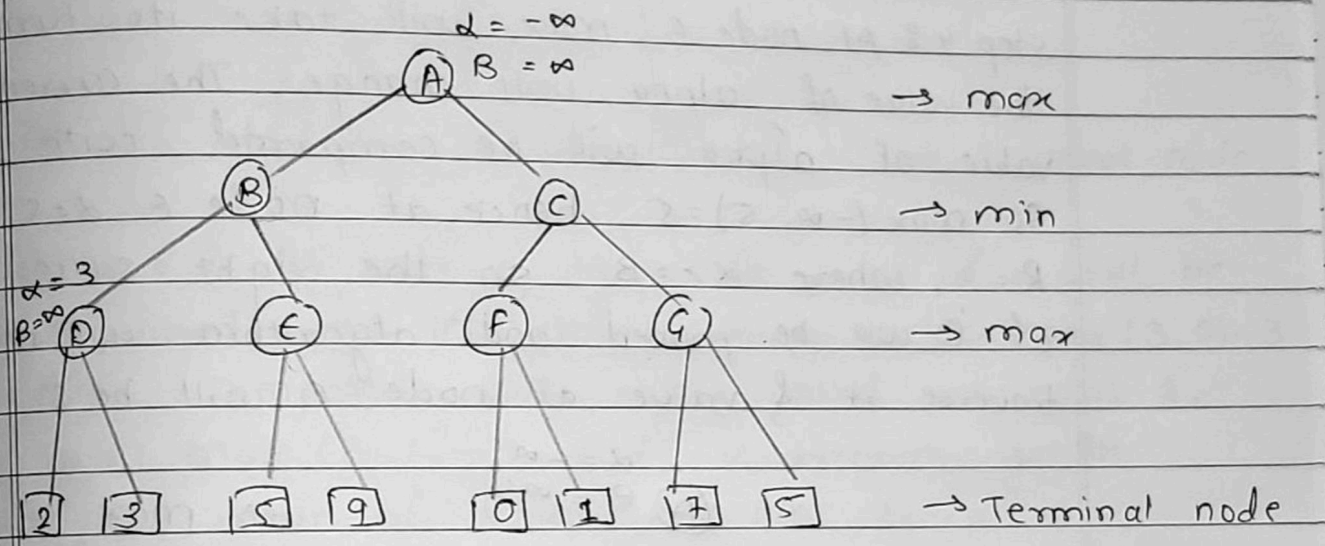
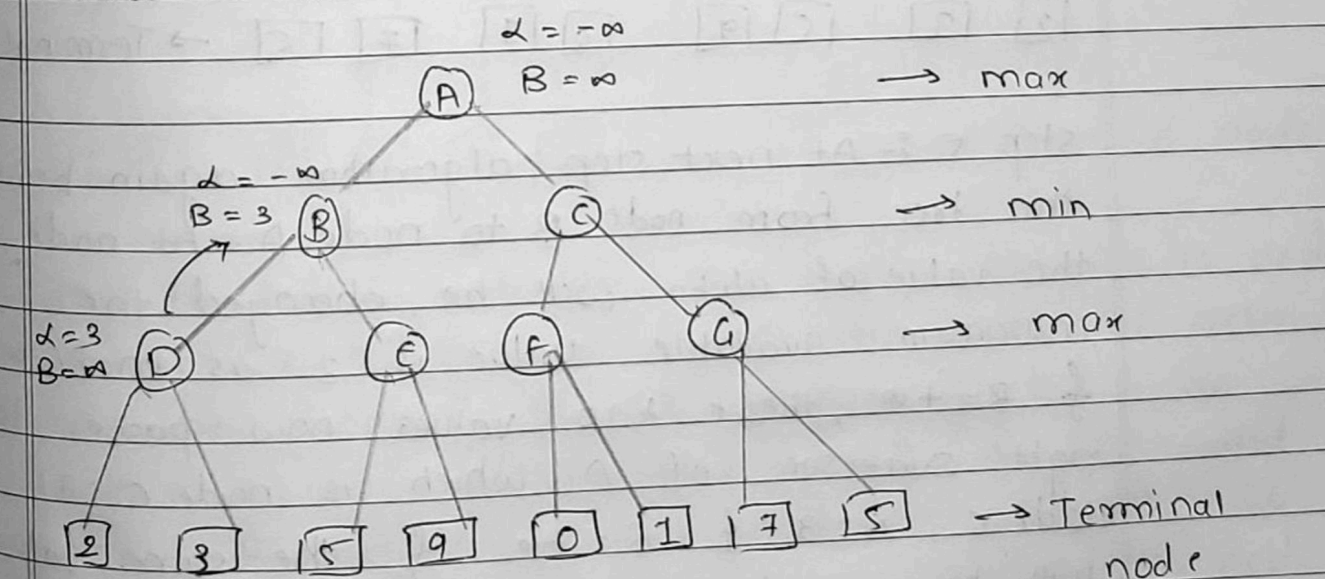
Step 2 :- At node D, the value of α will be calculated as its turn for max. The value of α is compared with firstly 2 and then 3 and the $\max(2,3) = 3$ will be value of α at node D and node value will also 3.



Step 3 :- Now algorithm back track to node B, where the value of B will change as this is turn of min, Now $B = +\infty$ will compare with available subsequent nodes value i.e. $\min(\infty, 3) = 3$, hence at node B now $\alpha = -\infty$, $B = 3$



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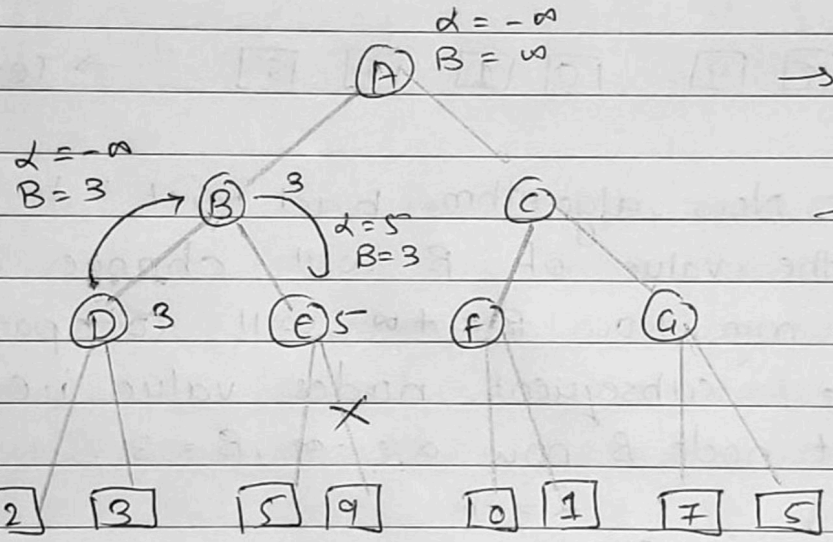
In the next step, algorithm traverse the next successor of Node B which is node E, and the value of $\alpha = -\infty$ and $B = 3$ will also be passed.

Step 4 :- At node E, max will take its turn and the value of alpha will change. The current value of alpha will be compared with 5, so $\max(-\infty, 5) = 5$, hence at node E $\alpha = 5$ & $B = 3$, where $\alpha >= B$, so the right successor of E will be pruned and algorithm will not traverse it & value at node E will be 5.



Step 5 :- At next step, algorithm again backtract the tree, from node B to node A. At node A, the value of alpha will be changed the maximum available value is 3 as $\max(-\infty, 3) = 3$ & $B = +\infty$, these two values now passes to right successor of A which is node C. At node C, $\alpha = 3$, & $B = +\infty$ & the same value will be passed on to node F.

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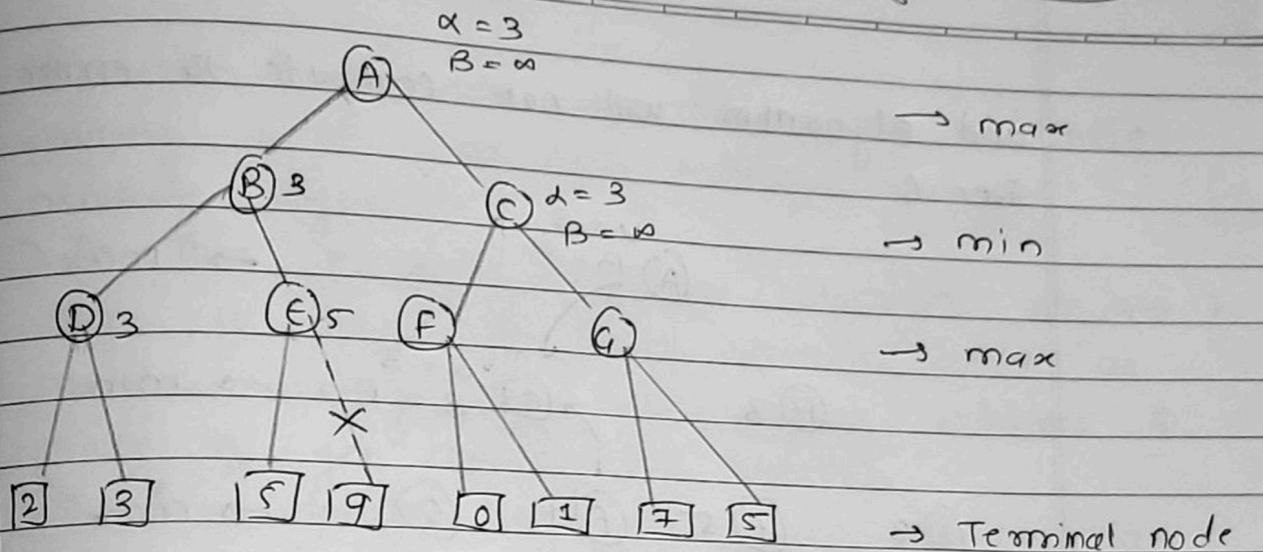
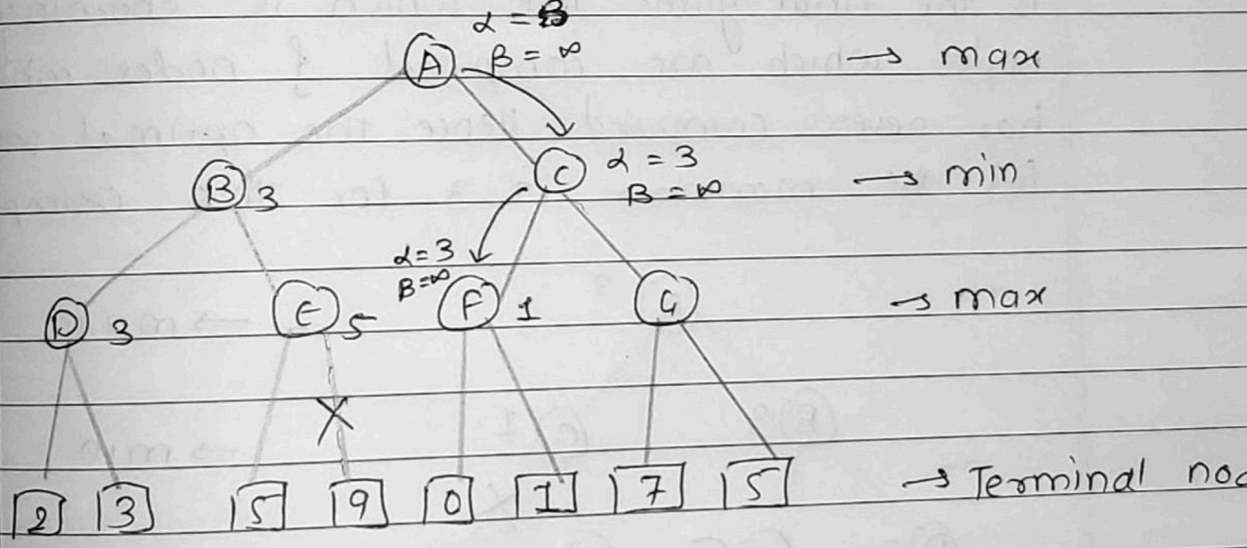


step 6 :- At node f, again the value of α will be compared with left child which is 0, max(3, 0) = 3 then compared with right child which is 1, and max(3, 1) = 3 still α remains 3 the node value of f will become 1



Step 7:- Node f returns the node value 1 to node C, at C α = 3, β = +∞, there the value of beta will be changed, it will compare with 1 so min(α, 1) = 1, Now at c, α = 3 & β = 1 and again it satisfies the condition α >= β, so next child of c which is G will be pruned

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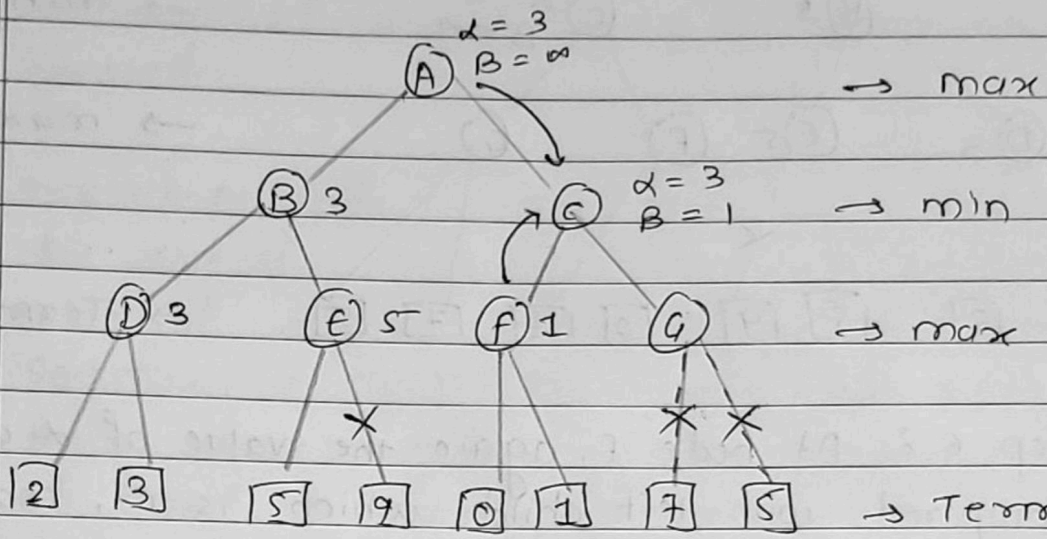
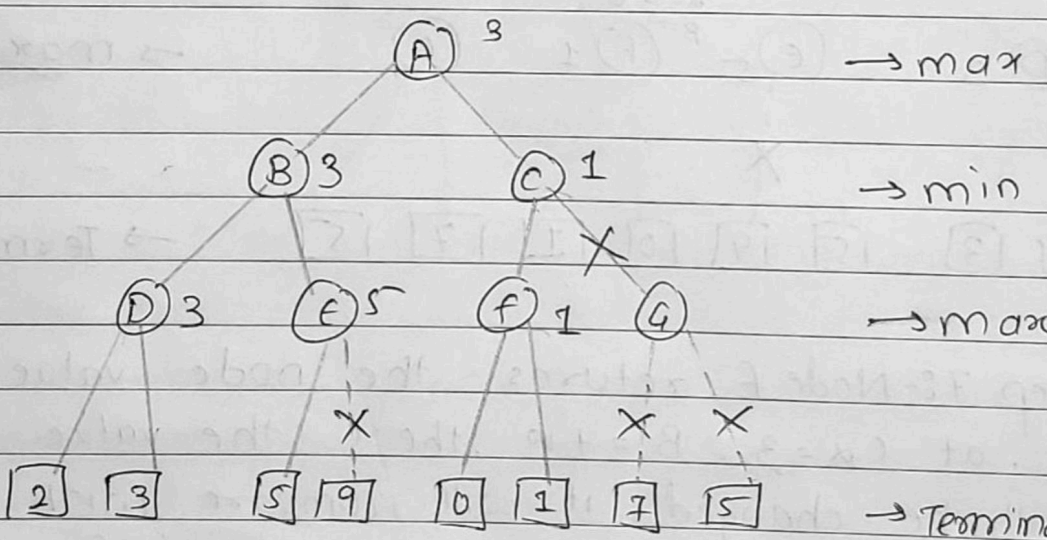
and algorithm will not compute the entire sub tree G



step 8 :- C, Now return value of 1 to A here the best value for A is max(3, 1) = 3. following is the final game tree which is showing nodes which are computed & nodes which has never computed. Hence the optimal valur for the maximizer is 3 for this example.



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Conclusion :- minimax algorithm using alphabeta pruning is an optimization technique for the minimax algorithm.

① In this example min-max algorithm requires 7 steps to obtain the final answer where as minimax using alphabeta pruning requires 6 steps to get obtain the answer.

② Therefore alphabeta pruning is an optimization technique for the minmax algorithm.

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