Name:- Pratik Sunil Gaikwad
TE-A-39
A.I

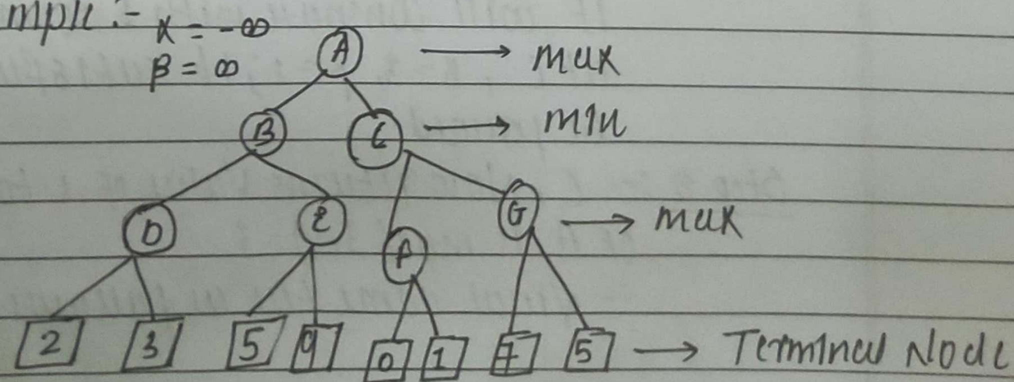
* Assignment No-03 *

Q.1 Explain the Min-max and Alpha beta pruning algorithm For adversal search with an Example.

→ 1/ The Min-Max algorithm computes minimax decision From the current state.
2/ It is used as searching technique in game problems.
3/ The Min-max algorithm complete depth-first exploration of game tree.

* algorithm :-
1/ Start Node is Max Node with current board configuration.
2/ Expand Nodes down to some depth of look ahead in the game.
3/ Apply Evaluation function at each of leaf Nodes.
4 Back up Values for each non-leaf nodes until computed For root node.
5/ At Min Nodes, the backed up Value is minimum of Values associated with children.
6/ At Max Nodes, backed up Value is maximum of Values associated with its children.

* Example :-



Step1 :- At first step, max player will start first move From Node A where $\alpha = -\infty$, $\beta = \infty$, these value pass to B where again $\alpha = -\infty$, $\beta = +\infty$, B passes to D

Step2 :- At Node D, value of α will be calculated for max. Value of α is compared with 2 and 3 (2,3) = 3 will be value α at node D & Node value will also 3.

Step 3 :- Now Algo, backtrack to Node B, value of β will change as its turn of min, $\beta = +\infty$; compare with available Node value; min(∞, 3) = 3, hence at Node B and now $\alpha = -\infty$, $\beta = 3$

Step 4 :- At Node E, max will take its turn, and value of α will change. current value of α will compared with 5 so max($-\infty$, 5) = 5; hence at Node E, $\alpha = 5$, $\beta = 3$; where $\alpha >= \beta$, Now value of E will be 5

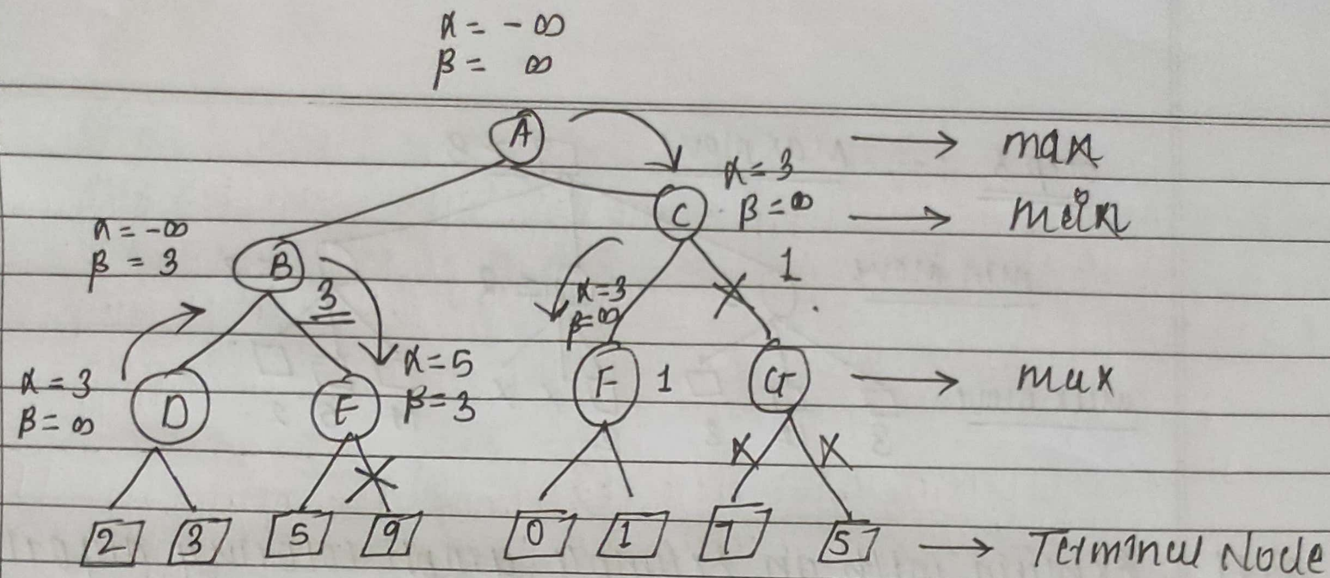
Step 5 :- At Next step, algorithm backtrack tree, At Node C, $\alpha = 3$, $\beta = +\infty$, same values will passed to Node F.

Step 6 :- At F, again compare with left child; max (3,2)=3 and then compare with right child which is 1; max (3,1) = 3 Now Node of F will be 1

Step 7 :- at C; $\alpha = 3$ and $\beta = +\infty$, here β will be changed. It will compare with 1 so min(∞, 1) = 1 Now at C, $\alpha = 3$, $\beta = 1$; It satisfies $\alpha >= \beta$ so, G will be pruned.

Step 8 :- C, Now returns value of 1 to A, here best value of A is max(3,1) = 3

- final game tree as follows :-



* Alpha Beta pruning →

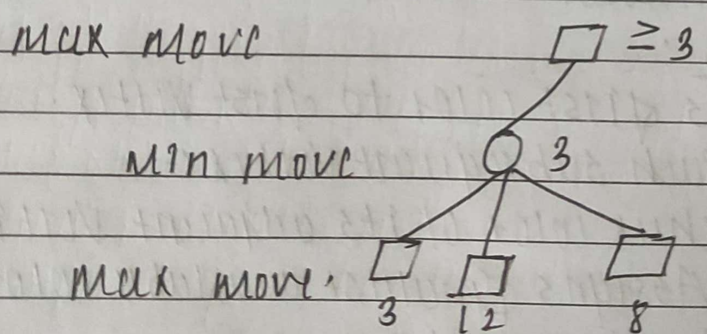
Algorithm:-

i) The problem with Min-max algorithm search is that number of game states it has to examine is exponential in number of moves.

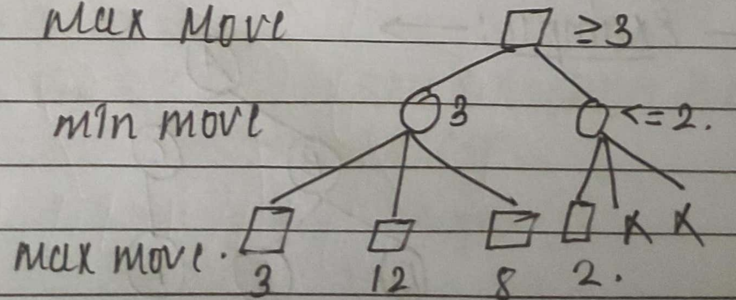
ii) α-β proposes to compute the correct minimax algorithm decision without looking at every node in game tree.

Example:-

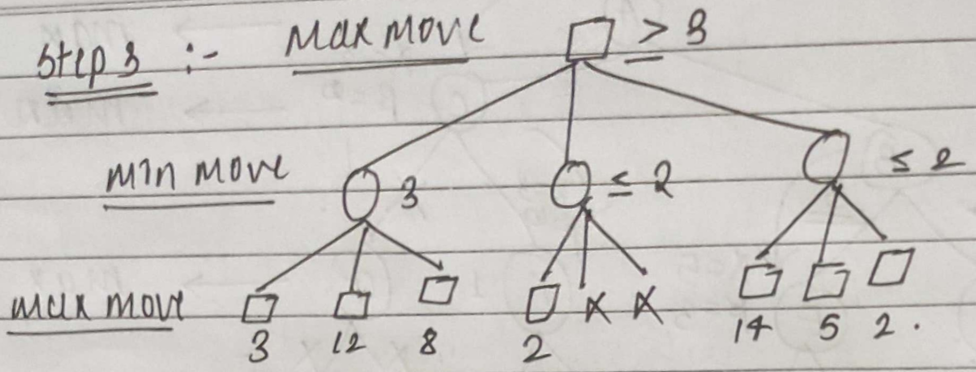
* Step 1:-



* Step 2:-



Step 3 :- Max move



Q.21 Explain with an example graph coloring algorithm.

→ 1] Graph coloring Algorithm is way of labelling a graph such that no two adjacent Nodes (vertices) share same color.

2] It is widely used in application such as no scheduling problems, register allocation in compilers.

* Algorithm :→

- The greedy algorithm assigns colors to each vertex one by one while ensuring that adjacent vertices do not have same color.

- Steps :-

i] Assigns first color to first vertex.

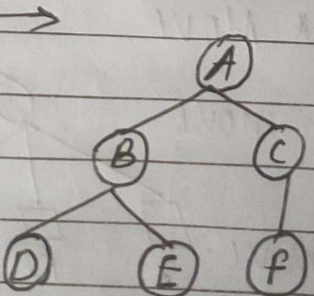
ii] For each subsequent vertex :-

1] check color of its adjacent vertices

2] Assigns smallest available color that's not used by its neighbour.

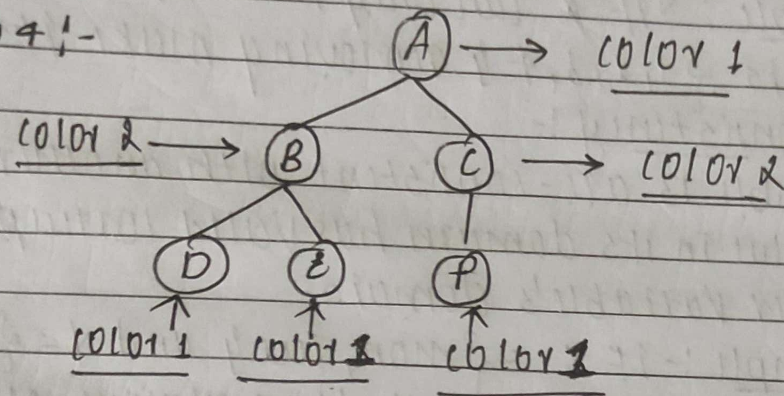
iii] Repeat until all vertices are colored.

* Example :→



Step 1 :- Start with A → Assign color 1.
Step 2 :- Move to B and C → Assign color 2 . (Adjacent to A)
Step 3 :- Move to D, E, F → Assign color 1 (Adjacent to B or C)

Step 4 :-



Q.8) Define constraint satisfaction problem. State types of consistencies.

→ 1/ A constraint satisfaction problem has various states and goal test, a traditional problem has converted into standard structure and very simple representation.

2/ A constraint satisfaction problem is defined by set of variables $X_1, X_2 \cdots X_n$ and set of constraints C_1, C_2, C_n

3/ Each variable X_i has non empty domain D_i of possible values.

4/ A state of problem is defined by an assignment of values to some or all of variables $\{X_i = V_i, X_j = V_j \cdots\}$

5/ An assignment that does not violate any constraints is called consistent.

6/ A complete assignment is one in which every variable is maintained and solution to CSP.

★ Types of ~~constraints~~ consistencies :→

i/ Node consistency :-

① - A variable is node-consistent if all values in its domain satisfy its unary constraints.

② - Example : If x can only have even numbers, but its domain is {1, 2, 3, 4} removing make its node consistent.

ii/ Arc consistency :-

① A variable is arc-consistent with another variable if every value in its domain has valid corresponding value in other variable's domain.

② - Example :- If x = {mon, Tue} and y = {mon, wed}, but constraint says x ≠ y then remove mon from x make it arc-consistent.

iii/ Path consistency :-

① Extends Arc-consistency by ensuring pair of variables satisfy constraint relative to 3rd variable.

② - Example :- If x, y, z are variables, 4 x and ≠ z are consistent through y

iv/ K - consistency :-

① A CSP is K-consistent if every valid assignment to k-1 variables can be extended to kth variable.

② - 2 - consistency = Arc consistency.
- 3 - consistency = Path consistency.
- Strong K - consistency = Problem is j-consistent for all j ≤ k.

7/ Examples of CSP :-

i/ Sudoku

ii/ Map coloring.

Q.7] Solve following Crypt Arithmetic Problem.

→ SEND
+MORE

MONEY

→

$$\begin{array}{ccccc} & & 1 & 1 & \\ & S_9 & E_5 & N_6 & D_7 \\ 1 & M_1 & O_0 & R_8 & E_5 \\ \hline M & O_0 & N_6 & E_5 & Y_2 \end{array}$$

[1]

0 → O
1 → M
2 → Y
3 → X
4 → X
5 → E
6 → N
7 → D
8 → R
9 → S

∴ SEND = 9567
MORE = 1085

MONEY = 10652

∴ unique solution is,
→ S=9, E=5, N=6, D=7, M=1, O=0, R=8, Y=2