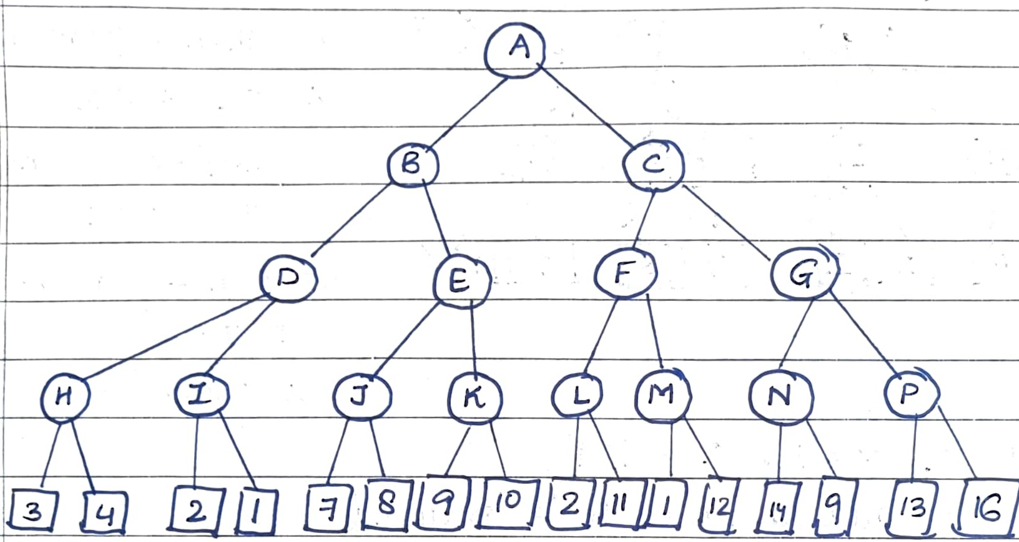
JUNAID GIRKAR
60004190057
TE COMPS A4

AI PRACTICE PROBLEMS

Alpha Beta Pruning

Q1

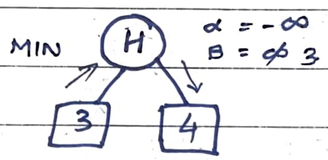


depth (d) = 5

No of child nodes (b) = 2.

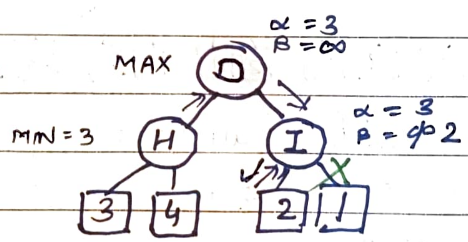
complexity $= O(b^d) = O(2^5) = O(32)$

STEP 1 Consider node H



∵ 3 < 4
min = 3

STEP 2 Consider node D



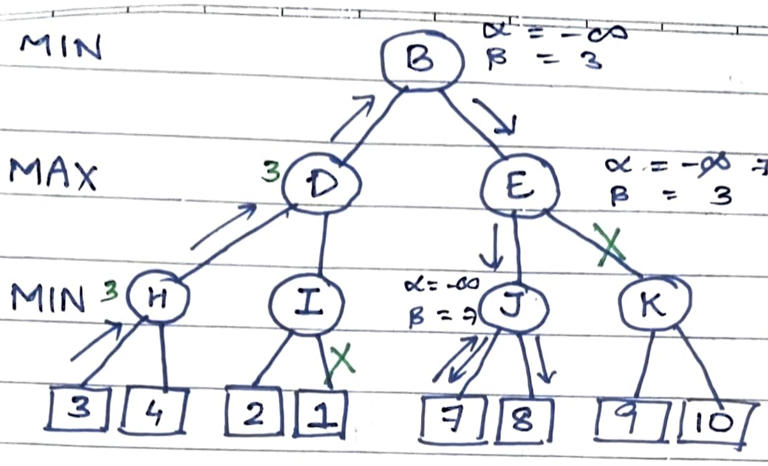
β = 2

∵ α ≥ β

∴ we prune branch with $\boxed{1}$

∴ At D, max = 3

STEP 3



At node B, $\alpha \not\geq B$

we then explore node E

At E, $\alpha \not\geq B$

we then explore node J

At J, $\alpha \not\geq B$

we then explore both terminals

$\because 7 < 8$

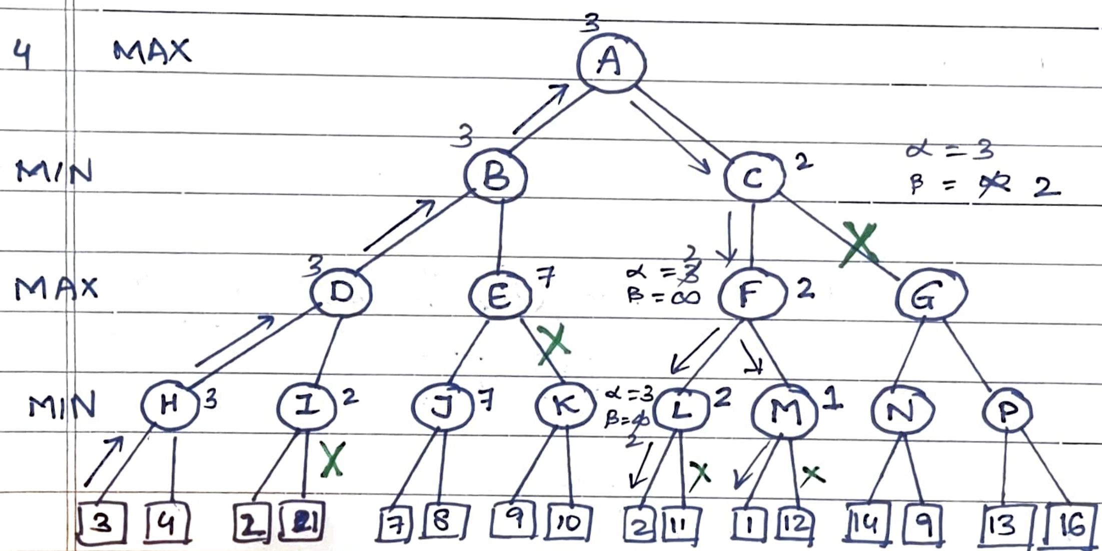
$\therefore$ J (min) = 7

At node E, $\alpha = 7$; $\because \alpha \geq \beta$

$\therefore$ Branch containing node K is pruned

$\therefore$ E (max) = 7 , B(min) = 3

STEP 4



From parent to child, values of α and B get passed

At node A, $\alpha \not\geq B$ $\therefore$ we explore C

At node C, $\alpha \not\geq B$ $\therefore$ we explore F

At node F, $\alpha \not\geq B$ $\therefore$ we explore L.

At node L, $\alpha \not\geq B$ $\therefore$ we explore terminal 2

At node L, $\beta = 2$ Now $\alpha \geq B$

$\therefore$ we prune branch containing terminal $\boxed{11}$

$\therefore$ L gets min value as 2.

At node F, $\alpha = 2$; $\alpha \not\geq \beta$ $\therefore$ we explore M

At node M, $\alpha \not\geq \beta$; we explore terminal $\boxed{1}$

Now $\beta = 1$; $\alpha \geq \beta$ $\therefore$ we prune branch containing $\boxed{12}$

M gets min value as 1

F gets max value as 2

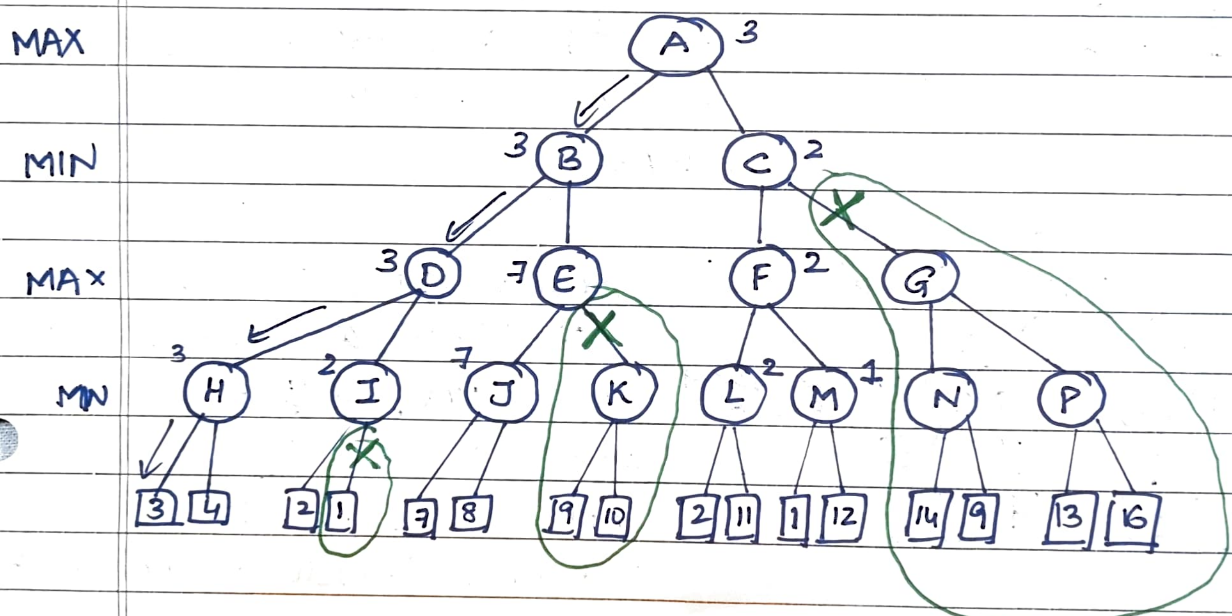
Now at node C, $\beta = 2$

$\therefore$ At C, $\alpha \geq \beta$; we prune branch containing node G

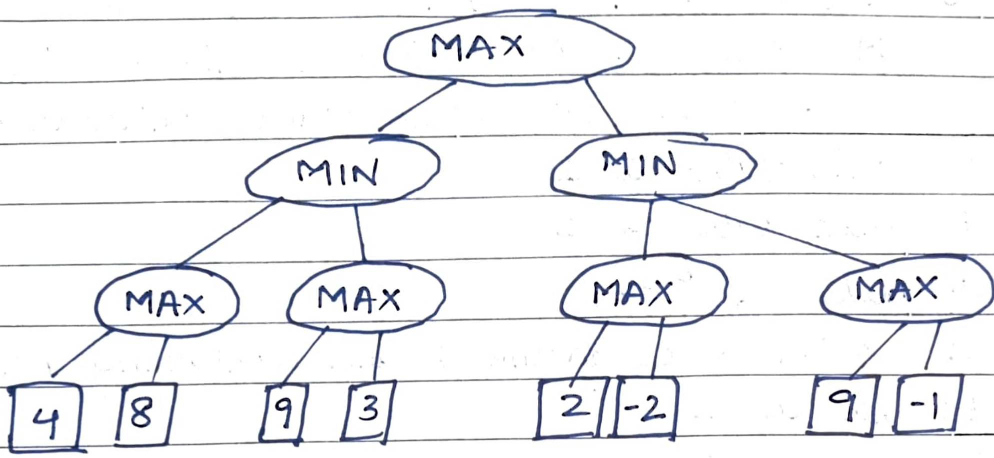
C gets min as 2

A gets max as 3

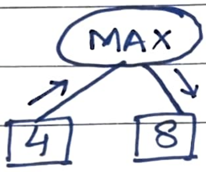
$\therefore$ Final Pruned tree is



Q2



STEP 1.



$\alpha = \cancel{-\infty}\ \cancel{4}\ 8$

$\beta = \infty$

$\alpha \ngtr \beta$ ∴ we explore $\boxed{4}$

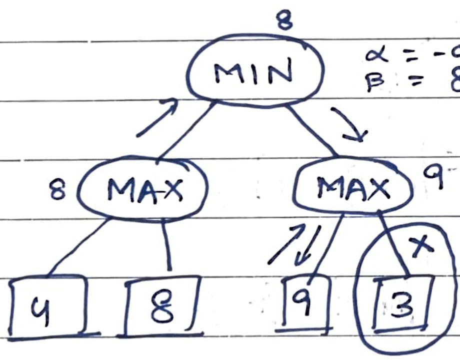
NOW $\alpha = 4$

∵ $\alpha \ngtr \beta$ ∴ we explore $\boxed{8}$

NOW $\alpha = 8$ [∵ $8 > 4$]

∴ MAX = 8

STEP 2



$\alpha = -\infty$
$\beta = 8$

$\alpha = \cancel{-\infty}\ 9$
$\beta = 8$

For node MIN, $\alpha = -\infty$, $\beta = 8$

∵ $\alpha \ngtr \beta$, we explore MAX

For node MAX, $\alpha \ngtr \beta$

∴ we explore $\boxed{9}$

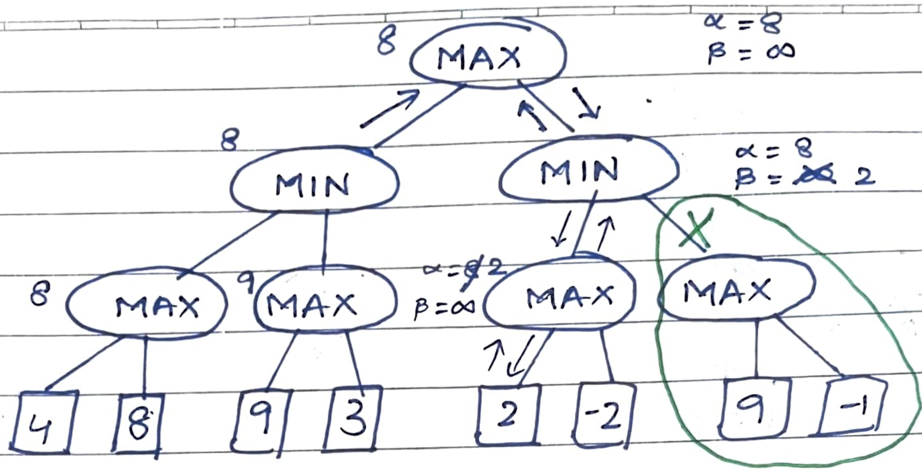
Now $\alpha = 9$, ∵ $\alpha \geq \beta$

∴ we prune branch containing $\boxed{3}$

∴ MAX = 9

MIN = 8

STEP 3



For node MAX, $\alpha = 8$, $\beta = \infty$

$\because \alpha \ngeq \beta$, explore MIN

At MIN, $\alpha \ngeq \beta$ $\therefore$ Exploring MAX

At MAX, $\alpha \ngeq \beta$ $\therefore$ exploring $\boxed{2}$

Now, $\alpha = 2$; $\because \alpha \ngeq \beta$, Exploring $\boxed{-2}$

$\because 2 > -2$

$\therefore \alpha = 2$

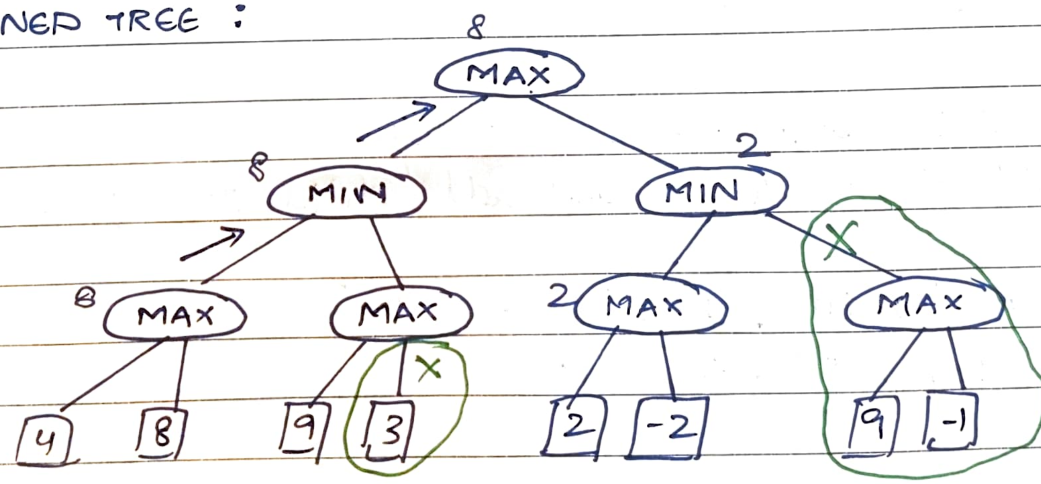
$\boxed{\therefore MAX = 2}$

At Node MIN, $\alpha = 8$; $\beta = 2$

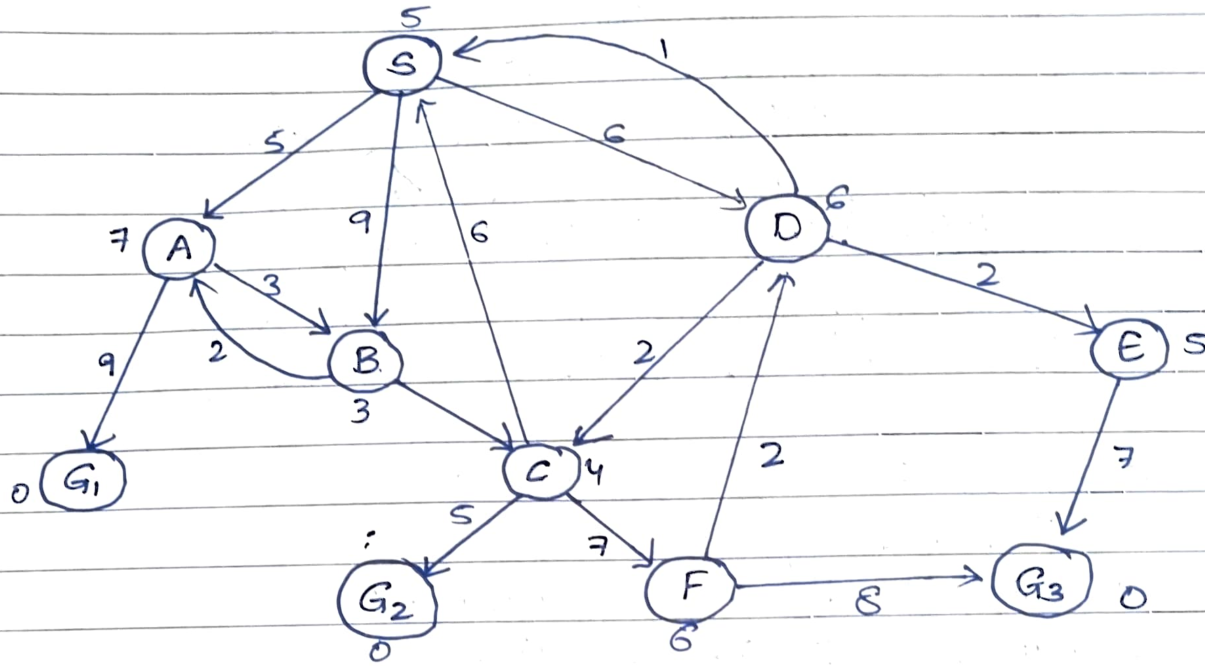
$\because \alpha \geq \beta$, $\therefore$ we prune branch containing MAX

$\boxed{\therefore MIN = 2}$

$\therefore$ PRUNED TREE :



Q3



Source → {S}
Goal states → {G_1, G_2, G_3}

open { S(5) }   [5+0]
closed { }

∴ f(n) of S is min added to closed and add child to open.

∴ open { A $\overset{5+7}{(12)}$, B $\overset{9+3}{(12)}$, D $\overset{6+6}{(12)}$ }
closed { S(5) }

∵ f(n) is same, we select first node in open and add it to closed and add child to open

open { B $\overset{8+3}{(11)}$, D $\overset{6+6}{(12)}$, G_1 $\overset{9+5+0}{(14)}$ }
closed { S(5), A(12) }

∵ f(n) of B through A is min, we update f(n) of B
∴ f(n) of B is min, we add B to closed and add its child to open

open { D(12), G_1(14), C(13) } $^{5+3+1+4}$
closed { S(5), A(12), B(11) }
f(n) of A through B will be greater than previous hence no change.

∵ f(n) of D is min, we add D to closed and add its child to open.

open { G_1(14), C(12) $^{6+2+4}$, E(13) $^{6+2+5}$ }
closed { S(5), A(12), B(11), D(12) }
f(n) of S through D will be greater than previous hence no change.
f(n) of C through D is less than previous hence change.

∵ f(n) of C is min we add C to closed and add its child to open

open { G_1(14), E(13), G_2(13) $^{6+2+5+0}$, F(21) $^{6+2+7+6}$ }
closed { S(5), A(12), B(11), D(12), C(12) }
f(n) of S through D will be greater than previous hence no change.

∵ f(n) of E and G_2 are same & min, we choose first one and add to closed and ~~its its~~ add its child to open
open { G_1(14), G_2(13), F(21), G_3(15) $^{6+2+7+0}$ }
closed { S(5), A(12), B(11), D(12), C(12), E(13) }

∵ f(n) of G2 is min we add it to closed and add its child to open.

open { G1 (14), F(21), G3(15) }

closed { S(5), A(12), B(11), D(12), C(12), E(13), G2(13) }

∵ G2 is a goal node and it is in closed list.

we construct the path

Path : S ⟶ D ⟶ C ⟶ G2

Cost : 6 + 2 + 5 = 13 //

5

Q.4 Genetic algorithm

Maximize function $f(x) = x^2$ with x in interval $[0, 31]$

$x = 0, 1, 30, 31$

1) Generate initial population at random. They are chromosome or genotype.

e.g: 01101 (13), 11000 (24)

01000 (8), 10011 (19)

2) calculate fitness

a) Decode it to decimal

01101 = 13   11000 = 24

01000 = 8   10011 = 19

b) Evaluate fitness, $f(x) = x^2$

$(13)^2 = 169$ $(24)^2 = 576$

$(8)^2 = 64$ $(19)^2 = 361$

3) selecting parents based on fitness in P

$$P_i = f_i \Big/ \sum_{j=1}^{n} f_{ij}$$

STRING NO	INITIAL POPULATION	X VALUE	FITNESS f_i $(f(x) = x^2)$	P_i $f_i / \Sigma f_i$	EXPECTED P_i $(n \times f_i)$
1	01101	13	169	0·14	0·56
2	11000	24	576	0·49	1·96
3	01000	8	64	0·054	0·22
4	10011	19	361	0·30	1·2.
SUM			1170	1·00	4·00
AVG			293	0·25	1·00
MAX			576	0·49	1·96
MIN			64	0·054	0·22.

2nd string is selected. 3rd has least value & is eliminated

STRING NO	MATING POOL	CROSSOVER POINT	OFFSPRING AFTER CROSSOVER	X	f_i
1	0110|1	4	01100	12	144
2	1100|0	4	11001	25	729
3	11|000	2	11011	27	729
4	10|011	2	10000	16	256
SUM					1754
AVG					439
MAX					729

MUTATION

STRING NO	OFFSPRING AFTER CROSSOVER	OFFSPRING AFTER MUTATION	X VALUE	fi
1	01100	11100	26	676
2	11001	11001	25	625
3	11011	11011	27	729
4	10000	10100	18	324
SUM				2354
AVG				588.5
MAX				729
MIN				324