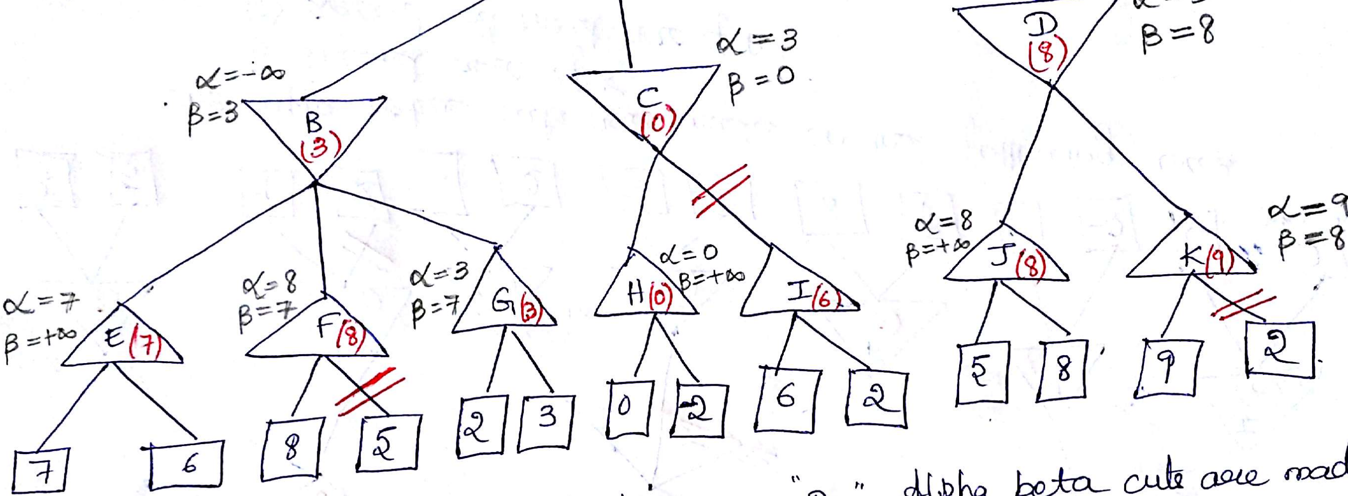
For min node,
if $\beta <= \alpha$ of MAX ancestor prune
For max node
if $\alpha >= \beta$ of MIN ancestor prune

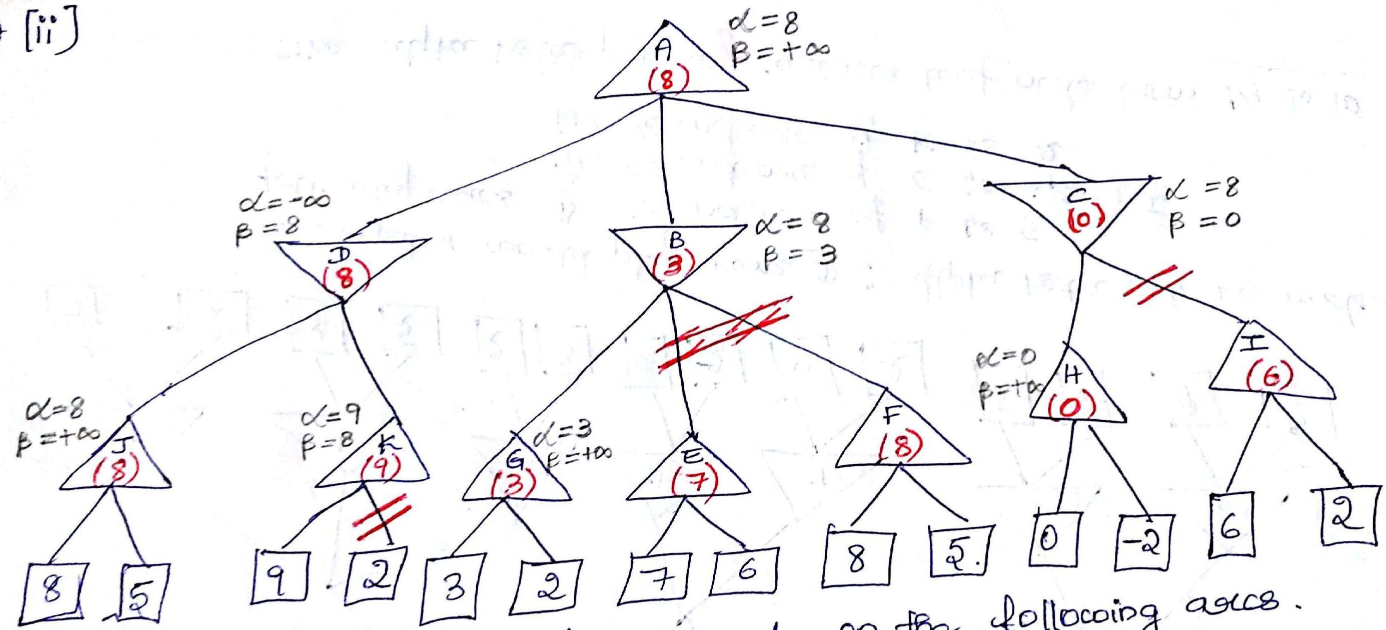
Question A [i]



The computer would play move "D": Alpha beta cuts are made on following arcs
i) second arc of F i.e 5
ii) second arc of C i.e 6, 2 of I
iii) second arc of K i.e 2

The alpha beta pruning reduces leaf node from 14 to 10

A [ii]



The alpha beta cuts are made on the following arcs.

i) second arc of K

ii) second and third arc of B

iii) second arc of C

The ordering reduces the no of leaf nodes from 14 to 7

B [i]   human starts the game by moving into in the 1 1 square and the count was found to be 25,872 leaf nodes without pruning. The count is different if he starts by moving into 0 2 square. I found the count to be 29592 leaf nodes when the move is made to 0 2 square. There will be differences in count based on the move.

[ii] For alpha beta pruning I am passing the alpha and beta values as a parameter to the min and max functions. In min function beta value is compared with best value (best<beta) and in the max function alpha value is compared with best value(best>alpha) and updates the alpha and beta values accordingly. In both the functions if alpha is greater than or equal to beta I am pruning it i.e. I am breaking it. By doing this the no of leaf nodes are being reduced and I found the count to be 1047 for a 1 1 initial move by human.

[iii] For iterative deepening I added one for loop that ran from 0 to 9 max depth in the make move function which enclosed the other two for loops. In tic tac toe game the branching factor decreases as we go to higher depth and I found the count of leaf nodes to be 3307.

[C]

8.28

a) $W(G,T)$

c) $W(G,T) \lor W(M,T)$

d) $\exists\, s\ W(J, s)$

f) $\forall s\ S(M,s,R) \rightarrow W(M,s)$

j) $\exists\, d, a, s\ C(d, a) \land O(J, d) \land S(B, T, a)$

C) 9.23 a) Premise

$$\forall x\,(Horse(x) \longrightarrow Animal(x))$$

Conclusion

$$\forall x\,(Headof(h,x) \land Horse(x)) \longrightarrow (Headof(h,x) \land Animal(x))$$

b) Remove Implication of premise

$$\forall x\,(\neg Horse(x) \lor Animal(x))$$

Negate the conclusion.

$$\neg[\forall x((Headof(h,x) \land Horse(x)) \longrightarrow (Headof(h,x) \land Animal(x)))]$$

$$\underline{A \to B = \neg A \lor B}$$

$$\Rightarrow \neg[\forall x(\neg(Headof(h,x) \land Horse(x)) \lor (Headof(h,x) \land Animal(x)))]$$

$$\underline{\neg\forall x\, A = \exists x \neg A}$$

$$\Rightarrow \exists x(\neg(\neg(Headof(h,x) \land Horse(x))) \land \neg(Headof(h,x) \land Animal(x)))$$

$$\Rightarrow \exists x((Headof(h,x) \land Horse(x)) \land \neg(Headof(h,x)) \lor \neg Animal(x))$$

$$\underline{\exists x\, B(x) \Rightarrow B(c)}$$

$$\Rightarrow (Headof(h,c) \land Horse(c)) \land (\neg(Headof(h,c)) \lor \neg Animal(c))$$

$$\Rightarrow \{Headof(h,c),\ Horse(c),\ (\neg(Headof(h,c),\ \neg Animal(c)),\ (\neg Horse(c), \neg Animal(c))\}$$

in CNF Form.

c). $\{\underline{Headof(h,c)},\ Horse(c),\ (\underline{\neg Headof(h,c)}, \neg Animal(c)),$

$(\neg Horse(c), \neg Animal(c))\}$

$\Rightarrow \{Horse(c),\ \underline{\neg Animal(c)},\ (\neg Horse(c), \underline{\neg Animal(c)})\}$

$\Rightarrow \{Horse(c),\ \neg Horse(c)\}$

$\Rightarrow$ which is a contradiction.