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Adversarial Search

(1) proof by induction on the MAX player turns ~~number of turns levels of the tree~~:
that at every ~~level on~~ turn:

$$\underbrace{MAX_{MIN}}_{\text{MAX against MIN}} \leq \underbrace{MAX_{min}}_{\text{MAX against another min strategy}}$$

base: the leaves (terminal nodes) MAX returns the value of the leave node no matter what is the min strategy he plays against.

so $MAX_{MIN} = MAX_{min}$

step: suppose it is true for every MAX turn before the k-th turn, and prove for the k-th turn.

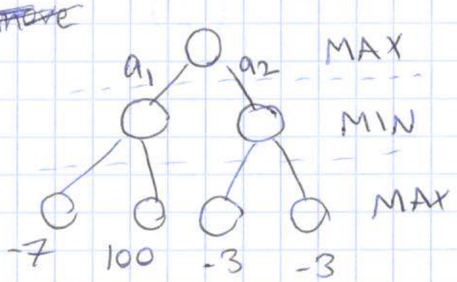
if by contradiction ~~of the~~ $MAX_{min} < MAX_{MIN}$

then the min player ~~chooses~~ chosed a lower value than the MIN player chosed for the node $\max_{s \in succ(k)} (min\_value(s))$ and may be for ~~an~~ another successor nodes, which contradicts the minimal property of MIN which chooses the minimal value of its successors.

$\boxtimes$

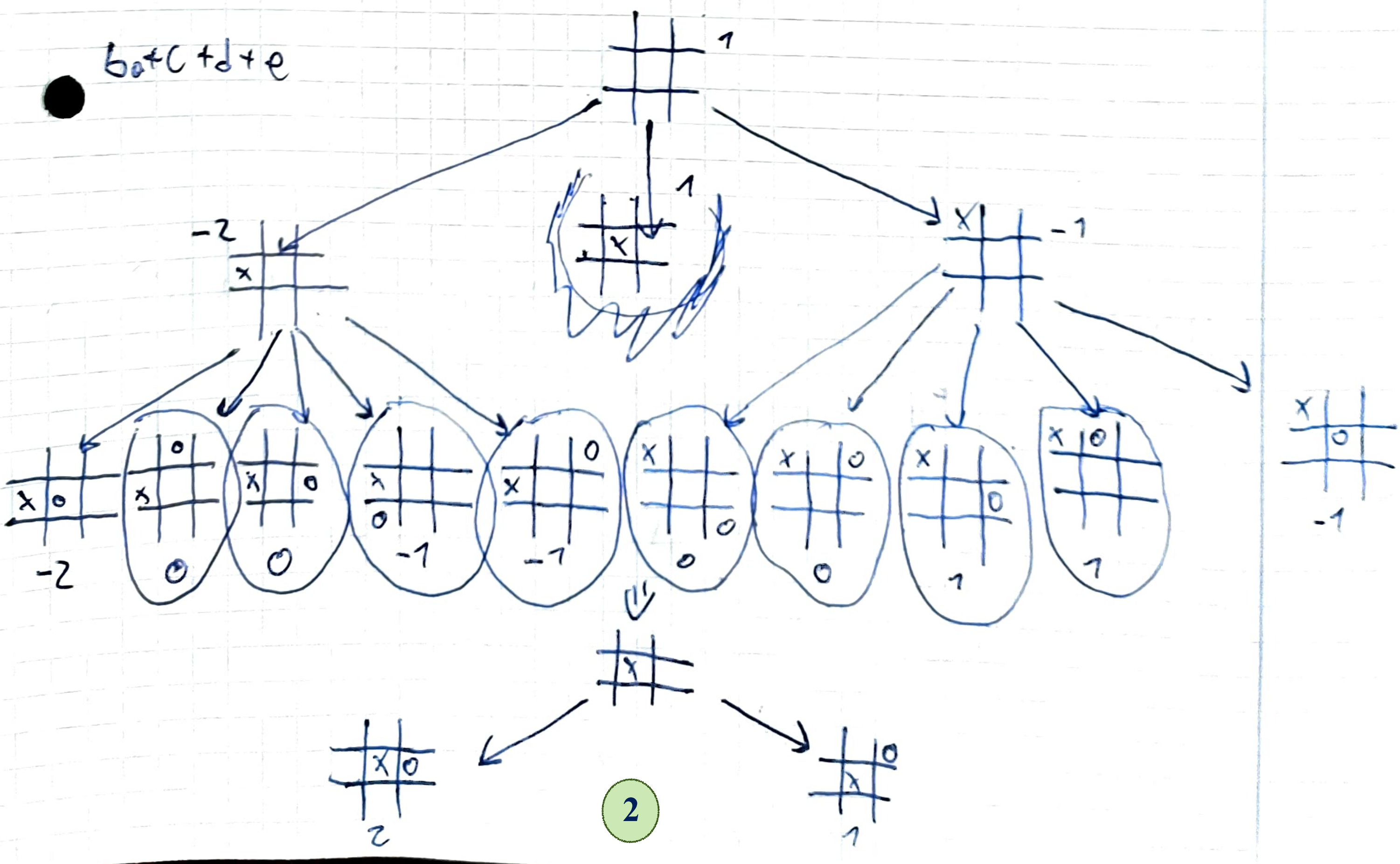
if the MIN choice is predictable, then a suitable MAX strategy can do better than the standard one.

if the MAX player can deceive the MIN player by ~~choo~~ some trap, like choosing unrational option, the result ~~may~~ will be better than the standard MAX. ~~for~~ in the following example if MAX set a trap for MIN by playing a_1, he will win if MIN fall for this trap. The ~~an~~ minimax ~~move~~ move is a_2 with value -3

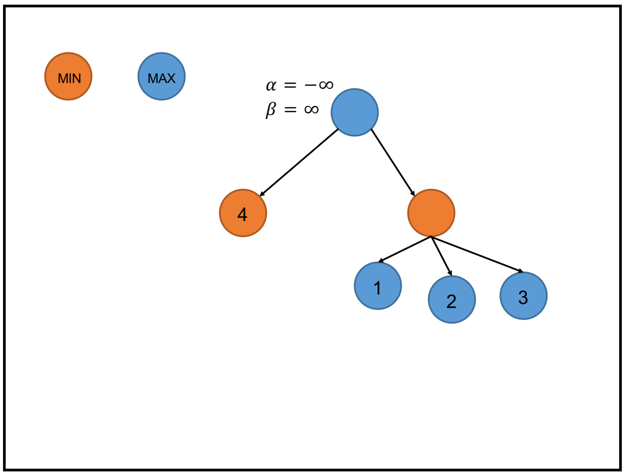


2.) a. there are 9 avilable spaces so the number of full games is less than $\binom{9}{4}$ than we will eliminate symetrey the its $\frac{\binom{9}{4}}{4}$ final boards then since it ended in the last space any order of moves coulde be applayed then its $\frac{\binom{9}{4}}{4}\cdot 5!\cdot 4! = \frac{9!}{4}$, than if we will ~~repeat the prosses for 8,7,6,5 each possible game leangths than~~ than there are total of 5 diffrent game lengths (9,8,7,6,5) and the lower the number the higher amunt of posiblitys the we will estemate $\frac{9!\cdot 5}{4} = \boxed{453600}$. this might be over or uder estimats for the face mension before and since some filling up of boards isnt leagal.

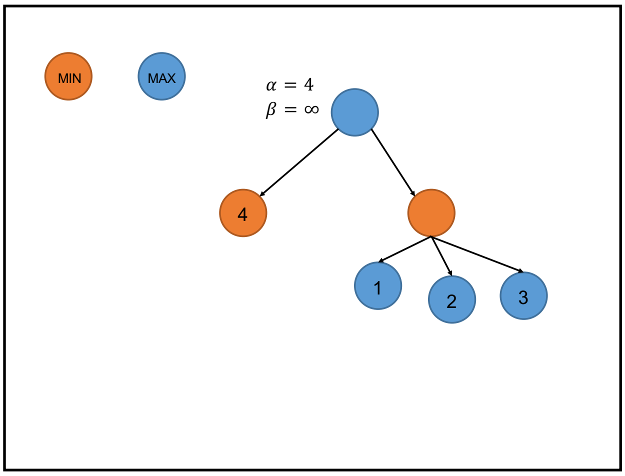
b+c+d+e



Adversarial Search Problem 3

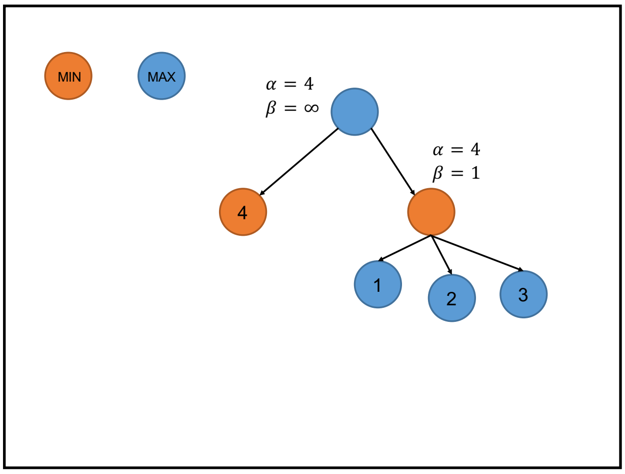


1

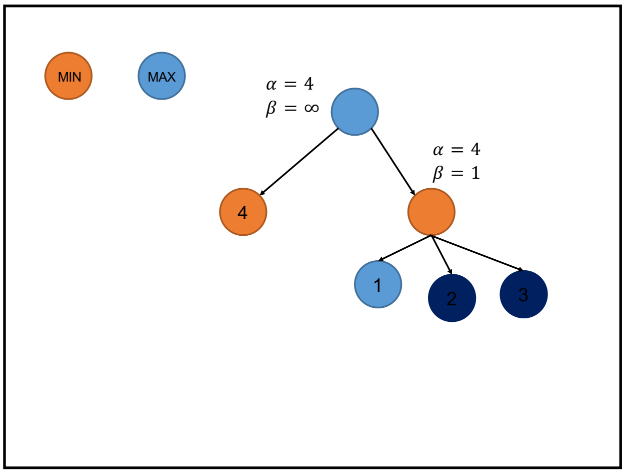


2

explore the only terminal node on the left its value is 4, update alpa.



3



4

explore the right node recursively, when reached the left terminal node with value 1, update beta, then beta <= alpah, so prune off and not explore 2 and 3.

Logic

1.)

a. $Q \to P$, $\neg Q \vee P$, $\boxed{(\neg Q \vee P)}$

b. $(P \to \neg Q) \to R$, $(\neg P \vee \neg Q) \to R$, $\neg(\neg P \vee \neg Q) \vee R$

$\to$ $(\neg\neg P \wedge \neg\neg Q) \vee R$, $(P \wedge Q) \vee R$, $\boxed{(P \vee R) \wedge (Q \vee R)}$

c. $\neg(P \wedge \neg Q) \to (\neg R \vee \neg Q)$, $(\neg P \vee \neg\neg Q) \to (\neg R \vee \neg Q)$,

$\to$ $(\neg P \vee Q) \to (\neg R \vee \neg Q)$, $\neg(\neg P \vee Q) \vee (\neg R \vee \neg Q)$, $(\neg\neg P \wedge \neg Q) \vee (\neg R \vee \neg Q)$

$\to$ $(P \wedge \neg Q) \vee (\neg R \vee \neg Q)$,

$\to$ $(P \vee (\neg R \vee \neg Q)) \wedge (\neg Q \vee (\neg R \vee \neg Q))$, $\boxed{(P \vee \neg R \vee \neg Q) \wedge (\neg R \vee \neg Q)}$

~~allready in cnf but can~~

allready in cnf but can be simplefied to $(\neg R \vee \neg Q)$

d. $\neg(P \to \neg Q) \to R$, $\neg(\neg P \vee \neg Q) \to R$,

$\to$ $(\neg\neg P \wedge Q) \to R$, $\neg(P \wedge Q) \vee R$, $(\neg P \vee \neg Q) \vee R$

$\to$ $\boxed{\neg P \vee \neg Q \vee R}$

e. $\neg(P \to (\neg R \vee \neg Q)) \to \neg R = \neg\neg(P \to (\neg R \vee \neg Q)) \vee \neg R = (P \to (\neg R \vee \neg Q)) \vee \neg R$
$= (\neg P \vee (\neg R \vee \neg Q)) \vee \neg R = \neg P \vee \neg R \vee \neg Q$

$\boxed{\neg P \vee \neg R \vee \neg Q}$