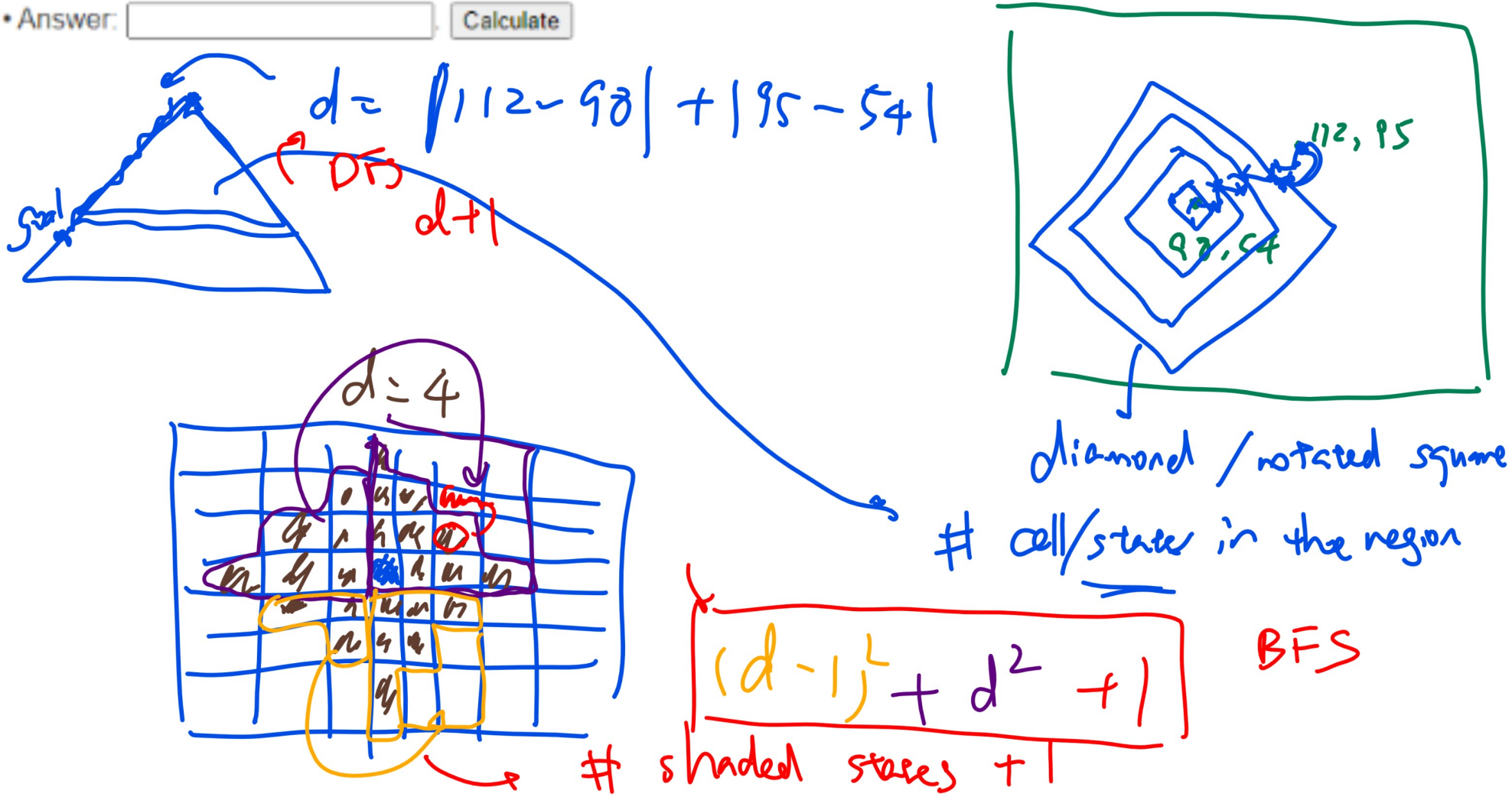
Question 2

XT

DFS

• [3 points] In a 200 by 140 grid, Tom is located at (98, 54) and Jerry is located at (112, 95). Tom uses BFS (Breadth First Search) to find Jerry and the successors of a state (one cell in the grid) are the four neighboring states on the grid (the cells above, below, to the left and to the right). What is the minimum number of states that need to be expanded to find (and expand) the goal state? The order in which the successors are added can be arbitrary. Include both the initial and the goal states.

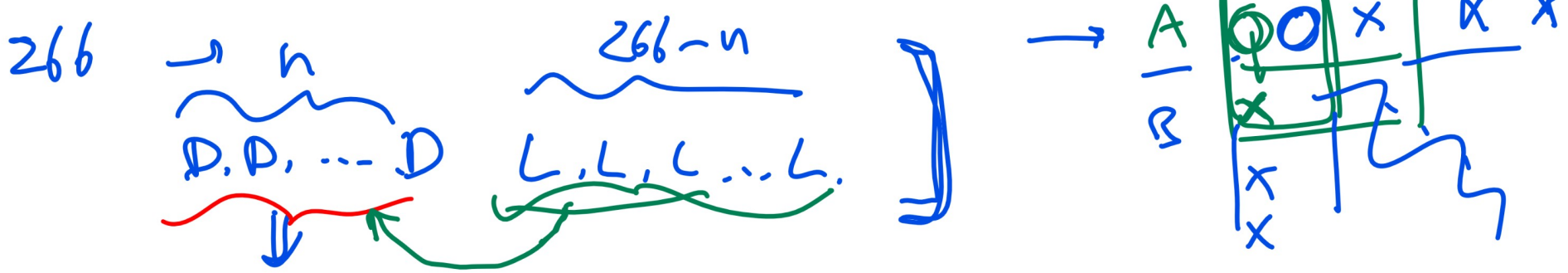
• Answer: Calculate



Question 2

• [4 points] There are 266 people living in the suburbs and all of them commute to work in the city. Every morning, each individual decides which way to drive to the city simultaneously: the Direct Way or the Long Way. The Long Way takes 1 hour of driving. The time spent on the Direct Way depends on the traffic is equal to $\frac{n}{c}$ hours, where n is the total number of cars taking the Direct Way, and $c = 19$ is the capacity. Each individual wants to minimize the driving time, break tie by choosing the Direct Way. What is the number of people taking the Long Way in the Nash equilibrium.

• Answer: 18, 19 Calculate



NE:

for these n people, D ≥ L min

time spent D ≤ time spent L

$\frac{n}{19} \leq 1 \Rightarrow n \leq 19$

for other 266-n people. L ≥ D min

time L ≤ time D

$1 \leq \frac{n+1}{19} \Rightarrow n \geq 18$

Question 3

• [4 points] Suppose the states are integers between 1 and 513. The initial state is 1, and the goal state is 513. The successors of a state i are $2i$ and $2i+1$, if exist. How many states are expanded using a Depth First Search? Include both the initial and goal states.

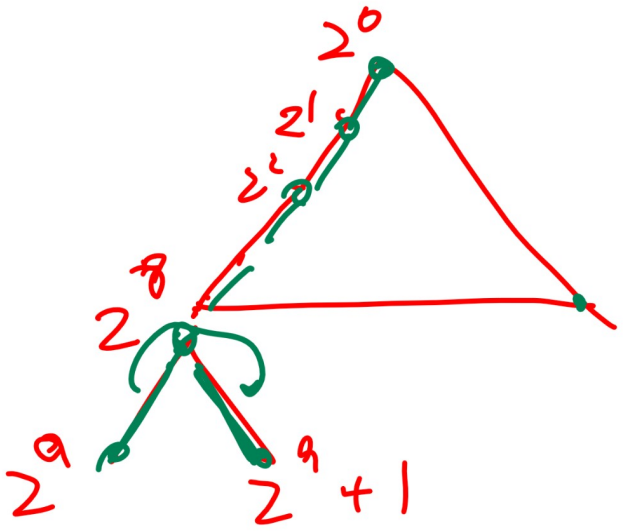
• Note: use the convention used in the lectures, push the states with larger index into the stack first.

• Answer: 11 . Calculate

$2^9 + 1$

BFS → 513

DFS → 11



Question 10

• [4 points] Given the following game payoff table, suppose the the row player uses a mixed strategy playing U with probability p, and column player uses a pure strategy. What is the smallest and largest value of p in a mixed strategy Nash equilibrium?

Row \ Col	L	R
U	9, 5	9, 0
D	9, 0	0, 10

q 1−q

p

1−p

→ you mix in a certain way so that I am indifferent.

for Row: $\begin{cases} U \geq D \\ U \overset{mix}{=} D \\ U \leq D \end{cases}$

$9 \geq 9 \cdot q + 0(1-q) \Rightarrow q \leq 1$

$q = 1$

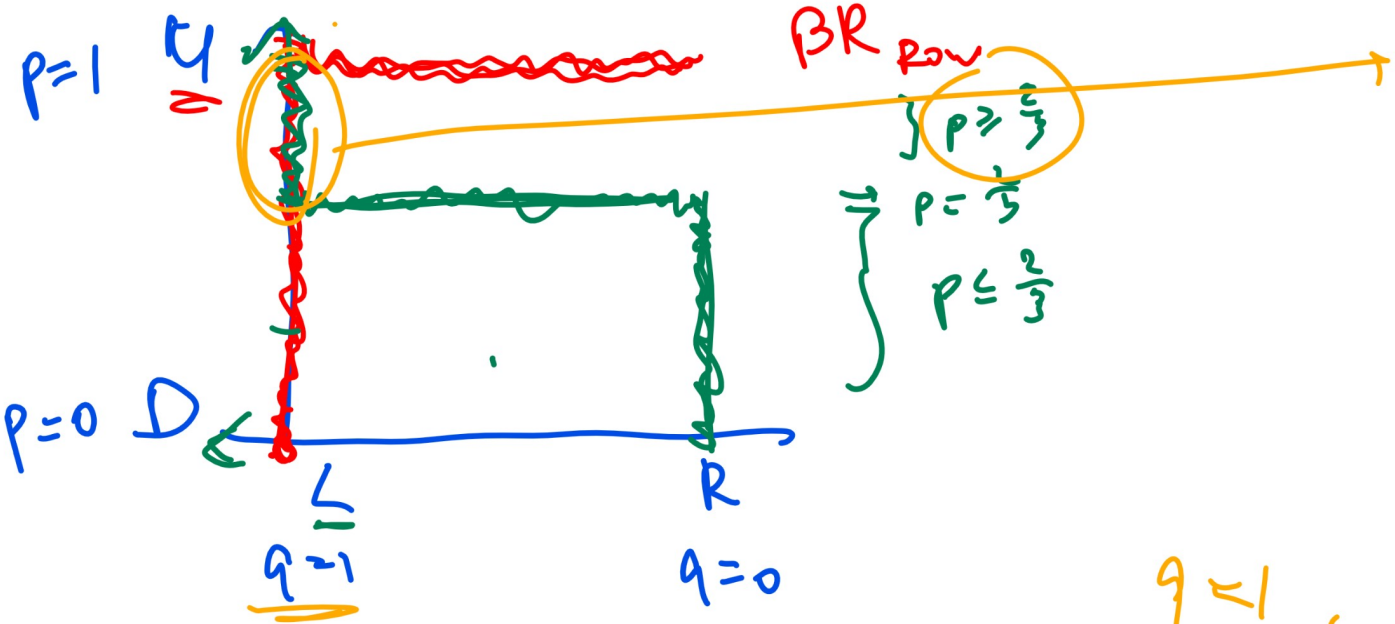
~~$q \geq 1$~~

for Col: $\begin{cases} L \geq R \\ L \overset{mix}{=} R \\ L \leq R \end{cases}$

$5p + 0(1-p) \geq 0p + 10(1-p) \Rightarrow p \geq \frac{2}{3}$

$p = \frac{2}{3}$

$p \leq \frac{2}{3}$

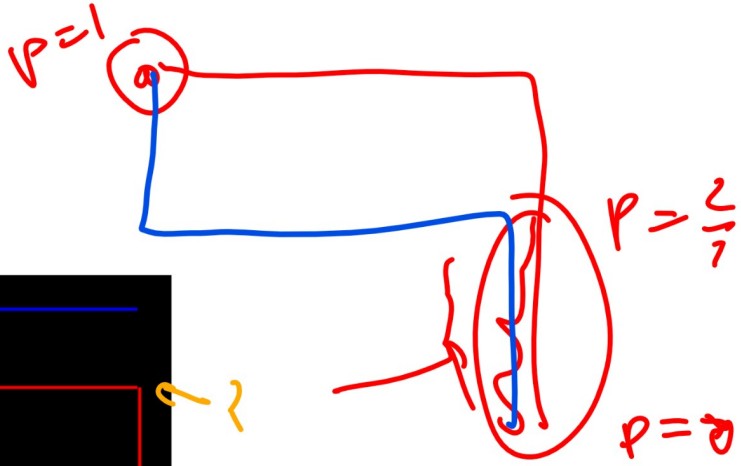


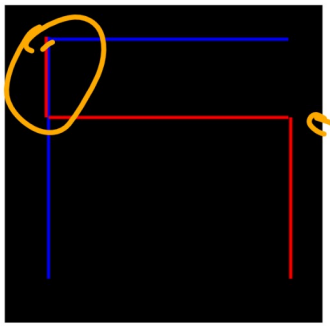
$q = 1$, L

$p \geq \frac{2}{3}$, $U^{(p)}$ $D^{(1-p)}$

range.

$\rightarrow \left[\frac{2}{3}, 1\right]$





$[0, 1]$

$\left[\frac{2}{3}, 1\right]$ not NE.

Question 3

• [3 points] There are $n = 101$ students in CS540, for simplificity, assume student 0 gets grade $g = 0$, student 1 gets grade $g = 1$, ..., student $n - 1$ gets grade $g = n - 1$. The payoff for each student who drop the course is 0, the payoff for the students who stay is $0.02\,g - 1.5$ if the student has the lowest grade among all students who decide to stay in the class, and the $0.02\,g - 1$ otherwise. If each student only uses actions that are rationalizable (i.e. survive the iterated elimination of strictly dominated actions), how many students will stay in the course? If there are multiple correct answers, enter one of them.

• Answer: Calculate

NE

$g=0$ { D → 0 ; S → $0.02g - 1.5 = -1.5 < 0$

$g=1$ { D → 0 ; S → $0.02 - 1.5 < 0$

!

$g \to$ { D → 0 ; S → $0.02 \cdot g - 1.5 = 0 \Rightarrow g = 75$

when $g = 74$, D is one best response. $\Rightarrow g = 75$

$g = 0 \ldots 74$ rationalizable $\Rightarrow$ D

$g = 76 \ldots 100$ rationalizable $\Rightarrow$ S $\leftarrow$

$g = 75$. D.S.

25 OR 26 Students will stay.

$g = 50 \rightarrow 74$ somethes S is prefered.

$\Downarrow$

$g = 0 \hookrightarrow S$

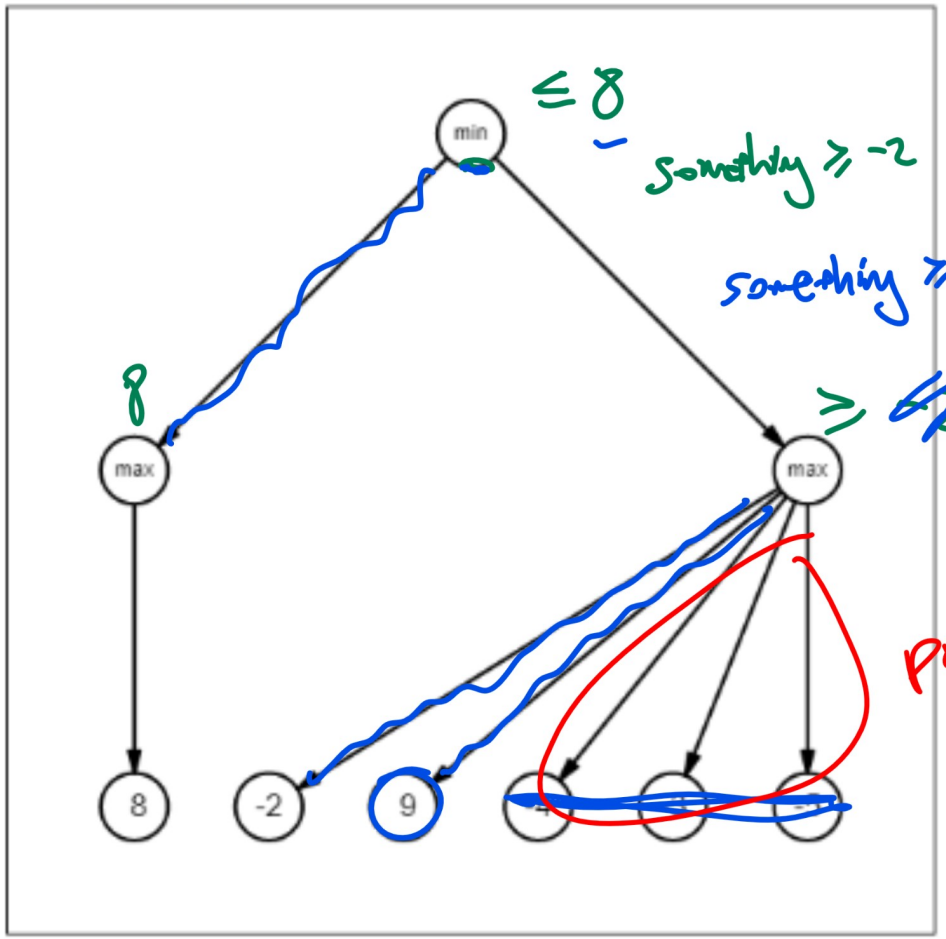
$0.02g - 1$ if S

0 if D

$\left\{ \begin{array}{ll} 0 - 49 & D \text{ is always BR} \\ 50 - 74 & D \text{ is BR if other players are rational} \\ 75 - 100 & S \text{ is always BR} \end{array} \right]$

Question 1

- [3 points] Which nodes are pruned by alpha-beta pruning? The min player moves first.
- Select the nodes:



≤ 8

something ≥ -2 could be better than 8, MIN

something ≥ 9 is never better than 9

≥ 9

pruned.

Question 1

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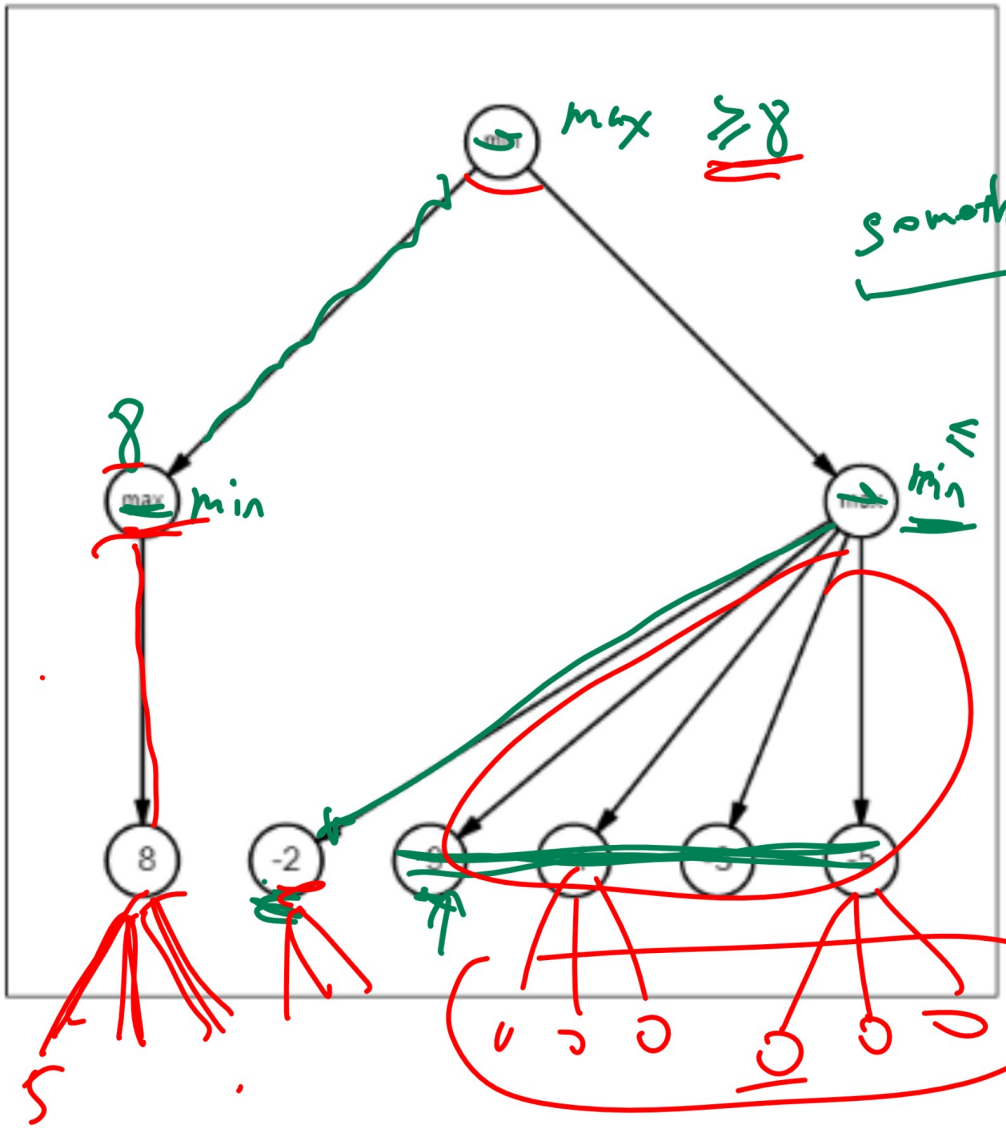

max ≥ β

something ≤ -2 is never better than β

min ≤ -2

pruned.