

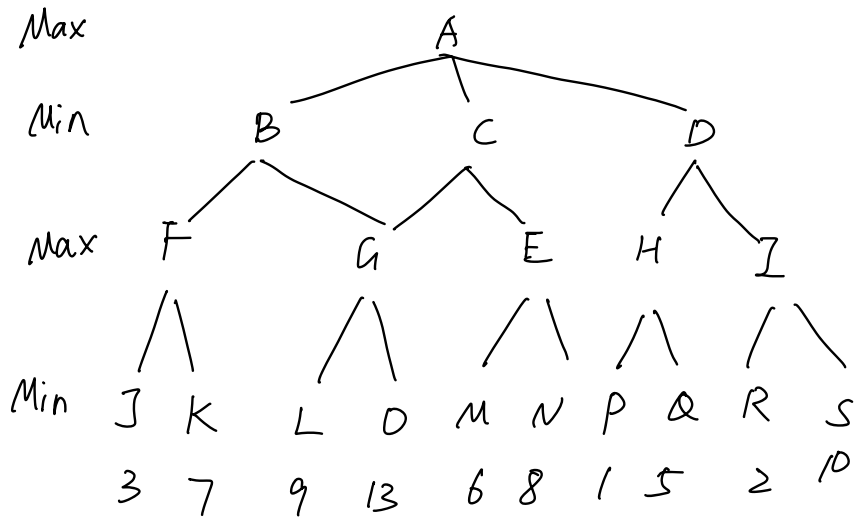
24-S1-Q2

(a) first \rightarrow Max

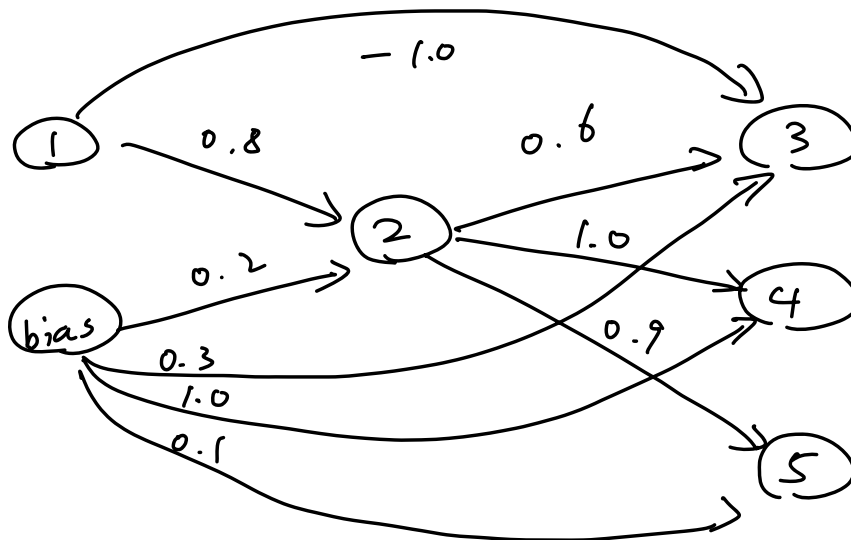
(i) $A \rightarrow B < D$?

(ii) left \rightarrow right $A - \beta$ pruning

(iii) not examined nodes



(b)



ReLU : hidden and output

output bias = 1.0

learning rate $\eta = 0.5$

$$\text{error} : E = \frac{1}{2} \sum_k (t_k - o_k)^2$$

$$\underset{\substack{\downarrow \\ \text{input}}}{\text{net}}_j = \sum_i (w_{ji} \underset{\substack{\downarrow \\ \text{include bias}}}{o_i})$$

\downarrow target output
 \swarrow actual output

$$o_j = \sigma(\text{net}_j)$$

\downarrow
output

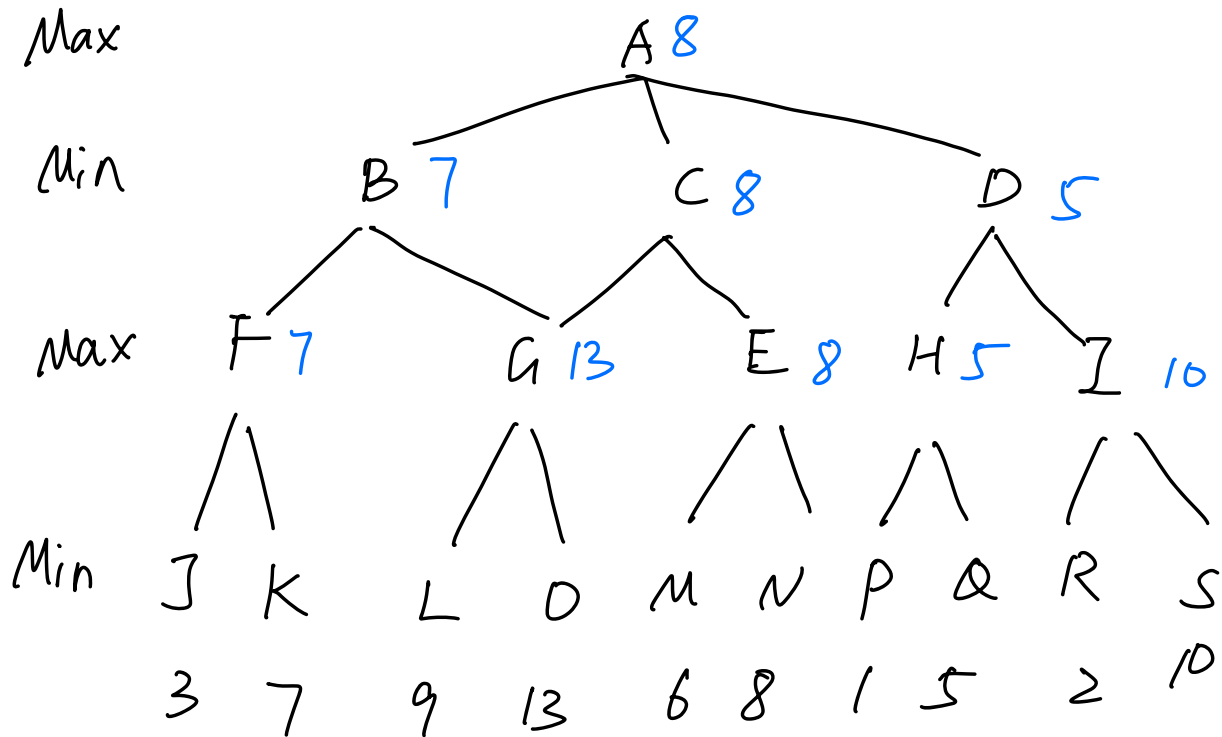
Backpropagation

Q(i) $x = (1, 0) \rightarrow t(0.1, 0.9, 0.1)$
actual output. at 2, 3, 4, 5

(ii) error

(iii) bias of unit 2. \rightarrow adjust

Solution (a) (i) ① compute result



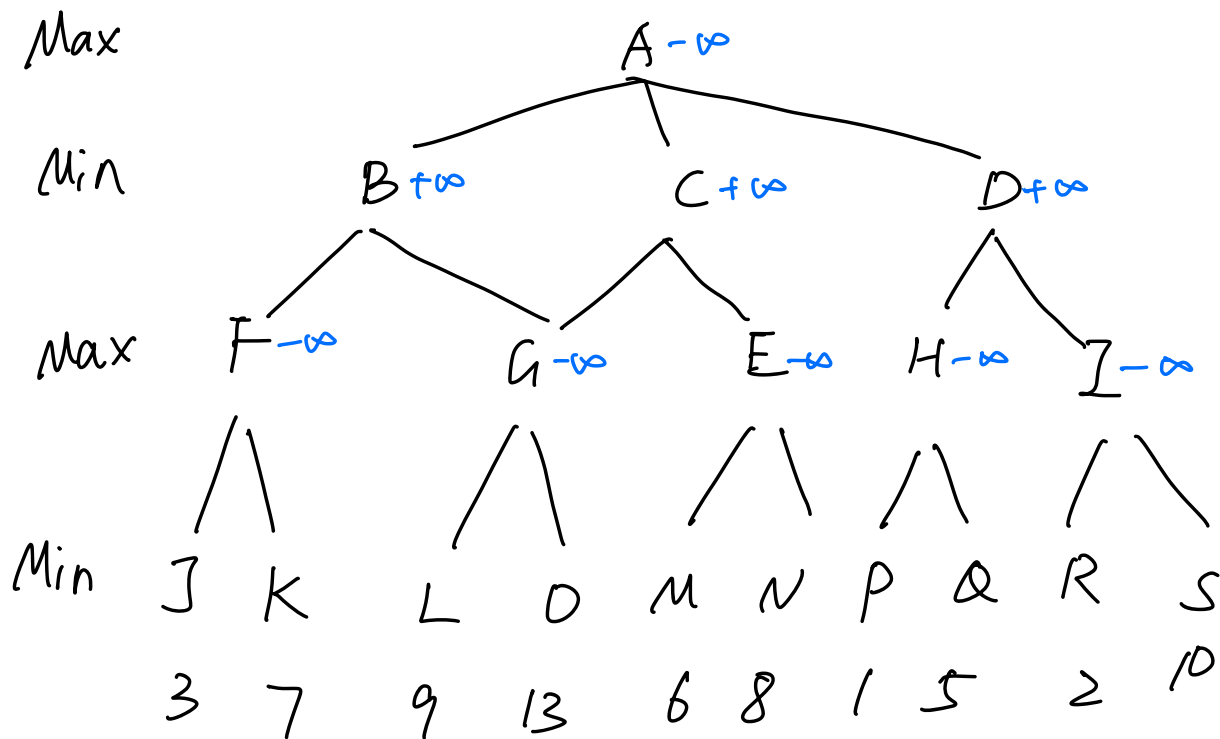
② the first player choose C

Since according to min-max algorithm
the first player is a Max player

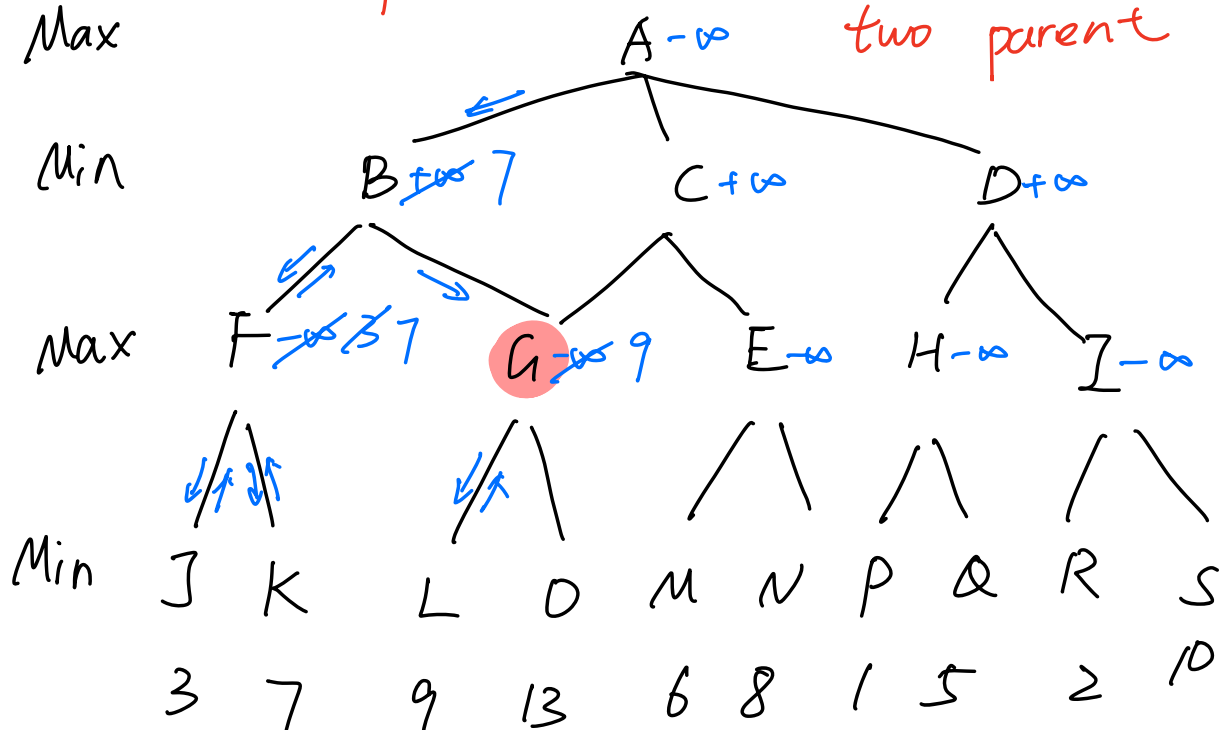
So he will choose the largest one

$8 > 7 > 5$, $C > B > D$, so he will choose
C

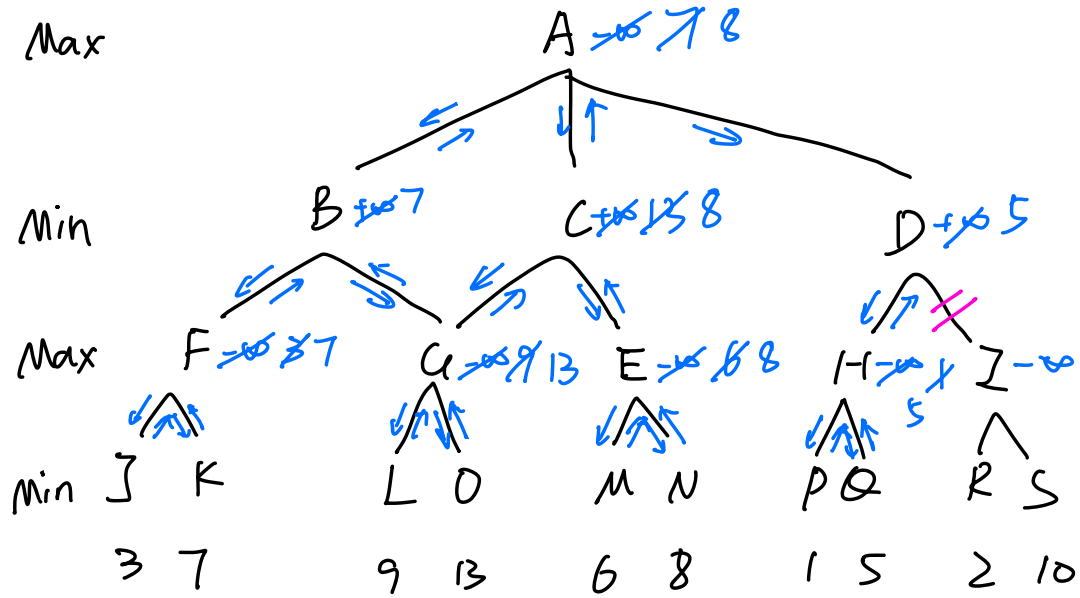
(ii) ① apply α - β pruning



② We can't prune the Node G, because G has two parent



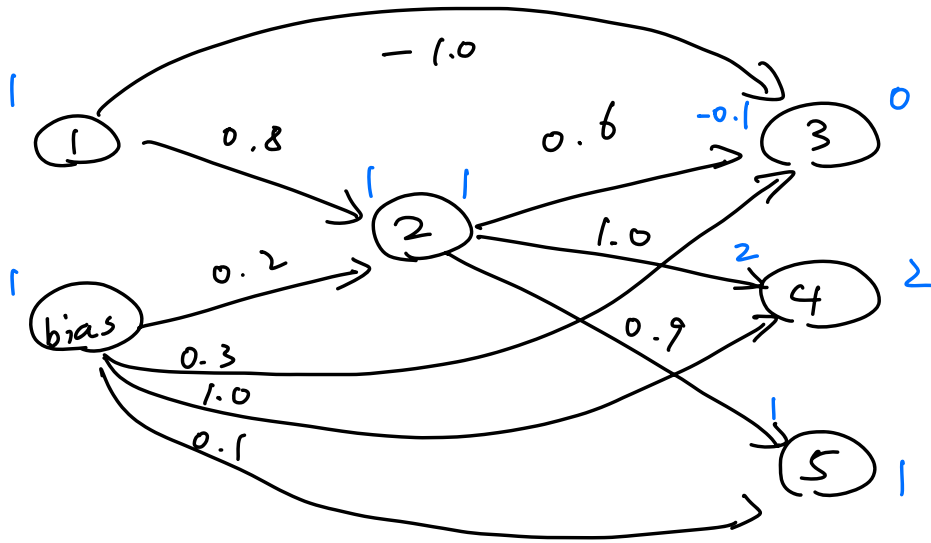
③



(iii) not visited node.

I R S

Solution (i) ① Forward-pass outputs



$$x_1 = 1 \quad \text{bias} = 1$$

$$\textcircled{2} \text{ net}_2 = 0.8 \times 1 + 0.2 \times 1 = 1$$

$$O_2 = \text{ReLU}(\text{net}_2) = \text{ReLU}(1) = 1$$

$$\textcircled{3} \text{ net}_3 = (-1) \times 1 + 0.6 \times 1 + 0.3 \times 1 = -0.1$$

$$O_3 = \text{ReLU}(\text{net}_3) = \text{ReLU}(-0.1) = 0$$

$$\textcircled{4} \text{ net}_4 = 1 \times 1 + 1 \times 1 = 2$$

$$O_4 = \text{ReLU}(\text{net}_4) = \text{ReLU}(2) = 2$$

$$\textcircled{5} \text{ net}_5 = 0.9 \times 1 + 0.1 \times 1 = 1$$

$$O_5 = \text{ReLU}(\text{net}_5) = \text{ReLU}(1) = 1$$

$$\textcircled{6} \text{ All in all, } O_2 = 1, O_3 = 0, O_4 = 2, O_5 = 1$$

$$\begin{aligned}
 \text{(ii) } \textcircled{1} \delta_3 &= 0 \times (t_3 - o_3) \\
 &= 0 \times (0.1 - 0) \\
 &= 0
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{2} \delta_4 &= 1 \times (0.9 - 2) \\
 &= -1.1
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{3} \delta_5 &= 1 \times (0.1 - 1) \\
 &= -0.9
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{4} \delta_2 &= \sigma'(net_2) \sum_k \delta_k w_{k2} \\
 &= 1 \times [\delta_3 w_{32} + \delta_4 w_{42} + \delta_5 w_{52}] \\
 &= 0 \times 0.6 + (-1.1) \times 1 + (-0.9) \times 0.9 \\
 &= -1.91
 \end{aligned}$$

$$\text{(iii) } \delta w_{2, \text{bias}} = \eta \delta_2 o_{\text{bias}}$$

$$= 0.5 \times (-1.91) \times 1$$

$$= -0.955$$

$$w_{2, \text{bias}} = 0.2 - 0.955$$

$$= -0.755$$

