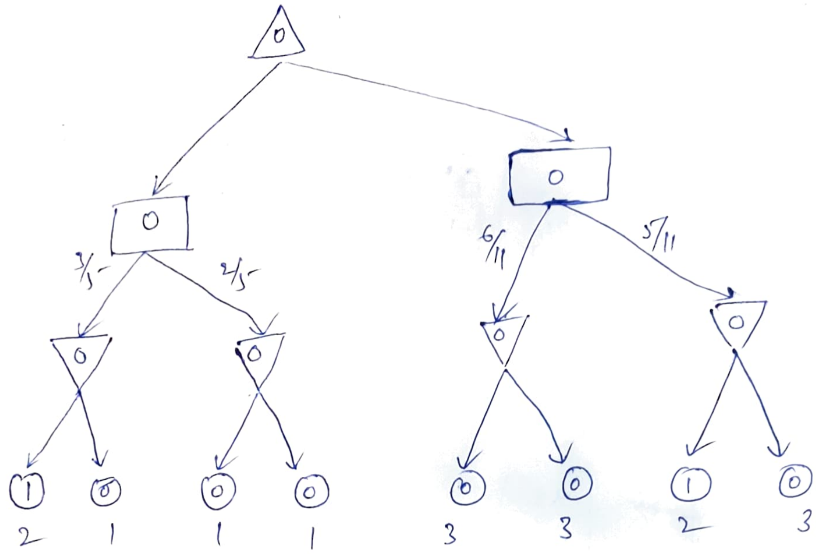
① $\{v_i\}_{i=1}^{8} = (1,0,0,0,0,0,1,0)$, $\{N_i\}_{i=1}^{8} = (2,1,1,1,3,3,2,3)$



$\theta_1 = \frac{3}{5}$ $\qquad$ $\theta_3 = \frac{6}{11}$

$\theta_2 = \frac{2}{5}$ $\qquad$ $\theta_4 = 5/11$

② $\gamma = 13/15$ $\quad r = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$ $\quad \pi_0 = \begin{pmatrix} a_1 \\ a_1 \end{pmatrix}$ $\quad P_{\pi_0} = \begin{pmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{pmatrix}$

$u_0 = (I - \gamma P_{\pi_0})^{-1} r$

$= \left(\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} - \frac{13}{15} \begin{pmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{pmatrix} \right)^{-1} \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

$= \begin{pmatrix} 1 - 39/60 & -13/60 \\ -13/60 & 1 - 39/60 \end{pmatrix}^{-1} \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

$= \begin{pmatrix} 21/60 & -13/60 \\ -13/60 & 21/60 \end{pmatrix}^{-1} \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

$= \dfrac{1}{\frac{21 \times 21}{60 \times 60} - \frac{13 \times 13}{60 \times 60}} \begin{pmatrix} 21/60 & 13/60 \\ 13/60 & 21/60 \end{pmatrix} \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

$= \dfrac{60 \times 60}{272} \begin{pmatrix} -\frac{21}{60} + 13/60 \\ -\frac{13}{60} + \frac{21}{60} \end{pmatrix} = \begin{pmatrix} \frac{-8}{60} \\ \frac{8}{60} \end{pmatrix} \times \dfrac{60 \times 60}{272}$

$= \begin{pmatrix} \frac{-480}{272} \\ \frac{480}{272} \end{pmatrix}$

$u_0 = \begin{pmatrix} -1.7647058824 \\ 1.7647058824 \end{pmatrix}$

$$\pi_1 = \arg\max_a P_a u_0$$

$$= \arg\max \left\{ \begin{pmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{pmatrix} \begin{bmatrix} -1.764705 \\ +1.764705 \end{bmatrix}, \begin{bmatrix} 1/4 & 3/4 \\ 3/4 & 1/4 \end{bmatrix} \begin{bmatrix} -1.764705 \\ +1.764705 \end{bmatrix} \right\}$$

$$= \arg\max \left\{ \begin{bmatrix} \frac{-1.764705}{2} \\ \frac{1.764705}{2} \end{bmatrix}, \begin{bmatrix} \frac{1.764705}{2} \\ \frac{-1.764705}{2} \end{bmatrix} \right\}$$

$$\pi_1 = \cancel{\arg\max} \begin{bmatrix} a_2 \\ a_1 \end{bmatrix}$$

$$P\pi_1 = \begin{bmatrix} 1/4 & 3/4 \\ 1/4 & 3/4 \end{bmatrix} \qquad u_1 = (I - \gamma P\pi_1)^{-1} r$$

$$= \left(\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \frac{13}{15} \begin{bmatrix} 1/4 & 3/4 \\ 1/4 & 3/4 \end{bmatrix} \right)^{-1} \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

$$= \begin{pmatrix} \frac{47}{60} & -39/60 \\ -\frac{13}{60} & \frac{21}{60} \end{pmatrix}^{-1} \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

$$= \frac{60 \times 60}{47 \times 21 - 13 \times 39} \begin{pmatrix} 21/60 & 39/60 \\ 13/60 & 47/60 \end{pmatrix} \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

$$= \frac{60 \times 60}{480} \begin{pmatrix} \frac{18}{60} \\ \frac{34}{60} \end{pmatrix} = \begin{pmatrix} \frac{18 \times 60}{480} \\ \frac{34 \times 60}{480} \end{pmatrix}$$

$$u_1 = \begin{pmatrix} 2.25 \\ 4.25 \end{pmatrix}$$

$$\pi_2 = \arg\max P_a u_1 = \arg\max \left\{ \begin{bmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{bmatrix} \begin{bmatrix} 2.25 \\ 4.25 \end{bmatrix}, \begin{bmatrix} 1/4 & 3/4 \\ 3/4 & 1/4 \end{bmatrix} \begin{bmatrix} 2.25 \\ 4.25 \end{bmatrix} \right\}$$

$$= \arg\max \left\{ \begin{pmatrix} \frac{6.75 + 4.25}{4} \\ \frac{2.25 + 12.75}{4} \end{pmatrix}, \begin{pmatrix} \frac{2.25 + 12.75}{4} \\ \frac{6.75 + 4.25}{4} \end{pmatrix} \right\}$$

$$= \arg\max \left\{ \begin{pmatrix} 11/4 \\ 15/4 \end{pmatrix}, \begin{bmatrix} 15/4 \\ 11/4 \end{bmatrix} \right\}$$

$$\pi_2 = \begin{bmatrix} a_2 \\ a_1 \end{bmatrix} \qquad \pi_1 == \pi_2$$

So

$$u^* = u_1 = \begin{pmatrix} 2.25 \\ \cancel{+2.4705} \\ \cancel{+2.64705} \\ 4.25 \end{pmatrix}$$

So, $u_i^* = \max_a Q^*(s_i, a)$

$$Q^*(s_i, a_k) = r_i + \gamma \sum_j P_{ij}^k \max_{a'} Q^*(s_i, a')$$

$$\therefore Q^*(s_i, a_k) = r_i + \gamma \sum_j P_{ij}^k a_i^*$$

$$Q^*(s_1, a_1) = r_1 + \gamma \sum_j P_{ij}^1 U_i^k$$

$$= -1 + \frac{13}{15}\left[\tfrac{3}{4} \times 2.25 + \tfrac{1}{4} \cdot 2.25\right] = -1 + \frac{13}{15}\left(\frac{9}{4}\right)$$

$$= -1 + \frac{39}{20}$$

$$= \frac{19}{20}$$

$$\boxed{\therefore Q^*(s_1, a_1) = 19/20}$$

$$Q^*(s_1, a_2) = r_1 + \gamma \sum_j P_{ij}^2 u_i^*$$

$$= -1 + \frac{13}{15}\left[\tfrac{1}{4} \times (2.25) + \tfrac{3}{4} \times (2.25)\right]$$

$$Q^*(s_1, a_2) = -1 + \frac{13}{15}\left(\frac{9}{4}\right)$$

$$\boxed{Q^*(s_1, a_2) = 19/20}$$

$$Q^*(s_2, a_1) = r_2 + \gamma \sum_j P_{2j}^1 u_2^*$$

$$= 1 + \frac{13}{15}\left[\tfrac{1}{4} \times 4.25 + \tfrac{3}{4} \times 4.25\right]$$

$$= 1 + \frac{13}{15} \cdot \frac{17}{4}$$

$$\boxed{Q^*(s_2, a_1) = \frac{60 + 13 \times 17}{60} = 4.6833}$$

$$Q^*(s_2, a_2) = r_2 + \gamma \sum_j P_{2j}^2 u_2^* = 1 + \frac{13}{15}\left[\tfrac{3}{4}(4.25) + \tfrac{1}{4}(4.25)\right]$$

$$\boxed{Q^*(s_2, a_2) = 1 + \frac{13}{15} \cdot \frac{17}{4} = 4.6833}$$

(c) False +ve. Not actually a criminal but is predicted ~~a~~ as one. The society won't have any problem but the individual will have.

False -ve. It implies, he is actually a criminal but is predicted not. This will have a great impact on society because they ~~can~~ ~~get~~ are exposed to threat, cuz ~~use~~ the criminal is being favored.

A cutoff of '0' would do, since we have '0' false -ve's. So that there will be no harm to the society. But, if the error rate is the concern then '9' is of ~~a~~ a desirable cutoff.

(b). The least error rate is '883' with different risk scores, ~~But~~ when using Net-class though, the error rate is ~~all~~ always less than '883'.

The Neural network model is good cuz the error rate is less when compared to compan risk scores.