Deadlock Algorithm

① Calculate the R vector

- V = R - A
- R = V + A

$$Q = \begin{bmatrix} 3 & 0 & 4 & 2 \\ 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 2 & 4 & 2 \end{bmatrix}$$ Request Matrix

$$A = \begin{bmatrix} 0 & 3 & 2 & 2 \\ 1 & 0 & 2 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 2 \end{bmatrix}$$ Allocation Matrix

$$+ \begin{bmatrix} 3 & 4 & 6 & 4 \end{bmatrix}$$

$$V = \begin{bmatrix} 0 & 1 & 0 & 0 \end{bmatrix}$$ Vector

$[0\ 1\ 0\ 0] + [3\ 4\ 6\ 4]$
$\Rightarrow [3\ 5\ 6\ 4]$ ← This is our R vector

if it now is all 0's its not deadlocked

② let's go through the algorithm

$$\begin{bmatrix} P_1 & 3 & 0 & 4 & 2 \\ P_2 & 1 & 1 & 0 & 0 \\ P_3 & 0 & 1 & 0 & 0 \\ P_4 & 1 & 2 & 4 & 2 \end{bmatrix} \leq \begin{matrix} 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 \end{matrix}$$

P_1: Deadlocked for now
P_2: Deadlocked for now
P_3: Allocated so $[0\ 1\ 0\ 0] + [1\ 0\ 1\ 0] = [1\ 1\ 1\ 0]$ ← will be used for future comparison
P_4: Deadlocked for now

Reiterate Deadlocked Rows (make sure to use updated R)

$$\begin{bmatrix} P_1 & 3 & 0 & 4 & 2 \\ P_2 & 1 & 1 & 0 & 0 \\ P_3 & 1 & 2 & 4 & 2 \end{bmatrix} \leq \begin{matrix} 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 2 & 1 & 3 & 0 \end{matrix}$$

P_1: Deadlocked
P_2: Allocated $[1\ 1\ 1\ 0] + [1\ 0\ 2\ 0] = [2\ 1\ 3\ 0]$
P_3: Deadlocked

End of Deadlock Detection (W) = $[2\ 1\ 3\ 0]$
Deadlocked Processes: P_1 & P_3

Banker's Algorithm

a.) Find V

$$C = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 2 & 3 & 3 & 2 \\ 3 & 3 & 4 & 1 \\ 2 & 1 & 2 & 2 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 0 & 1 & 6 \\ 1 & 1 & 0 & 1 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 2 & 2 \end{bmatrix}$$

$$+ \quad 3\ 4\ 4\ 4$$

$$R = [3\ 6\ 5\ 7]$$

V = R - A (sum of columns)

$[3\ 6\ 5\ 7] - [3\ 4\ 4\ 4]$
$= [0\ 2\ 1\ 3]$

b. the safe state, find Q

Q = C - A

$$Q = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 2 & 3 & 2 \\ 3 & 0 & 3 & 0 \\ 1 & 1 & 0 & 0 \end{bmatrix}$$

b2.) Use the V vector to satisfy Processes w/ Q

$P_1 \begin{bmatrix} 0 & 1 & 0 & 1 \end{bmatrix} \leq 0\ 2\ 1\ 3$ True $[0\ 1\ 0\ 1] + [0\ 2\ 1\ 3] = [1\ 2\ 2\ 3]$

$P_2 \begin{bmatrix} 1 & 2 & 3 & 2 \end{bmatrix} \leq 1\ 2\ 2\ 3$ False

$P_3 \begin{bmatrix} 3 & 0 & 3 & 0 \end{bmatrix} \leq 1\ 2\ 2\ 3$ False

$P_4 \begin{bmatrix} 1 & 1 & 0 & 0 \end{bmatrix} \leq 1\ 2\ 2\ 3$ True $[1\ 2\ 2\ 3] + [1\ 0\ 2\ 2] = [2\ 2\ 4\ 5]$

Reiterated through false rows

$P_2 \begin{bmatrix} 1 & 2 & 3 & 2 \end{bmatrix} \leq 2\ 2\ 4\ 5$ True $[2\ 2\ 4\ 5] + [1\ 1\ 0\ 1] = [3\ 3\ 4\ 6]$

$P_3 \begin{bmatrix} 3 & 0 & 3 & 0 \end{bmatrix} \leq 3\ 3\ 4\ 6$ True $[3\ 3\ 4\ 6] + [0\ 3\ 1\ 1] = [3\ 6\ 5\ 7]$

Final V = [3 6 5 7]
This is safe!! ♡