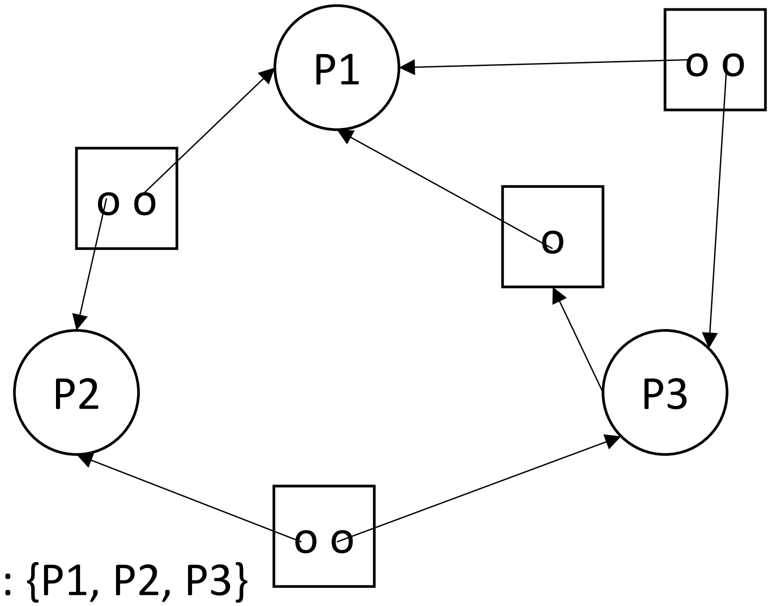
Question 2a. deadlock → cycle

True

Contradiction: Assume a deadlock exists without a cycle

An acyclic graph/subgraph can have a deadlock.

Acyclic graph:



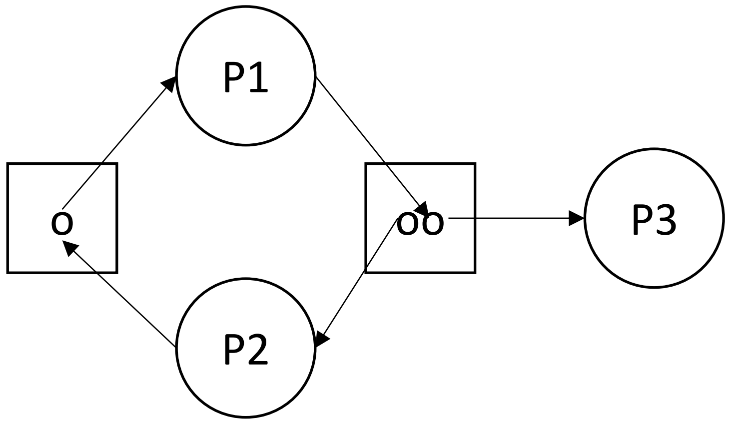
Reduction Sequence: {P1, P2, P3}
{P2, P1, P3} or {P1, P3, P2}

For a system to be deadlocked the system must have all processes blocked, in order to be blocked a process must have a fulfilled request, the process must wait till the request edge can be satisfied. If all processes in the system of process have an unfulfilled request edge that cannot be satisfied, then all process will be blocked in a total deadlock. The request in a well defined system is only unsatisfiable if the requested resource is being held by another process, this source waiting can only happen in a cycle, the process must on the other process to free up the resource, If all processes are waiting on another process to free up resource they are in a circular wait leading to a deadlock. An acyclic graph will always have at least one process that can run to completion and free the resources leading to full graph reduction. So an acyclic graph is always reducible this contradicts the assumption that an acyclic graphs can cause deadlock. Therefore a cycle is a necessary condition for a deadlock.

Question2b. cycle → deadlock

False

Counter Example:

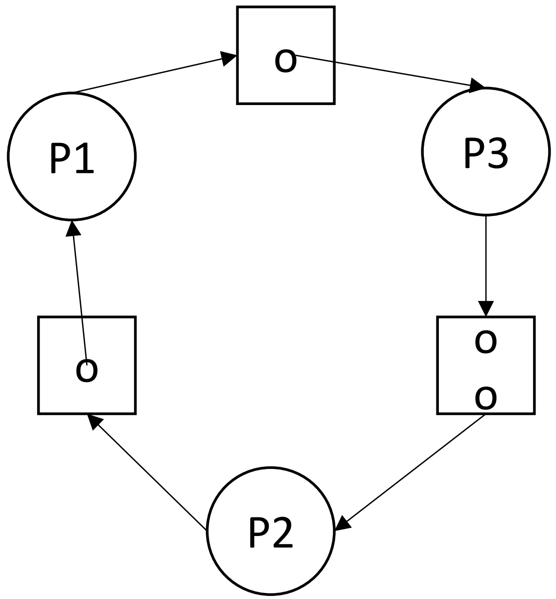


Reduction Sequence: P3, P1, P2

Question 2c. knot → deadlock

False

Counter Example: Non Expedient Graph Knot



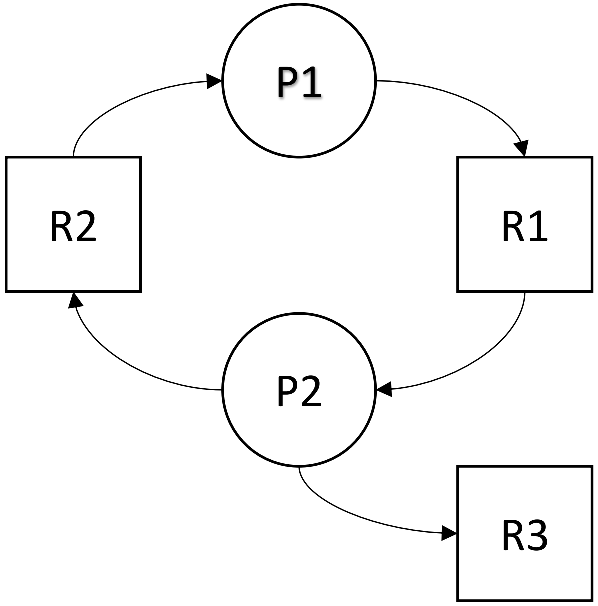
Expedient & Knot → deadlock

The Graph is reducible
Reduction Sequence: {P2, P1, P3}
Or {P3, P2, P1}

Question 2d. deadlock → knot

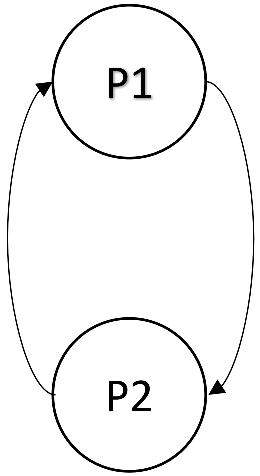
False

Counter Example: Single-Unit Resource



=>

Wait-for graph



Question 3a

$$C = \begin{bmatrix} 4 & 1 & 4 \\ 3 & 1 & 4 \\ 5 & 6 & 13 \\ 1 & 1 & 6 \end{bmatrix} \quad A = \begin{bmatrix} 0 & 1 & 4 \\ 2 & 0 & 1 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$$

Need = C – A => $\begin{bmatrix} 4 & 0 & 0 \\ 1 & 1 & 3 \\ 4 & 4 & 12 \\ 0 & 1 & 3 \end{bmatrix}$

SAFE!!!

Total = (5, 8, 15)

Free = (1, 5, 6)

This system is safe because the resource needs of two of our processes can be fulfilled, P1 and P4 need vectors can be satisfied with the free units. Either P1 and P4 can still run to completion freeing up the resource for the rest of the system.

Question 3 b

$$C = \begin{bmatrix} 4 & 1 & 4 \\ 3 & 1 & 4 \\ 5 & 6 & 13 \\ 1 & 1 & 6 \end{bmatrix} \quad A = \begin{bmatrix} 0 & 1 & 4 \\ 2+1 & 0 & 1 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix} \quad \text{Need} = A - C \Rightarrow \begin{bmatrix} 4 & 0 & 0 \\ 0 & 1 & 3 \\ 4 & 4 & 12 \\ 0 & 1 & 3 \end{bmatrix}$$

Total = (5, 8, 15)

SAFE!!!

Free = (0, 5, 6)

This Allocation is safe because the resource needs of two of our processes can be fulfilled, P1 and P4 need vectors can be satisfied with the free units. Either P1 and P4 can still run to completion freeing up the resource for the rest of the system.

Question 3c

$$C = \begin{bmatrix} 4 & 1 & 4 \\ 3 & 1 & 4 \\ 5 & 6 & 13 \\ 1 & 1 & 6 \end{bmatrix} \qquad A = \begin{bmatrix} 0 & 1 & 4 \\ 2 & 0 & 1 \\ 1 \quad 2 & 1 + 4 \\ 1 & 0 & 3 \end{bmatrix} \qquad \text{Need} = A - C \Rightarrow \begin{bmatrix} 4 & 0 & 0 \\ 1 & 1 & 3 \\ 4 & 4 & 8 \\ 0 & 1 & 3 \end{bmatrix}$$

Total = (5, 8, 15)

NOT SAFE!!!

Free = (1, 5, 2)

This allocation is not safe because the resource needs of any of our processes in our system of processes cannot be fulfilled leading to a deadlock, so all processes will be blocked waiting for a resource that is not available.

Question 4

FIFO

P0	P1	P2	P3	P4	
0	80	105	120	145	155

((0-0)+(80-15)+(105-15)+(120-85)+(145-90))/5

(0 + 65 + 90 + 35 + 55)/5

245/5 = 49

SJF

P0	P2	P4	P1	P3	
0	80	95	105	120	155

((0-0)+(80-15)+(95-90)+(105-15)+(130-85))/5

(0 + 65 + 5 + 90 + 45)/5

205/5 = 41

SRT

P0	P2	P1	P0	P3	P4	P3	P0	
0	15	30	55	85	90	100	120	155

((0-0)+(15-15)+(30-15)+(55-15)+(85-85)+(90-90)+(100-90)+(120-85))/5

(0 + 0 + 15 + 40 + 0 + 0 + 10 + 35)/5

100/5 = 20

RR

P0	P1	P2	P0	P1	P2	P0	P1	P0	P3	P4	P0	P3	P0	P3	P0	
0	20	30	40	50	60	65	75	80	90	100	110	120	130	140	145	155

((0-0)+(20-15)+(30-15)+(40-20)+(50-30)+(60-40)+(65-50)+(75-60)+(80-75)+(90-85)+(100-90)+(110-90)+(120-100)+(130-120)+(140-130)+(145-140))/5

(0+5+15+20+20+20+15+15+5+5+10+20+20+10+10+5)/5

195/5 = 39

ML

P0	P1	P0	P3	P4	P3	P0	P2	
0	15	40	85	90	100	120	140	155

((0-0)+(15-15)+(40-15)+(85-85)+(90-90)+(100-90)+(120-85)+(140-15))5

(0+0+25+0+0+10+35+125)/5

195/5 = 39