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Problem 6.1: safe states

$t = (6, 17, 9, 10, 7)$ $u = colsum(A) = (4, 17, 9, 7, 4)$

$a = t - u = (6, 17, 9, 10, 7) - (4, 17, 9, 7, 4) = (2, 0, 0, 3, 3)$

$$N = \begin{bmatrix} 2 & 5 & 3 & 3 & 2 \\ 3 & 5 & 8 & 10 & 1 \\ 4 & 12 & 4 & 9 & 2 \\ 6 & 1 & 4 & 5 & 5 \\ 1 & 2 & 3 & 4 & 5 \end{bmatrix} - \begin{bmatrix} 0 & 5 & 3 & 1 & 1 \\ 0 & 2 & 1 & 1 & 1 \\ 0 & 7 & 1 & 2 & 1 \\ 3 & 1 & 1 & 1 & 0 \\ 1 & 2 & 3 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 0 & 0 & 2 & 1 \\ 3 & 3 & 7 & 9 & 0 \\ 4 & 5 & 3 & 7 & 1 \\ 3 & 0 & 3 & 4 & 5 \\ 0 & 0 & 0 & 2 & 4 \end{bmatrix} \quad a = (2, 0, 0, 3, 3)$$

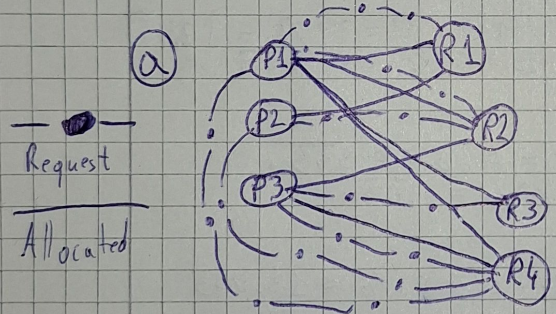
Process 1 is the only one that can execute, and even after it finishes the other processes can't proceed so the system by definition is **NOT** in a safe state

Problem 6.2: deadlock detection

$u = \langle 1, 2, 1, 3 \rangle$ $t = \langle 2, 2, 1, 3 \rangle$

$a = \langle 1, 0, 0, 0 \rangle$

(a)



↖ "I tried my best to draw it clearly"

(b) Deadlock?

Process 1: Not fulfilled we only have $\langle 1, 0, 0, 0 \rangle$
Process 2: Finishes and releases allocated resources $\langle 0, 1, 0, 1 \rangle$ so $a = (1, 1, 0, 1)$
Process 1: Not fulfilled yet.
Process 3: Needs $(0, 1, 0, 1)$ and that we have at $a = (1, 1, 0, 1)$. It completes and releases allocated resources $(0, 0, 1, 1)$ so now we have $(1, 1, 1, 2)$.

Process 1: Finishes because it needs $(1, 1, 1, 1)$ and we have that.

So all processes complete eventually. NO DEADLOCK.

6.3

Problem 6.3: scheduling strategies

(a) FCFS:

A AA AAAA BBBBBC CCCCCCCCCC DDDEFF

SPTF:

A A A AAA A B B B B B D D D E F F C C C C C C C C C

LPTF:

A AAAAAAC C C C C C C C C C B B B B B D D D F F E

RR:

A B A C A D A E A F B C B D B E B F E D C E C F C D C

(b) Turnaround Average and Wait Average

FCFS: Turnaround Times: 7 + 9 + 16 + 16 + 15 + 14 = 77/6 = $12.8\overline{33}$
Wait Times: 0 + 4 + 7 + 13 + 14 + 12 = 50/6 = $8.\overline{333}$

SPTF: TT: 7 + 9 + 21 + 7 + 6 + 6 = 56/6 = $9.3\overline{33}$
WT: 0 + 4 + 12 + 4 + 5 + 4 = 29/6 = $4.8\overline{33}$

LPTF: TT: 7 + 18 + 11 + 16 + 17 + 14 = 83/6 = $13.8\overline{33}$
WT: 0 + 13 + 2 + 13 + 16 + 12 = 56/6 = $9.3\overline{33}$

RR: TT: 26 + 15 + 11 + 18 + 11 + 14 = 105/6 = 17.50
WT: 19 + 10 + 12 + 15 + 10 + 12 = 78/6 = 13

THE END