

Problem Sheet #6

Problem 6.1: safe states

(2 points)

A system has $n = 5$ processes, $m = 5$ resource types, and the number of resources for each resource type is given by $t = (6, 17, 9, 9, 7)$. The system is in the following state:

$$M = \begin{bmatrix} 2 & 5 & 3 & 3 & 2 \\ 3 & 5 & 8 & 9 & 1 \\ 4 & 9 & 4 & 9 & 2 \\ 6 & 1 & 4 & 5 & 5 \\ 1 & 2 & 3 & 4 & 5 \end{bmatrix} \quad A = \begin{bmatrix} 1 & 5 & 3 & 1 & 1 \\ 0 & 2 & 1 & 1 & 1 \\ 0 & 7 & 1 & 2 & 1 \\ 3 & 1 & 1 & 1 & 0 \\ 1 & 2 & 3 & 2 & 1 \end{bmatrix}$$

Is the system in a safe state? Provide a calculation to justify your answer.

Problem 6.2: deadlock detection

(1+1 = 2 points)

A system has $n = 3$ processes, $m = 4$ resource types, and the number of resources for each resource type is given by $t = (3, 2, 3, 1)$. The system is in the following state:

$$A = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 \end{bmatrix} \quad N = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

- Draw the corresponding resource allocation graph.
- Is the system deadlocked? Provide a calculation to justify your answer.

Problem 6.3: scheduling strategies

(4+2 = 6 points)

A computer system with a single CPU has to execute six processes A, \dots, F . The arrival times and the execution times of the processes are given by the following table.

process	arrival time	execution time
A	0	9
B	4	8
C	6	2
D	8	5
E	13	4
F	15	1

- Draw the schedule for the scheduling strategies first-come first-served (FCFS), shortest processing time first (SPTF), longest processing time first (LPTF), and round robin (RR) with a time slice of 1 time unit. Assume that arrivals happen before a scheduling point and that new processes are added at the end of the run queue.
- For each schedule, calculate the average turnaround time \bar{t} and the average waiting time \bar{w} .