Operating Systems CO-562

Abumansur Sabyrrakhim
Assignment 5

Problem 5.1

A system has n = 4 processes, m = 5 resource types, and the number of resources for each resource type is given by t = (6, 15, 8, 10, 9). The system is in the following state:

Lets see if the system is safe state. First, we need to find N (Need / Max allocation):

$$N = M - A = \begin{bmatrix} 3 & 5 & 8 & 10 & 1 \\ 2 & 5 & 3 & 3 & 2 \\ 4 & 12 & 4 & 9 & 2 \\ 6 & 1 & 4 & 5 & 5 \end{bmatrix} - \begin{bmatrix} 0 & 2 & 1 & 1 & 1 \\ 0 & 5 & 3 & 1 & 1 \\ 0 & 7 & 1 & 2 & 1 \\ 3 & 1 & 1 & 1 & 0 \end{bmatrix} = \begin{bmatrix} 3 & 3 & 7 & 9 & 0 \\ 2 & 0 & 0 & 2 & 1 \\ 4 & 5 & 3 & 7 & 1 \\ 3 & 0 & 3 & 6 & 5 \end{bmatrix}$$

Now, lets find a:

$$a = t - \text{colsum}(A) = (6\ 15\ 8\ 10\ 9) - (3\ 15\ 6\ 5\ 3) = (3\ 0\ 2\ 5\ 6)$$

So, now we need to find sequence, s.t. all processes can obtain their needed resources and then terminate:

$$Need_i \leq \text{work} \Rightarrow \text{work} = \text{work} + \text{allocation}$$

P_1: (3 3 7 9 0) is larger than a $\Rightarrow$ cannot be allocated
P_2: (2 0 0 2 1) $\leq$ a $\Rightarrow$ can be allocated, so a = (3 5 5 6 7)
P_3: (4 5 3 7 1) is larger than a $\Rightarrow$ cannot be allocated
P_4: (3 0 3 6 5) $\leq$ a $\Rightarrow$ can be allocated, so a = (6 6 6 7 7)
P_1: (3 3 7 9 0) is larger than a $\Rightarrow$ cannot be allocated
P_3: (4 5 3 7 1) $\leq$ a $\Rightarrow$ can be allocated, so a = (6 13 7 9 8)
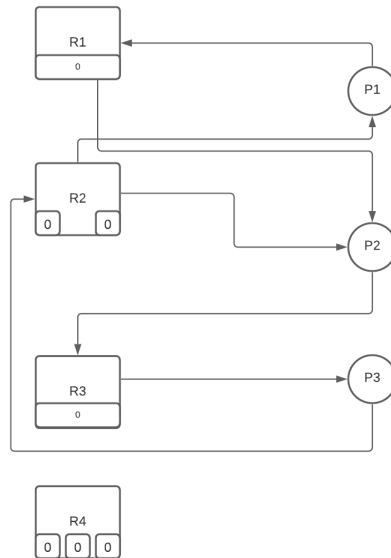P_1: (3 3 7 9 0) $\leq$ a $\Rightarrow$ can be allocated, so a = (6 15 8 10 9)

Hence, the system sequence is $P_2 \rightarrow P_4 \rightarrow P_3 \rightarrow P_1$.

Problem 5.2

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

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

(a)

- R_2 is allocated in P_1
- R_1 and R_2 are allocated in P_2
- R_3 is allocated in P_3
- P_1 needs R_1 resources
- P_2 needs R_3 resources
- P_3 needs R_2 resources

(b)

$$a = t - \text{colsum}(A) = (1\ 2\ 1\ 3) - (1\ 2\ 1\ 0) = (0\ 0\ 0\ 3)$$

Now we need to see if we can allocate processes and get safe sequence:

P_1: $(0\ 1\ 0\ 0)$ is larger than a $\Rightarrow$ cannot be allocated
P_2: $(1\ 1\ 0\ 0)$ is larger than a $\Rightarrow$ cannot be allocated
P_3: $(0\ 0\ 1\ 0)$ is larger than a $\Rightarrow$ cannot be allocated

We cannot allocate processes, since they aren't satisfied with the available resources, hence, system gets deadlocked.

Problem 5.3

Five processes arrived in the order P4 P1 P5 P3 P2 and they are all ready at time t=0. Process P1 needs 2 time units, P2 needs 3 time units, P3 needs 6 time units, P4 needs 10 time units, and P5 needs 19 time units. There is only one CPU in the system.

(a)

Draw the resulting schedule for the scheduling strategies first-come first-served(FCFS),longest processing time first (LPTF), shortest job first (SJF) and round robin (RR) with a time slice of 2 time units.

FCFS:

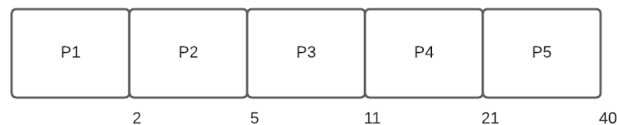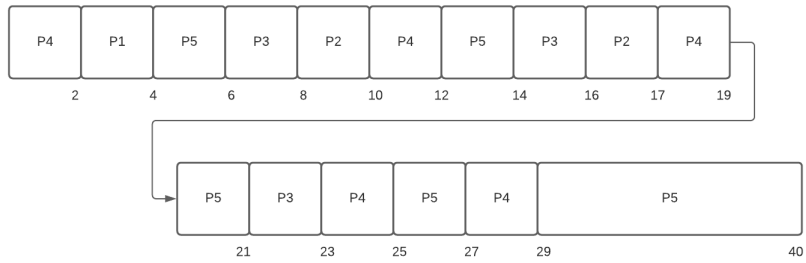| P4	P1	P5	P3	P2
	10	12	31	37	40

LPTF:

P5	P4	P3	P2	P1
	19	29	35	38	40

SJF:

P1	P2	P3	P4	P5
	2	5	11	21	40

RR:

P4	P1	P5	P3	P2	P4	P5	P3	P2	P4

2   4   6   8   10   12   14   16   17   19

P5	P3	P4	P5	P4	P5

21   23   25   27   29   40

(b)

Average completion time of each process:

	FCFS	LPTF	SJF	RR
P_4	10	29	21	29
P_1	12	40	2	4
P_5	31	19	40	40
P_3	37	35	11	23
P_2	40	38	5	17
Total	130	161	79	113
Average	26	32.2	15.8	22.6

Problem 5.4

(a)

file	symbol	internal	external	weak symbol	strong symbol
a.c	x		✓	✓	
a.c	y		✓	✓	
a.c	f	✓			✓
a.c	g		✓		✓
b.c	x		✓		✓
b.c	y	✓			✓
b.c	f		✓		✓
b.c	g		✓	✓	

4

(b)

Output:

```
main.c :   (.text) + 0xa :   undefined reference to ' f '

collect2:   error:   ld returned 1 exit status
```

The function f() is undefined, so linker exists with the error code.