University of Tlemcen
Computer Science Department

1st Year Engineer
"Introduction to the operating systems 2"

Session 12: Revision

Exercises

Academic year: 2023-2024

Exercise n° 1

On considère un système possédant deux processeurs et une seule file d'attente pour les processus prêts.

Soit le scénario d'arrivée des processus suivants : A, B, C, et D, ayant les caractéristiques suivantes (la priorité 1 correspond à la plus faible priorité). Le processeur 1 (CPU1) a la priorité d'accès à la file des processus prêts par rapport au processeur (CPU2).

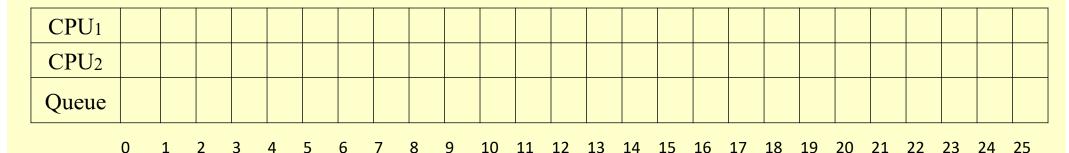| Processus	Priorité	Date d'arrivée	Durée d'exécution
P_1	2	0	4
P_2	4	2	5
P_3	3	0	6
P_4	1	0	7

Exercise n° 1

We consider a system with two processors and a single queue for ready processes.

Let's consider the arrival scenario of the following processes : P_1, P_2, P_3, and P_4, with the following characteristics (priority 1 corresponds to the lowest priority). Processor 1 (CPU1) has priority access to the queue of ready processes over processor (CPU2).

Process	Priority	Arrival date	Running time
P_1	2	0	4
P_2	4	2	5
P_3	3	0	6
P_4	1	0	7

1) Complete the diagrams for each of the following scheduling algorithms:
   a) FCFS (First Come First Served),
   b) Highest priority preemptive (with requisition),
   c) Round Robin (RR with quantum = 2)

CPU$_1$																									
CPU$_2$																									
Queue																									

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0   1   2   3   4   5   6   7   8   9   10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25
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2) Calculate the waiting time (WT) and response time (RT) of the processes.

Solution of exercise 1

a) FCFS (First Come First Served)

	0	1	2	3	4	5	6	7	8	9	10			
CPU$_1$	P$_1$	P$_1$	P$_1$	P$_1$	P$_4$	P$_4$	P$_4$	P$_4$	P$_4$	P$_4$	P$_4$			
CPU$_2$	P$_3$	P$_3$	P$_3$	P$_3$	P$_3$	P$_3$	P$_2$	P$_2$	P$_2$	P$_2$	P$_2$			
Queue	P$_4$	P$_4$	P$_4$	P$_4$	P$_2$	P$_2$								
			P$_2$	P$_2$										

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

b) Highest pre-emptive priority (with requisition)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CPU_1	P_3	P_3	P_3	P_3	P_3	P_3	P_1	P_1							
CPU_2	P_1	P_1	P_2	P_2	P_2	P_2	P_2	P_4	P_4	P_4	P_4	P_4	P_4	P_4	
Queue	P_4	P_4	P_1	P_1	P_1	P_1	P_4								
			P_4	P_4	P_4	P_4									

c) Round Robin (RR avec quantum = 2)

CPU$_1$	P$_1$	P$_1$	P$_4$	P$_4$	P$_1$	P$_1$	P$_4$	P$_4$	P$_3$	P$_3$	P$_2$				
CPU$_2$	P$_3$	P$_3$	P$_2$	P$_2$	P$_3$	P$_3$	P$_2$	P$_2$	P$_4$	P$_4$	P$_4$				
Queue	P$_4$	P$_4$	P$_1$	P$_1$	P$_4$	P$_4$	P$_3$	P$_3$	P$_2$	P$_2$					
			P$_3$	P$_3$	P$_2$	P$_2$									

0   1   2   3   4   5   6   7   8   9   10   11   12   13   14

2) Calculate the waiting time (WT) and response time (RT) for processes

Process	Algo. FCFS		Algo. Highest priority		Algo. RR (Q=2)	
	Waiting time	Response time	Waiting time	Response time	Waiting time	Response time
P_1	0	4	4	8	2	6
P_2	4	9	0	5	4	9
P_3	0	6	0	6	4	10
P_4	4	11	7	14	4	11

Exercise n°2

1) Determine the number of page faults generated by the FIFO, LRU and second-chance FIFO algorithms on the reference chain: 1, 2, 3, 1, 7, 4, 1, 2, 7, 4, 3, 1 with 4 page frames.

2) Determine the number of page faults generated by the FIFO algorithm on the reference chain: 1,2,3,4,1,2,5,1,2,3,4,5 in the following two cases:

   a) *With 3 page frames*

   b) *With 4 page frames*

Solution

❑ FIFO algorithm

	1	2	3	1	7	4	1	2	7	4	3	1
C_0	**1**	1	1	1	1	**4**	4	4	4	4	4	4
C_1		**2**	2	2	2	2	**1**	1	1	1	1	1
C_2			**3**	3	3	3	3	**2**	2	2	2	2
C_3					**7**	7	7	7	7	7	**3**	3
Page fault	x	x	x		x	x	x	x			x	

The number of page faults is: 8

❑ LRU algorithm

	1	2	3	1	7	4	1	2	7	4	3	1
C_0	**1**	1	1	1	1	1	1	1	1	1	**3**	3
C_1		**2**	2	2	2	**4**	4	4	4	4	4	4
C_2			**3**	3	3	3	3	**2**	2	2	2	**1**
C_3					**7**	7	7	7	7	7	7	7
Page fault	x	x	x		x	x		x			x	x

The number of page faults is: 8

❑ Second chance algorithm

	1	2	3	1	7	4	1	2	7	4	3	1
C_0	1^1	1^1	1^1	1^1	1^1	4^1	4^1	4^1	4^1	4^1	4^0	4^0
C_1		2^1	2^1	2^1	2^1	2^0	1^1	1^1	1^1	1^1	1^0	1^1
C_2			3^1	3^1	3^1	3^0	3^0	2^1	2^1	2^1	2^0	2^0
C_3					7^1	7^0	7^0	7^0	7^1	7^1	3^1	3^1
Page fault	x	x	x		x	x	x	x			x	

The number of page faults is: 8

2) FIFO algorithm: **3, 2, 1, 0, 3, 2, 4, 3, 2, 1, 0, 4**

a) With 3 frames

	3	2	1	0	3	2	4	3	2	1	0	4
C_0	**3**	3	3	**0**	0	0	**4**	4	4	4	4	4
C_1		**2**	2	2	**3**	3	3	3	3	**1**	1	1
C_2			**1**	1	1	**2**	2	2	2	2	**0**	0
Page fault	x	x	x	x	x	x	x			x	x	

The number of page faults is: 9

2) FIFO algorithm: **3, 2, 1, 0, 3, 2, 4, 3, 2, 1, 0, 4**

a) With 4 frames

	3	2	1	0	3	2	4	3	2	1	0	4
C_0	**3**	3	3	3	3	3	**4**	4	4	4	**0**	0
C_1		**2**	2	2	2	2	2	**3**	3	3	3	**4**
C_2			**1**	1	1	1	1	1	**2**	2	2	2
C_3				**0**	0	0	0	0	0	**1**	1	1
Défaut de page	x	x	x	x			x	x	x	x	x	x

The number of page faults is: 10

We noticed that even when we increased the size of RAM and consequently the number of frames, there was an increase in the number of page faults. This is the Belady anomaly.