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OPERATING SYSTEMS (CT104H)
ASSIGNMENT # 1
Due date: April 11
Please use English to answer the following questions.

Declaration of own work

I, *Ngô Hồng Quốc Bảo*, certify that this assignment is my own work, is not copied from any other person's work.

CHAPTER 1: INTRODUCTION

1. What are the components of a computer system?
2. What is an operating system? What are the goals of an OS?
3. What is a bootstrap program? Why do we need it?
4. Distinguish computer system architecture: single processor systems, multi-processor systems, and clustered systems
5. Describe the difference between symmetric and asymmetric multiprocessing. What are their advantages and disadvantages?
6. How does an interrupt differ from a trap?

CHAPTER 4: CPU SCHEDULING

Use **FCFS, SJF non-preemptive, and SJF preemptive** scheduling algorithms to answer questions:

- Draw Gantt charts that illustrate the execution of these processes for each of the scheduling algorithms
- What is the waiting time of each process for each of the scheduling algorithms? What is the average waiting time for each of the scheduling algorithms?
- What is the response time of each process for each of the scheduling algorithms? What is the average response time for each of the scheduling algorithms?
- What is the turnaround time of each process for each of the scheduling algorithms? What is the average turnaround time for each of the scheduling algorithms?

7. The system consists of 4 processes

Process	CPU time	Arrival time
P1	5	0
P2	24	3
P3	3	5
P4	20	8

8. The system consists of 5 processes

Process	CPU time	Arrival time
P1	6	1
P2	8	3
P3	1	5
P4	3	6
P5	6	7

9. The system consists of 4 processes

10. The system consists of 3 processes

Process	CPU time	Arrival time
P1	5	2
P2	7	1
P3	3	3
P4	1	4

Process	CPU time	Arrival time
P1	8	0
P2	4	4
P3	1	1

Task:

1. Components of a computer system are:
   - CPU (stands for Central Processing Unit)
   - RAM
   - Graphics card
   - Hard drives
   - Input devices
   - Output devices
   - Power Supply
2. An operating system acts as an intermediary between the user of a computer and the computer hardware. The purpose of an operating system is to provide an environment in which can execute programs in a convenient and efficient manner.
3. A bootstrap program is the first code that is executed when the computer system is started. For a computer to start running - for instance, when it is powered up or rebooted, it needs to have an initial program to run. This initial program is bootstrap program. The entire operating system depends on the bootstrap program to work correctly as it loads the operating system.
4. Distinguish computer system architecture:
   - ➔ *Single-Processor Systems*: There is only one main CPU capable of executing a general-purpose instruction set, including instructions from user processes.
   - ➔ *Multiprocessor Systems*: Systems have two or more processors in close communication, sharing the computer bus and sometimes the clock, memory, and peripheral devices.
   - ➔ *Clustered Systems*: is another type of multiprocessor system. The difference of the clustered systems and multiprocessor systems is that clustered systems are composed of two or more individual systems - or nodes - joined together. Each node can be a single-processor system or a multiprocessor system.
5. The difference between symmetric and asymmetric multiprocessing:
   - ❖ The most distinguishable point between symmetric and asymmetric multiprocessing is that the tasks in OS are handled only by the master processor in Asymmetric Multiprocessing. On the other hand, all the processors in symmetric multiprocessing run the tasks in OS.
   - ❖ In symmetric multiprocessing, each processor may have its own private queue of ready processes, or they can take processes from a common ready queue. But, in asymmetric multiprocessing, master processor assigns processes to the slave processors.
   - ❖ All the processor in Symmetric Multiprocessing has the same architecture. But the structure of processors in asymmetric multiprocessor may differ.

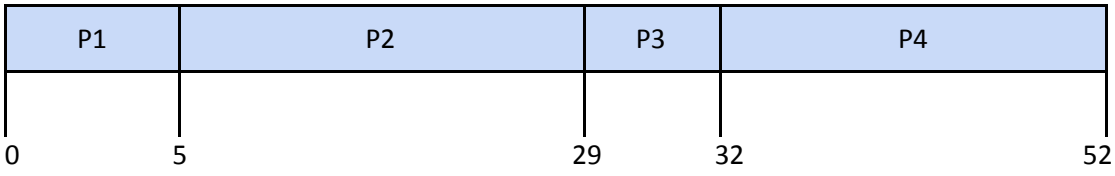
- ❖ Processors in symmetric multiprocessing communicate with each other by the shared memory. However, the processors in Asymmetric Multiprocessing need not to communicate with each other as they are controlled by the master processor.
- ❖ In case, the master processor fails, a slave processor is turned to master processor to continue the execution. But, if a processor in symmetric multiprocessing fails, the computing capacity of the system is reduced.
- ❖ Asymmetric Multiprocessor is simple as only master processor accesses the data structure whereas, symmetric multiprocessor is complex as all the processors need to work in synchronisation.

6. Difference between an interrupt and a trap:
   - ❖ Trap and Interrupt are two types of events. The difference between trap and interrupt is that the trap is triggered by a user program to invoke OS functionality while the interrupt is triggered by a hardware device to allow the processor to execute the corresponding interrupt handler routine.
   - ❖ The trap is a signal raised from a user program that indicates the operating system to perform on some functionality immediately while interrupt is a signal to the processor emitted by hardware indicating an event that needs immediate attention.
   - ❖ A trap is generated by an instruction in the user program while an interrupt is generated by hardware devices.
   - ❖ A trap invokes OS functionality. It transfers the control to the trap handler. An interrupt triggers the processor to execute the corresponding interrupt handler routine.
   - ❖ Also, a trap is synchronous and can arrive after the execution of any instruction while an interrupt is asynchronous and can occur at the execution of any instruction.
   - ❖ A trap is also called a software interrupt while an interrupt is also called a hardware interrupt.

7.

➢ **FCFS:**

- ○ Grant chart:

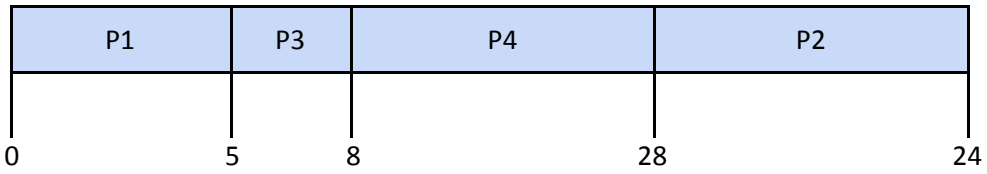


- ○ Waiting time, Response time and Turnaround time:

	Waiting time	Response time	Turnaround time
P1	0 - 0 = 0	0 - 0 = 0	5 - 0 = 5
P2	5 - 3 = 2	5 - 3 = 2	29 - 3 = 26
P3	29 - 5 = 24	29 - 5 = 24	32 - 5 = 27
P4	32 - 8 = 24	32 - 8 = 24	52 - 8 = 44
Average Time	12.5	12.5	25.5

➢ **SJF preemptive:**

- Grant chart:

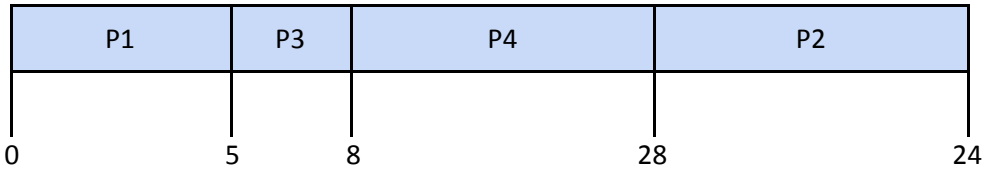


- Waiting time, Response time and Turnaround time:

	Waiting time	Response time	Turnaround time
P1	0 - 0 = 0	0 - 0 = 0	5 - 0 = 5
P2	28 - 3 = 25	28 - 3 = 25	52 - 3 = 49
P3	5 - 5 = 0	5 - 5 = 0	8 - 5 = 3
P4	8 - 8 = 0	8 - 8 = 0	28 - 8 = 20
Average Time	6.25	6.25	19.25

➢ **SJF non-preemptive:**

- Grant chart:



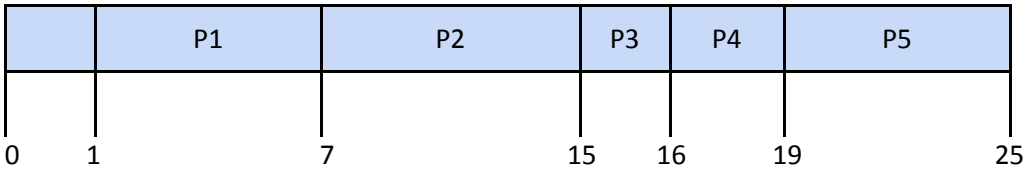
- Waiting time, Response time and Turnaround time:

	Waiting time	Response time	Turnaround time
P1	0 - 0 = 0	0 - 0 = 0	5 - 0 = 5
P2	28 - 3 = 25	28 - 3 = 25	52 - 3 = 49
P3	5 - 5 = 0	5 - 5 = 0	8 - 5 = 3
P4	8 - 8 = 0	8 - 8 = 0	28 - 8 = 20
Average Time	6.25	6.25	19.25

8.

➢ **FCFS:**

- Grant chart:

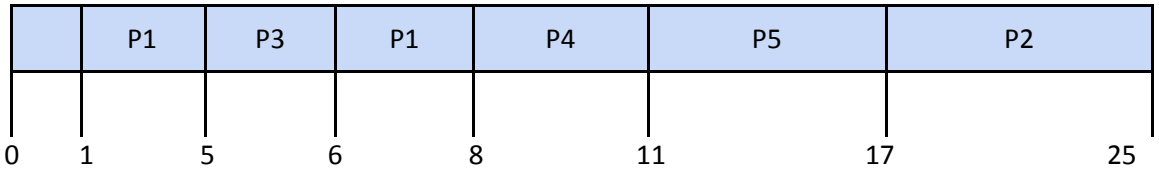


- Waiting time, Response time and Turnaround time:

	Waiting Time	Response Time	Turnaround time
P1	1 - 1 = 0	1 - 1 = 0	7 - 1 = 6
P2	7 - 3 = 4	7 - 3 = 4	15 - 3 = 12
P3	15 - 5 = 10	15 - 5 = 10	16 - 5 = 11
P4	16 - 6 = 10	16 - 6 = 10	19 - 6 = 13
P5	19 - 7 = 12	19 - 7 = 12	25 - 7 = 18
Average	7.2	7.2	12

➢ **SJF preemptive:**

- Grant chart:



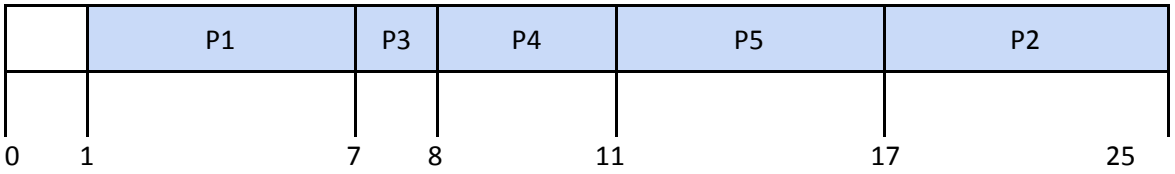
- Waiting time, Response time and Turnaround time:

	Waiting Time	Response Time	Turnaround time
P1	(1 - 1) + (6 - 5) = 1	1 - 1 = 0	8 - 1 = 7
P2	17 - 3 = 14	17 - 3 = 14	25 - 3 = 22
P3	5 - 5 = 0	5 - 5 = 0	6 - 5 = 1
P4	8 - 6 = 2	8 - 6 = 2	11 - 6 = 5

P5	11 - 7 = 4	11 - 7 = 4	17 - 7 = 10
Average time	4.2	4	9

➢ SJF non-preemptive:

- Grant chart:



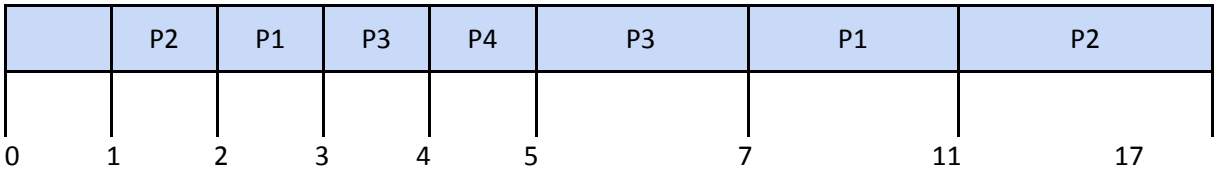
- Waiting time, Response time and Turnaround time:

	Waiting Time	Response Time	Turnaround time
P1	1 - 1 = 0	1 - 1 = 0	7 - 1 = 6
P2	17 - 3 = 14	17 - 3 = 14	25 - 2 = 22
P3	7 - 5 = 2	7 - 5 = 2	8 - 5 = 3
P4	8 - 6 = 2	8 - 6 = 2	11 - 6 = 5
P5	11 - 7 = 4	11 - 7 = 4	17 - 7 = 10
Average time	4.4	4.4	9.2

9.

➢ SJF preemptive:

- Grant chart:



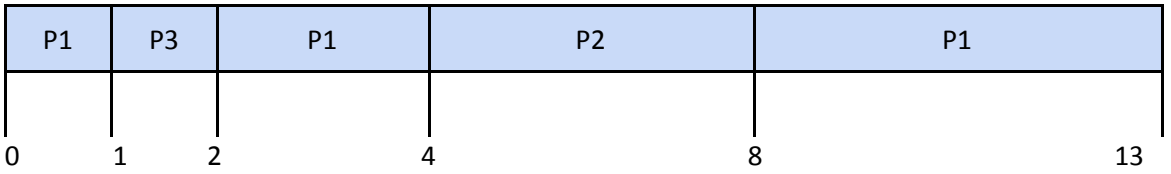
- Waiting time, Response time and Turnaround time:

	Waiting Time	Response Time	Turnaround Time
P1	(2 - 2) + (7 - 3) = 4	2 - 2 = 0	11 - 2 = 9
P2	(1 - 1) + (11 - 2) = 9	1 - 1 = 0	17 - 1 = 16
P3	(3 - 3) + (5 - 4) = 1	3 - 3 = 0	7 - 3 = 4
P4	5 - 5 = 0	5 - 5 = 0	28 - 8 = 20
Average Time	3.5	0	12.25

10.

➢ SJF preemptive:

- Grant chart:



- Waiting time, Response Time, Turnaround Time

	Waiting Time	Response Time	Turnaround Time
P1	(0 - 0) + (2 - 1) + (8 - 2) = 7	0 - 0 = 0	13 - 0 = 13
P2	4 - 4 = 0	4 - 4 =0	8 - 4 = 4
P3	1 - 1 = 0	1 - 1 = 0	2 - 1 = 2
Average Time	2.333	0	6.333