

Tutorial 1

Exercise 1:

We are interested in the execution of three programs (jobs) P1, P2, and P3 that run on a single-processor configuration and arrive in order. The sequence of actions for the jobs is as follows:

P1	P2	P3
5 Unit of time CPU - 2 Unit of time I/O - 3 Unit of time CPU	- 1 Unit of time CPU - 4 Unit of time I/O	- 1 Unit of time I/O - 4 Unit of time CPU

We assume that:

- The **system control task takes 1 unit** of CPU computation time, regardless of its nature.
 1. Provide the execution diagrams of the jobs in the three operating modes: **monoprogramming**, **multiprogramming**, and **time-sharing** (the time quantum is equal to 2 units of time).
 2. Calculate **the response times** for each job as well as **the average response time** of the system in the three operating modes mentioned above.

Exercise 2:

Indicate which of the following instructions are considered **privileged** or **non-privileged**

- a) Loading memory management registers.
- b) Writing to the program counter.
- c) Reading the clock.
- d) Setting the clock.
- e) Changing the processor priority.
- f) Switching to supervisor mode.
- g) Rebooting.
- h) Reading the status register.
- i) Disabling interrupts.
- j) Writing to the instruction register.

Exercise 3:

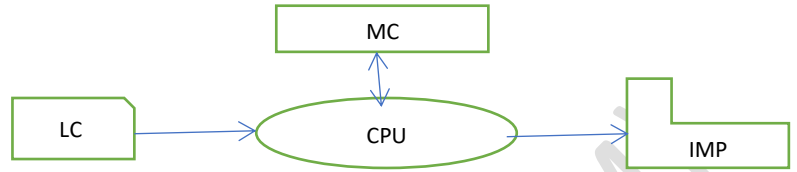
Consider a computing machine that must process a set of jobs. The characteristics of the machine and the typical job are as follows:

Machine:

- Card reader (LC) speed: 1000 cards/min.
- Printer (IMP) speed: 1000 lines/min.

Job:

- Phase 1: Reading 300 cards (program and data).
- Phase 2: Computation for 1 min.
- Phase 3: Printing 500 lines.



We are interested in studying *the evolution of computer systems*. Consider the following configuration:

To study the performance of this machine, we will choose 2 parameters to account for the system's performance.

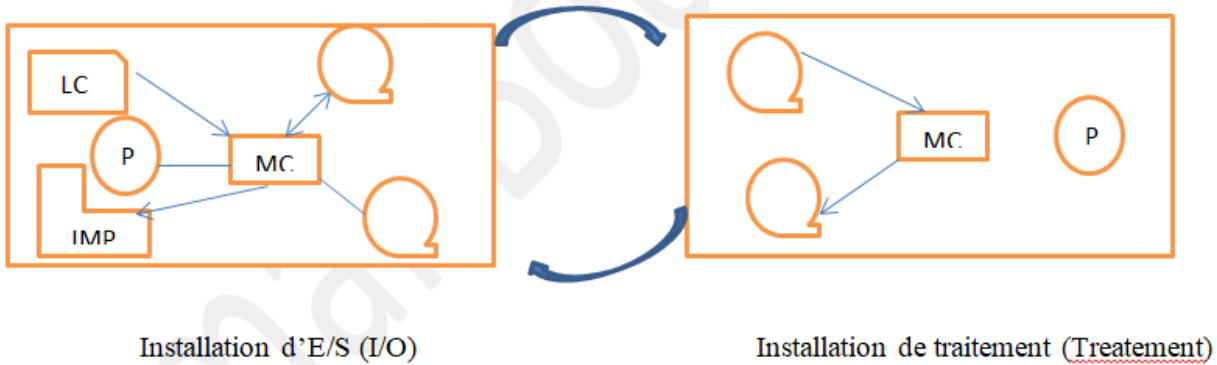
- CPU occupancy: **N** = fraction of time (percentage) spent by the CPU executing jobs.
- Job throughput: **D** = number of jobs executed per unit of time (**hour**).

(N: processor efficiency; D: user satisfaction).

1. Justify the choice of parameters N and D? (i.e., why were N and D chosen?).
2. Assume the system is managed under *open-door policy* where the system is entirely allocated to each user for a **duration of 15 minutes**. What are the values of N and D?

Now the system is managed by a *job scheduler*. What are the new values of N and D?

In the system configuration, there is no channel, which translates into the disadvantage of occupying the CPU during I/O time (data input and output results). The output of the CPU can only be increased by running parallel inputs/outputs and parallel processing. To do this, we use the following configuration:



The system used the batch processing technique.

Suppose the **batch** consists of **50 jobs** and the tape transfer time is 5 minutes.

- What is the total execution time of a batch?

Calculate the flow rate?

- What is the minimum waiting rate for each job?