Tuto N°2 OSII
Synchronization of processes using Semaphores

Exercise 01: University Restaurant

A university restaurant can serve a limited number of meals. The number of meals served at any given time cannot exceed the number of seats available in the restaurant. Let nbp be this number of seats.It is assumed that everyone washes their hands before eating and after eating. The restaurant has nbl sinks (nbl is less than nbp). The nbp seats and nbl sinks constitute the resources to be shared between students. Processes represent the progression of students inside the restaurant. The general scheme (protocol) of a process is then:

-Enter the restaurant
-*<Eat>*
-Leave the restaurant

1. Define the synchronization points.
2. Define the conditions for crossing these synchronization points.
3. Write the program of a processi using semaphores.

Exercise 02: Producer-Consumer Problem

Consider two cooperating processes **P** and **C,** called respectively producer and consumer. The producer reads a file **F**, message by message, and transmits each message to the consumer. The role of a consumer is to print these messages. The producer stops as soon as it encounters a message whose content is equal to the word "**End**". Communication between these two processes is realized through a buffer of n elements (one element = one message).

These two processes must respect the following constraints:

* The consumer cannot remove a message that the producer is in the process of depositing.
* The producer must not deposit a message in the buffer when it is full: it must wait.
* The consumer must remove the messages once and only once.
* If the producer (respectively the consumer) is waiting because the buffer is full (respectively empty) it must be woken up as soon as this condition ceases to be true.

1. Define the synchronization points
2. Define the conditions for crossing these synchronization points
3. Write the program of each of the processes (P and C) using semaphores.
4. Generalize the previous solution to the case of multiple producers and multiple consumers.

Exercise 03: The Readers-Writers Model

Consider two classes of processes called Readers and Writers. These processes share a file. Readers can only read the file and writers can only write to the file.

The processes in these two classes must meet the following constraints:

- **Multiple readers can read the file simultaneously.**
- **Only one writer at a time can write to the file.**
- **A reader and a writer cannot use the file at the same time.**

1. Define the synchronization points
2. Define the conditions for crossing these synchronization points
3. Write the programs for each class of processes (Readers and Writers), using semaphores, in the following cases:
   a. Priority to readers.
   b. FIFO order.
   c. Priority to writer**s.**