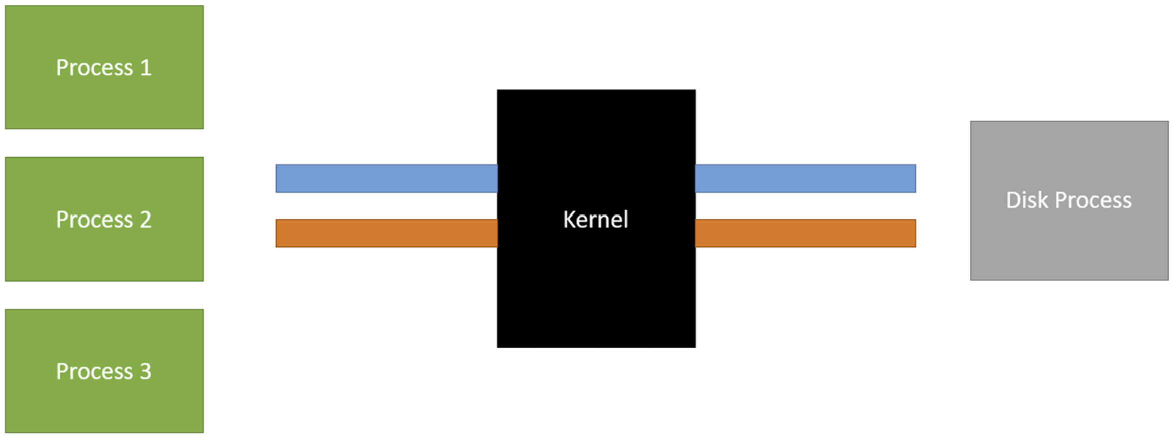
Zewail city for science and technology

Computer and Information engineering

CIE 302

Project – Phase 1



In phase 1 of the project; we're going to build a simulation of how processes send I/O requests to the kernel and how kernel handle these request; emphasizing the fact that doing I/O should be done by a process working in kernel mode i.e. more privileged.

You're going to write the logic for three different types of processes:

1- **Disk Process; the process handling storage.**
   - The storage handled by the Disk will be simulated by 10 char arrays (each array of size 64 chars). Each array will be referred to as a slot.
   - This process only communicates with the kernel process.
   - It communicates with the kernel process through two message queues; the **UP queue** and the **DOWN queue**; the kernel process sends data addition and deletion requests on the DOWN queue queue and the Disk process responds on the down queue with the status of the request (either success or failure).
   - The kernel process can also ask the Disk process about its status (the number of available slots) by sending a **SIGUSR1**. The Disk responds on the **UP queue** by sending a message containing the number of available slots. The message should have an mtype that indicates that it's a Disk status message.
   - The Disk process also keeps a **local CLK variable** that is managed by the Kernel. It increments it when it receives a **SIGUSR2** from the kernel.

- The operations of adding and deleting data from the Disk slots have latencies; addition takes 3 CLK cycles and deletion takes 1 CLK cycle.
- Data addition and deletion are straight forward; when the disk receives a data addition request it writes the data to any free slot it has. When it receives a data deletion request it deletes the data in the slot specified in the deletion request.

2- **Kernel Process; works as the mediator between user processes and Disk.**
- Makes sure that all processes (user processes and Disk process) are in sync by sending a **SIGUSR2** to all processes every 1 second so that they can all increment their CLK variables.
- The kernel process communicates with the disk process through two streams (message queues);
  - **The UP Queue;** where it receives data addition/deletion requests status and disk status messages.
  - **The DOWN queue;** where it sends data addition/deletion requests.
- The kernel process communicates with user processes through two streams (message queues);
  - **The UP Queue;** where it receives data addition and deletion requests from user processes.
  - **The DOWN queue;** where it sends requests status to the user processes.
- When the kernel receives a data addition request on the up queue; it checks the disk status by sending a SIGUSR1 to the Disk Process. If the disk has free slots it sends the data to it to be added. If not; the kernel responds to the process telling it that its request can't be handled.
- When the kernel receives a data deletion request, it sends it directly to the Disk. The disk response will determine how the kernel will respond to the user process.
- The kernel response to the user process is one of the following 4 responses.
  - "0" i.e. successful ADD.
  - "1" i.e. successful DEL.
  - "2" i.e. unable to ADD.
  - "3" i.e. unable to DEL.
- On the side of all of that, the kernel keeps a log file of all the events.

3- **User Process; the process doing I/O requests.**
- Every process reads a file that has all the I/O requests it should do listed. The file format is as follows.

```
Time       Operation      Data
```

Where Time is the CLK cycle in which it should add its request to the UP Queue, Operation is the operation type(addition or deletion), and Data is either the data to be added or the slot number to be deleted.

10	**ADD**	**“Hello”**
13	**ADD**	**“This is me”**
20	**DEL**	**<slot number 0 ~ 9>**

- The process should formulate its requests as follows before adding them to the UP Queue:
    - Add request:

A	**The msg itself i.e. “Cairo University”**

    - Delete request:

D	**<slot number>**

- When a process sends an ADD/DELETE request**; it should block** waiting for the response of the DOWN queue.
- The process increments its **local CLK variable** when it receives SIGUSR2 from the kernel.