PROCESSES
Process

- A process is a set of sequential steps that are required to do a particular task.

- A process is an instance of a program in execution.

- For e.g.: in Windows, if we edit two text files, simultaneously, in notepad, then it means we are implementing two different instances of the same program.

- For an operating system, these two instances are separate processes of the same application.
A process needs certain resources such as:

- CPU Time
- Memory Files
- I/O Devices

to accomplish its task.

These resources are allocated to the process either when it is created or while it is executing.
Process States

- A process goes through a series of process states for performing its task.
- As a process executes, it changes state.
- Various events can cause a process to change state.
The various states of a process are:

- **new**
- **admitted**
- **interrupt**
- **exit**
- **terminated**
- **ready**
- **running**
- **waiting**
- **I/O or event completion**
- **scheduler dispatch**
- **I/O or event wait**
Process States

- **New:**
  - A process that has just been created.

- **Ready:**
  - The process is ready to be executed.

- **Running:**
  - The process whose instructions are being executed is called running process.
Process States

- **Waiting:**
  - The process is waiting for some event to occur such as completion of I/O operation.

- **Terminated:**
  - The process has finished its execution.

- **Note:** Only one process can be *running* on any processor at any instant. However, there can be many processes in *ready* and *waiting* states.
Process Control Block (PCB) is a data structure used by operating system to store all the information about a process.

- It is also known as Process Descriptor.

- When a process is created, the operating system creates a corresponding PCB.
Process Control Block (PCB)

- Information in a PCB is updated during the transition of process states.

- When a process terminates, its PCB is released.

- Each process has a single PCB.
Process Control Block (PCB)

- The PCB of a process contains the following information:

  - process state
  - process number
  - program counter
  - registers
  - memory limits
  - list of open files
  - ...
Process Control Block (PCB)

- **Process Number:** Each process is allocated a unique number for the purpose of identification.

- **Process State:** It specifies the current state of a process.

- **Program Counter:** It indicates the address of next instruction to be executed.
Process Control Block (PCB)

- **Registers:** These hold the data or result of calculations. The content of these registers is saved so that a process can be resumed correctly later on.

- **Memory Limits:** It stores the amount of memory units allocated to a process.

- **List of Open Files:** It stores the list of open files and their access rights.
In multiprogramming, several processes are kept in main memory so that when one process is busy in I/O operation, other processes are available to CPU.

In this way, CPU is busy in executing processes at all times.

This method of selecting a process to be allocated to CPU is called Process Scheduling.
Process scheduling consists of the following sub-functions:

- **Scheduling**: Selecting the process to be executed next on CPU is called scheduling.
  - In this function a process is taken out from a pool of ready processes and is assigned to CPU.
  - This task is done by a component of operating system called **Scheduler**.
Process Scheduling

- **Dispatching**: Setting up the execution of the selected process on the CPU is called dispatching.
  - It is done by a component of operating system called **Dispatcher**.
  - Thus, a dispatcher is a program responsible for assigning the CPU to the process, that has been selected by the Scheduler.

- **Context Save**: Saving the status of a running process when its execution is to be suspended is known as context save.
In multiprogramming, several processes are there in ready or waiting state.

These processes form a queue.

The various queues maintained by operating system are:
- Job Queue
- Ready Queue
- Device Queue
Scheduling Queues

- **Job Queue:**
  - As the process enter the system, it is put into a job queue. This queue consists of all processes in the system.

- **Ready Queue:**
  - It is a doubly linked list of processes that are residing in the main memory and are ready to run.
Scheduling Queues

- **Device Queue:**
  - It contains all those processes that are waiting for a particular I/O device.
  - Each device has its own device queue.

- Diagram on the next slide shows the queues.
Scheduling Queues
Context Switch

- Switching the CPU from one process to another process requires saving the state of old process and loading the saved state of new process.

- This task is known as **Context Switch**.

- When context switch occurs, operating system saves the context of old process in its PCB and loads the saved context of the new process.
Context Switch

process $P_0$  operating system  process $P_1$

executing

interrupt or system call

save state into PCB$_0$

... ...

reload state from PCB$_1$

idle

executing

interrupt or system call

save state into PCB$_1$

... ...

reload state from PCB$_0$

idle

idle
Thank You 😊

Have a Nice Day