Chapter : Processes

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Chapter : Processes

- Process Concept
- Process Scheduling
- Operations on Processes

Process

Program: Passive entity

- Process is instance of a program under executing
- Process – a program in execution
  - Active Entity b/c it has Program Counter associated to it.

- Process execution must progress in sequential manner
- A process includes:
  - program counter
  - stack
  - data section

Process

- A process has **text section/ code section.**
- It also includes the current activity, as represented by the value of the **program counter and the contents of the processor's registers.**
- **A process also** includes **the process stack, which contains:**
  - **temporary data (**such as function parameters, return addresses, and local variables)
  - **data section,** which contains global variables.
- A process may also include a **heap,** which is memory that is dynamically allocated during process run time.

Process

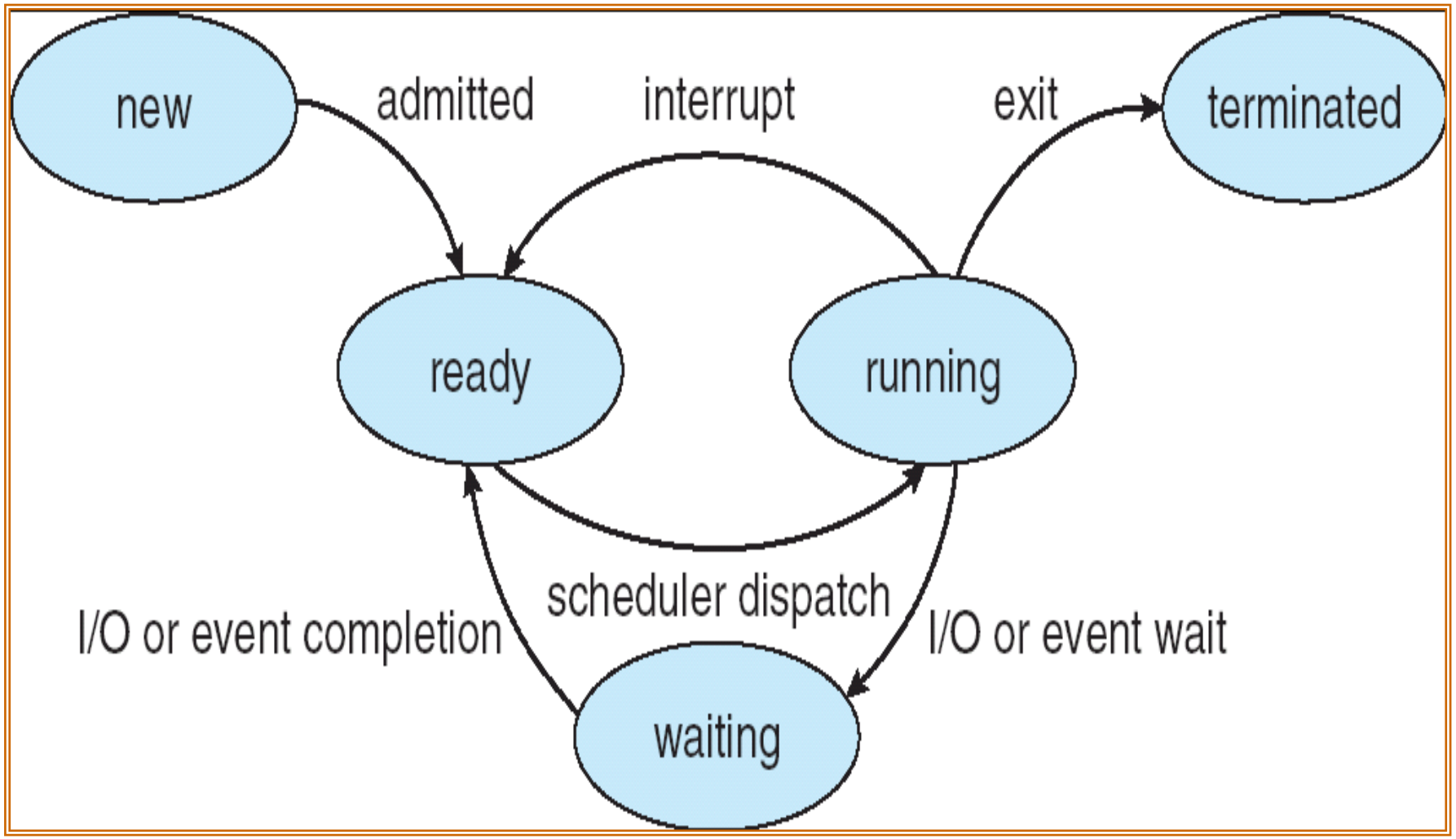
- A program is a passive entity, such as a file containing a list of instructions stored on disk.

- A process is an active entity with a program counter specifying the next instruction to execute and a set of associated resources.

Process States

- As a process executes, it changes *state*
  - **new**: The process is being created
  - **ready**: The process is waiting to be assigned to a processor and is ready to get executed
  - **running**: Instructions are being executed
  - **waiting**: The process is waiting for some event to occur/ waiting for resources
  - **terminated**: The process has finished execution

Process States



Process Control Block (PCB)

Process Control Block (PCB, also called Task Controlling Block) is a data structure in the operating system kernel containing the information needed to manage a particular **process**.

The PCB is "the manifestation of a **process** in an operating system".

Process Control Block (PCB)

Information associated with each process:

1. **Process State-** new, ready….etc.
2. **Pointer-** to the parent process
3. **Program Counter-** next instruction to be executed.
4. **Process Number- Unique identification** number in OS
5. **CPU Registers-** Various CPU registers **where process** need to be **stored for execution** for running state.
6. **CPU Scheduling Information-** Process Priority and other info. required for scheduling

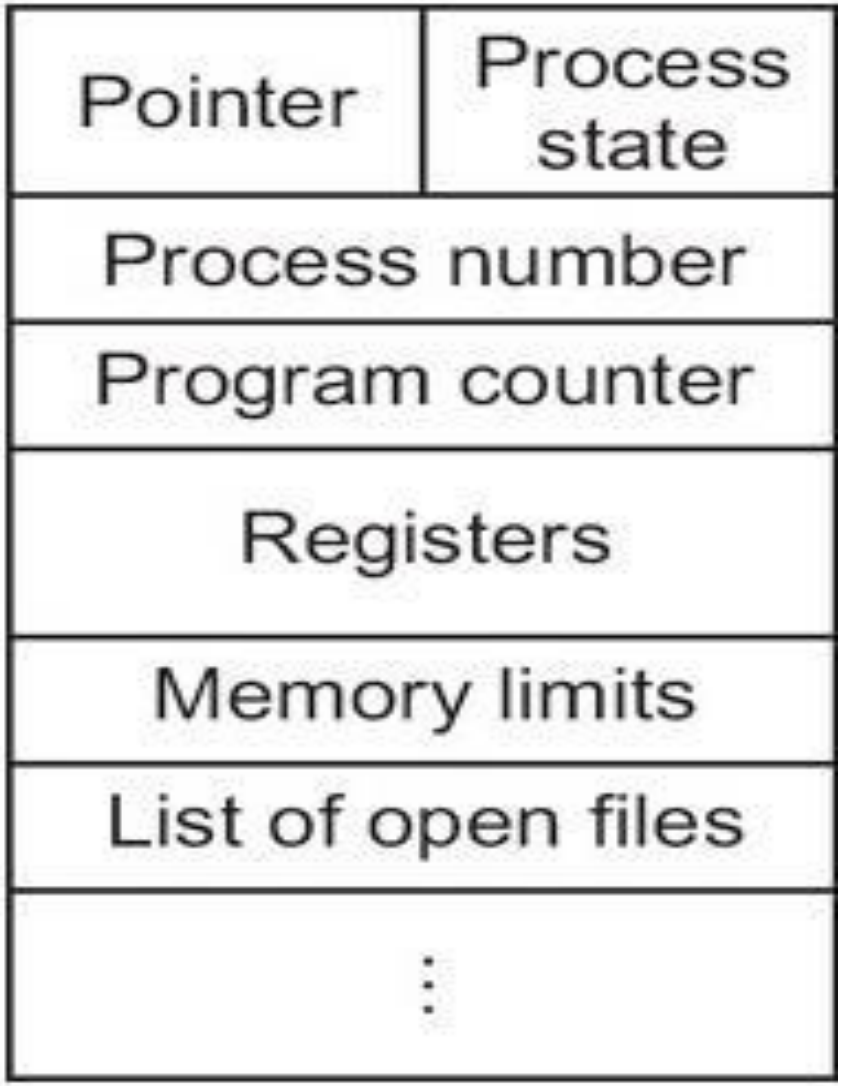
Process Control Block (PCB)

7. **Memory-Management Information-** Registers, Page tables (where process is saved)used by OS

8. **Accounting Information-** For how long CPU and other resources are allocated to process

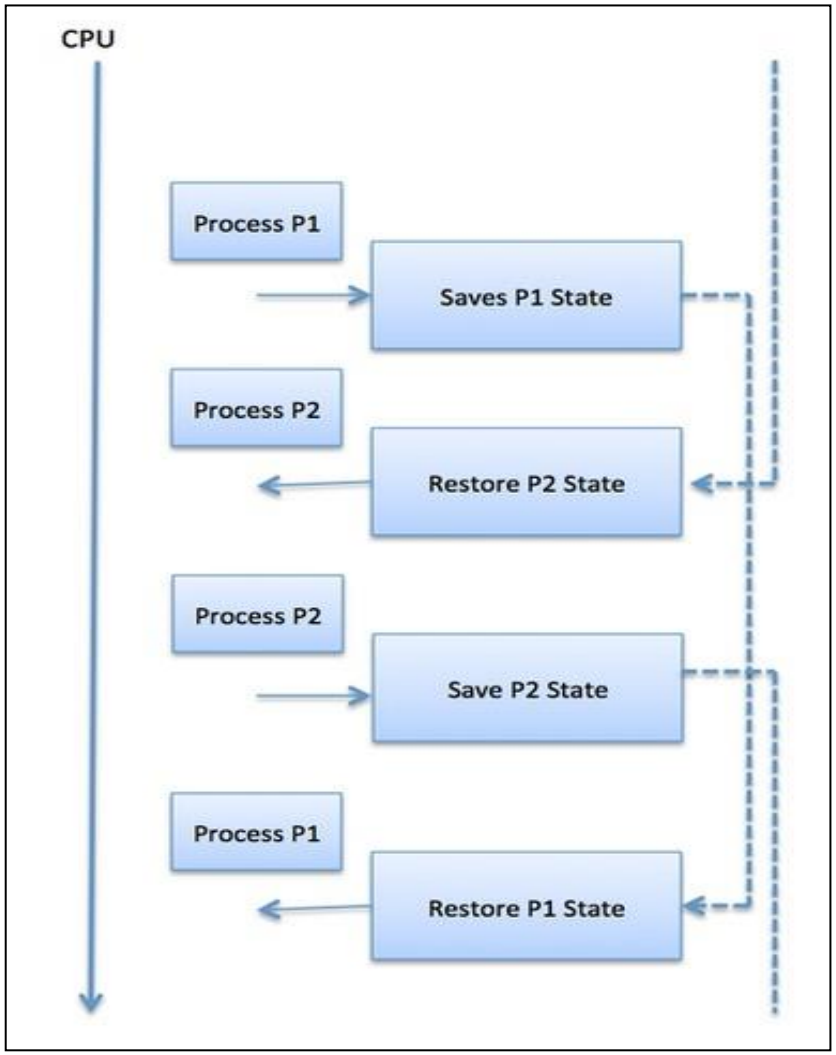
9. **I/O Status Information-** List of devices allocated to the process

Process Control Block (PCB)



Context Switch

When CPU switches to another process, the system must save the state of the old process in the stack and load the saved state for the new process or reload the state of current process from stack.



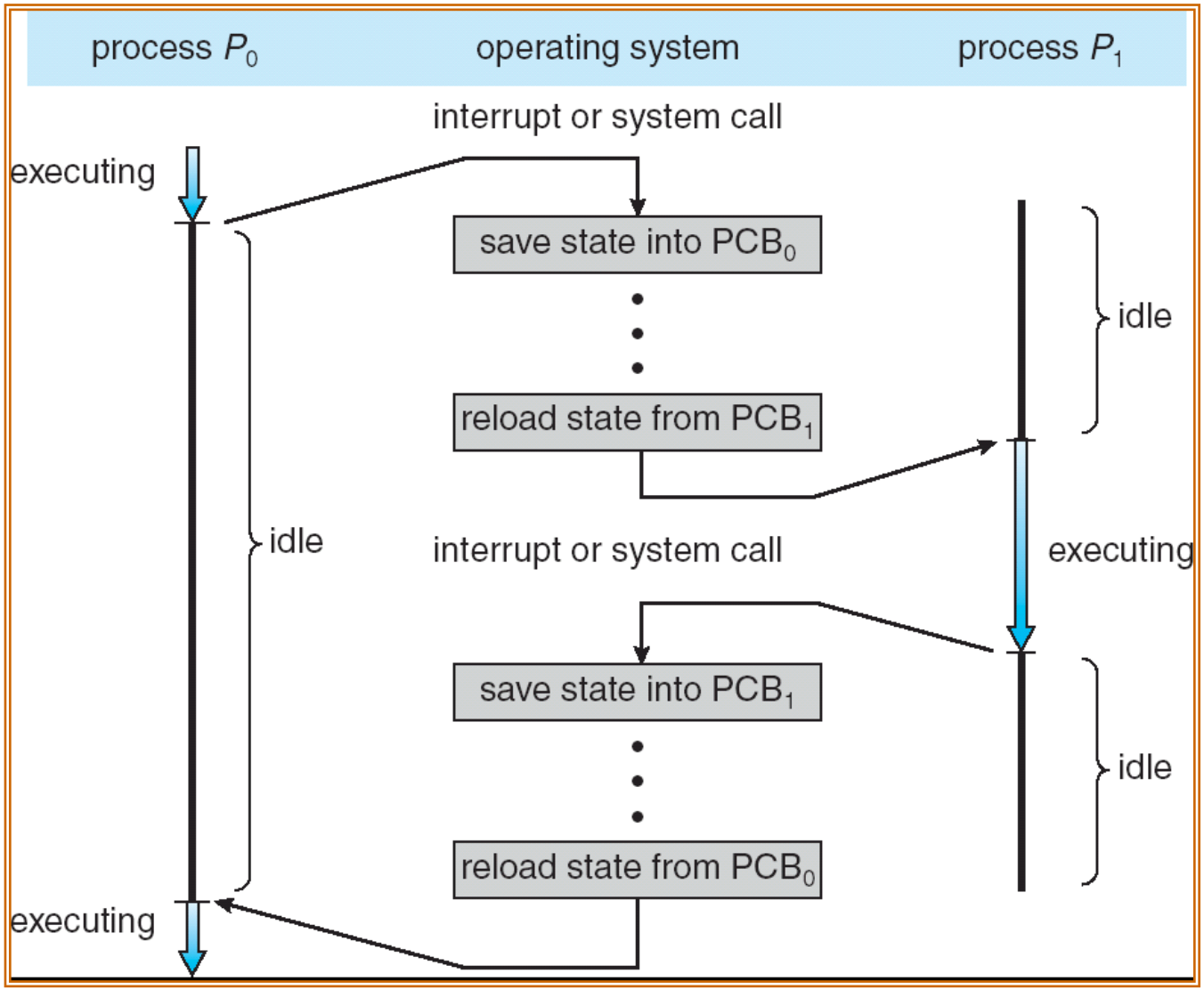
Context Switch

- Switching the CPU to another process requires **saving** the state of the old process and **loading** the saved state for the new process. This task is known as a **context switch**.
- The **context** of a process is represented in the **Process Control Block(PCB)** of a process;
- it includes the value of the CPU registers, the process state and memory-management information.
- When a context switch occurs, the Kernel saves the context of the old process in its PCB and loads the saved context of the new process scheduled to run.

Context Switch

- Context switch time is **pure overhead**, because the **system does no useful work while switching**.
- Its speed varies from machine to machine, depending on the memory speed, the number of registers that must be copied, and the existence of special instructions(such as a single instruction to load or store all registers).
- Typical speeds range from 1 to 1000 microseconds.

CPU Switch From Process to Process



Scheduling Queues

- The activity of determining which process in the ready state should be moved to the running state is known as Process Scheduling.

- The prime aim of the process scheduling system is:
  - To keep the CPU busy all the time and to deliver minimum response time for all programs.
  - For achieving this, the scheduler must apply appropriate rules for swapping processes.

Scheduling Queues

Schedulers fall into one of the two general categories:

- **Non pre-emptive scheduling:** When the currently executing process gives up the CPU voluntarily.
- **Pre-emptive scheduling:** When the operating system decides to favor another process, pre-empting the currently executing process.

Scheduling Queues

- The process scheduling is the activity of the process manager that handles the removal of the running process from the CPU and the selection of another process on the basis of a particular strategy.

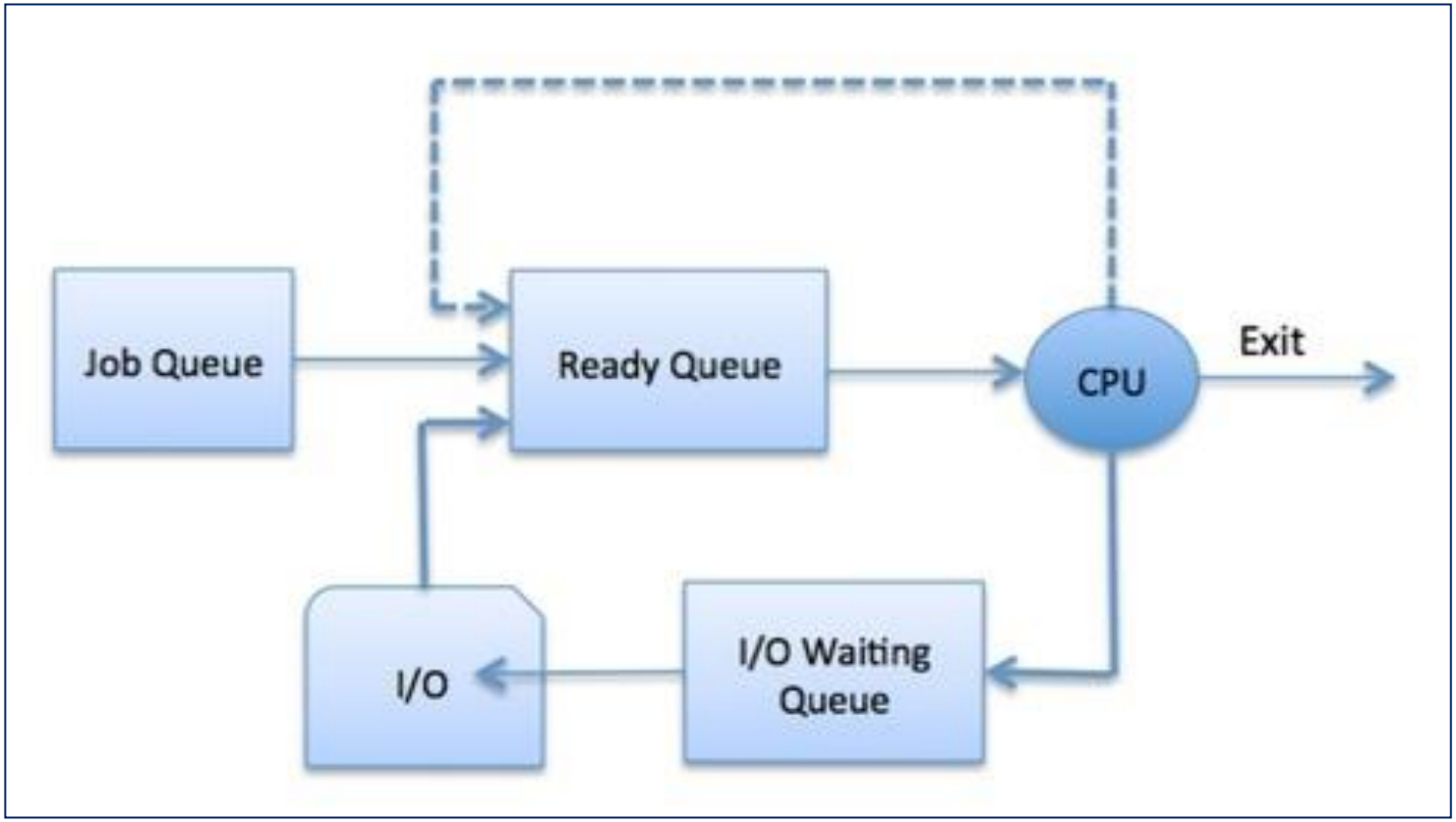
Scheduling Queues

- The OS maintains all PCBs in Process Scheduling Queues.
- The OS maintains a separate queue for each of the process states and PCBs of all processes in the same execution state are placed in the same queue.
- When the state of a process is changed, its PCB is unlinked from its current queue and moved to its new state queue.

Process Scheduling Queues

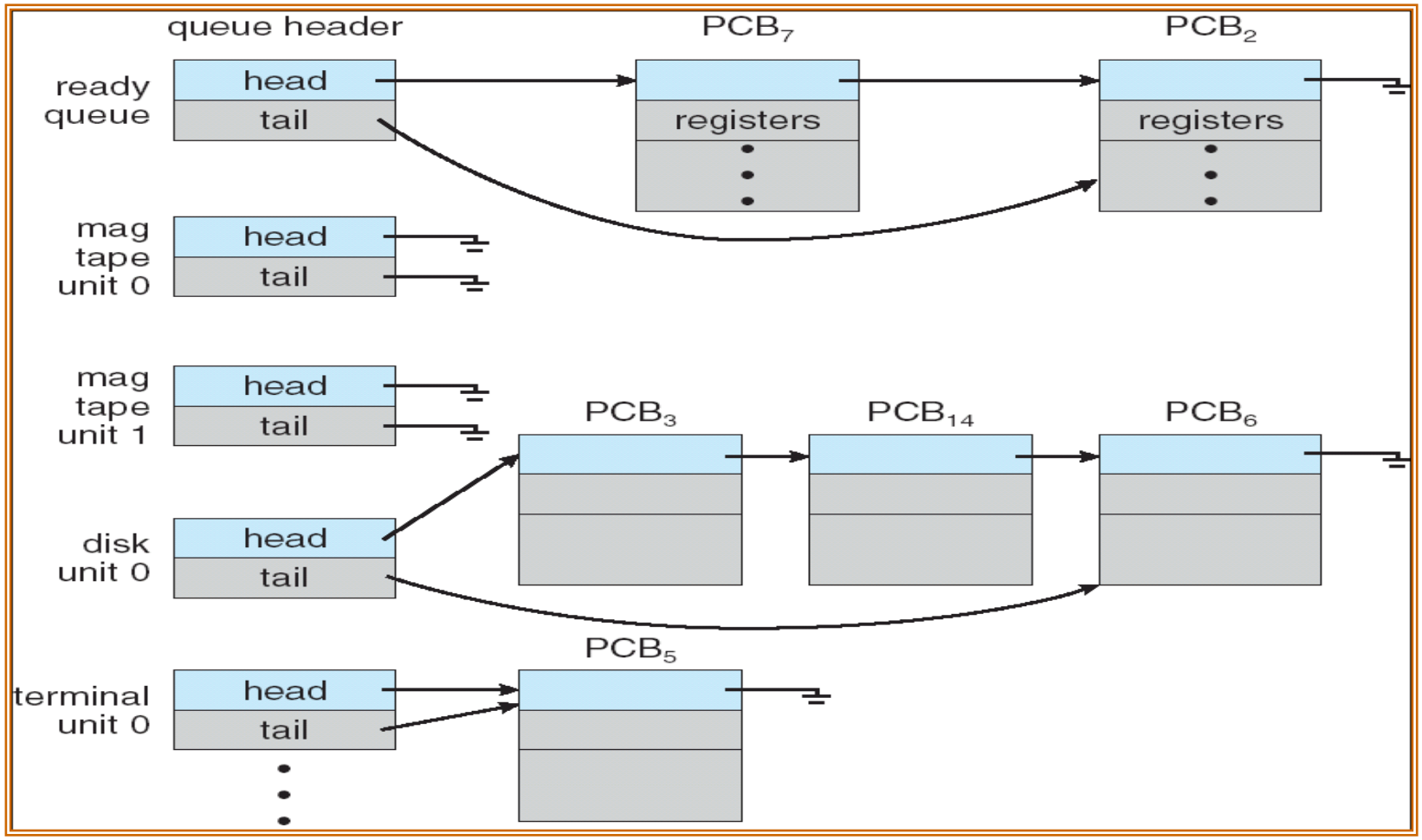
- **Job queue** − This queue keeps all the processes in the system.
- **Ready queue** − This queue keeps a set of all processes residing in main memory, ready and waiting to execute.
  - A new process is always put in this queue.
- **Device queues** − The processes which are blocked due to unavailability of an I/O device constitute this queue.

Process Scheduling Queues

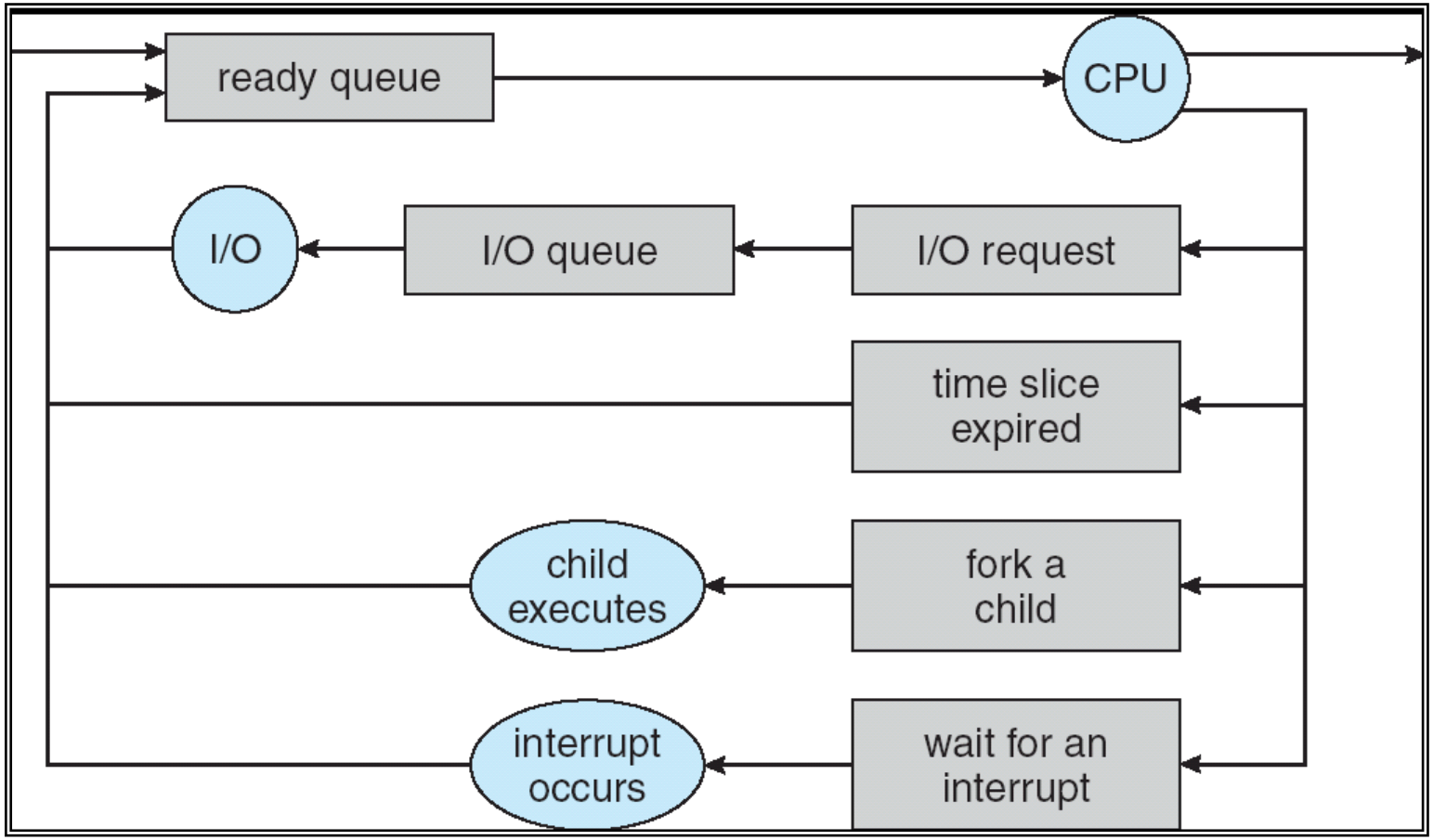


Ready Queue And Various I/O Device Queues

Ready Queue is implemented using Linked List



Queuing Diagram



MCQ

1. CPU performance is measured through _____.

- **a.** Throughput
- **b.** MHz
- **c.** Flaps
- **d.** None of the above

MCQ

1. a

MCQ

2. Which of the following is a criterion to evaluate a scheduling algorithm?

a. CPU Utilization: Keep CPU utilization as high as possible

b. Throughput: number of processes completed per unit time

c. Waiting Time: Amount of time spent ready to run but not running

d. All of the above

MCQ

2. d

MCQ

3. _____ does the job of allocating a process to the processor.

a. Long term scheduler

b. Short term scheduler

c. Medium term scheduler

d. Dispatcher

MCQ

3. d

Schedulers

- Schedulers are special system software which handle process scheduling in various ways.
- Their main task is to select the jobs to be submitted into the system and to decide which process to run.

Schedulers are of three types −

- Long-Term Scheduler
- Short-Term Scheduler
- Medium-Term Scheduler