OPERATING SYSTEMS

Subject code : CSC 404

Subject In-charge

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Module 2 : Processes

Few terms

Job

Program

Task

Process

Thread

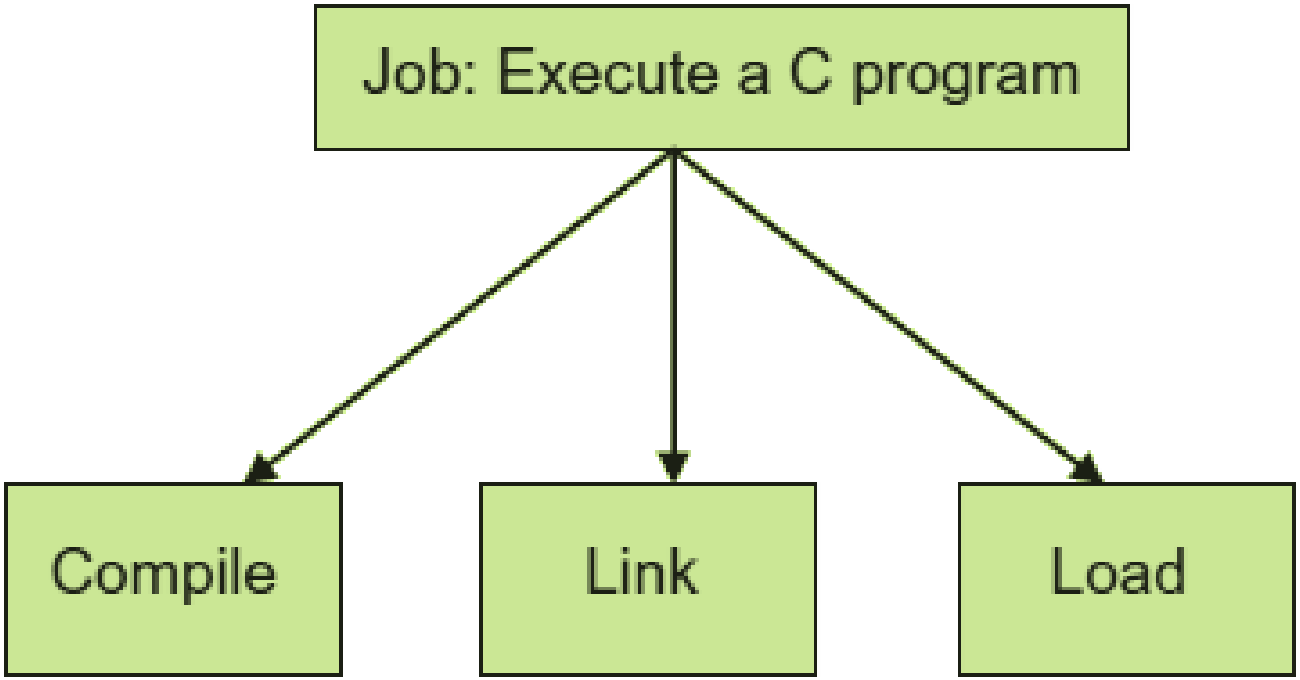
PROGRAM AND JOB

Program and Job used in batch systems.

Program is classical term used for user's computation

Job is a sequence of single programs

Job as a sequence of programs



Processes

- Process Concept
- Process Scheduling
- Process Description
- Process Control Block

Process Concept

An operating system executes a variety of programs:

- Batch system – jobs
- Time-shared systems – user programs or tasks

The term process is different from job or program.

Process – a program in execution;

Process vs. Program

A program is a set of instructions written by programmer and stored somewhere.

It means program is a passive entity and continues to exist at a place.

A program is a set of instructions that are to perform a designated task, where as the process is an operation which takes the given instructions and perform the manipulations as per the code, called ‘execution of instructions’.

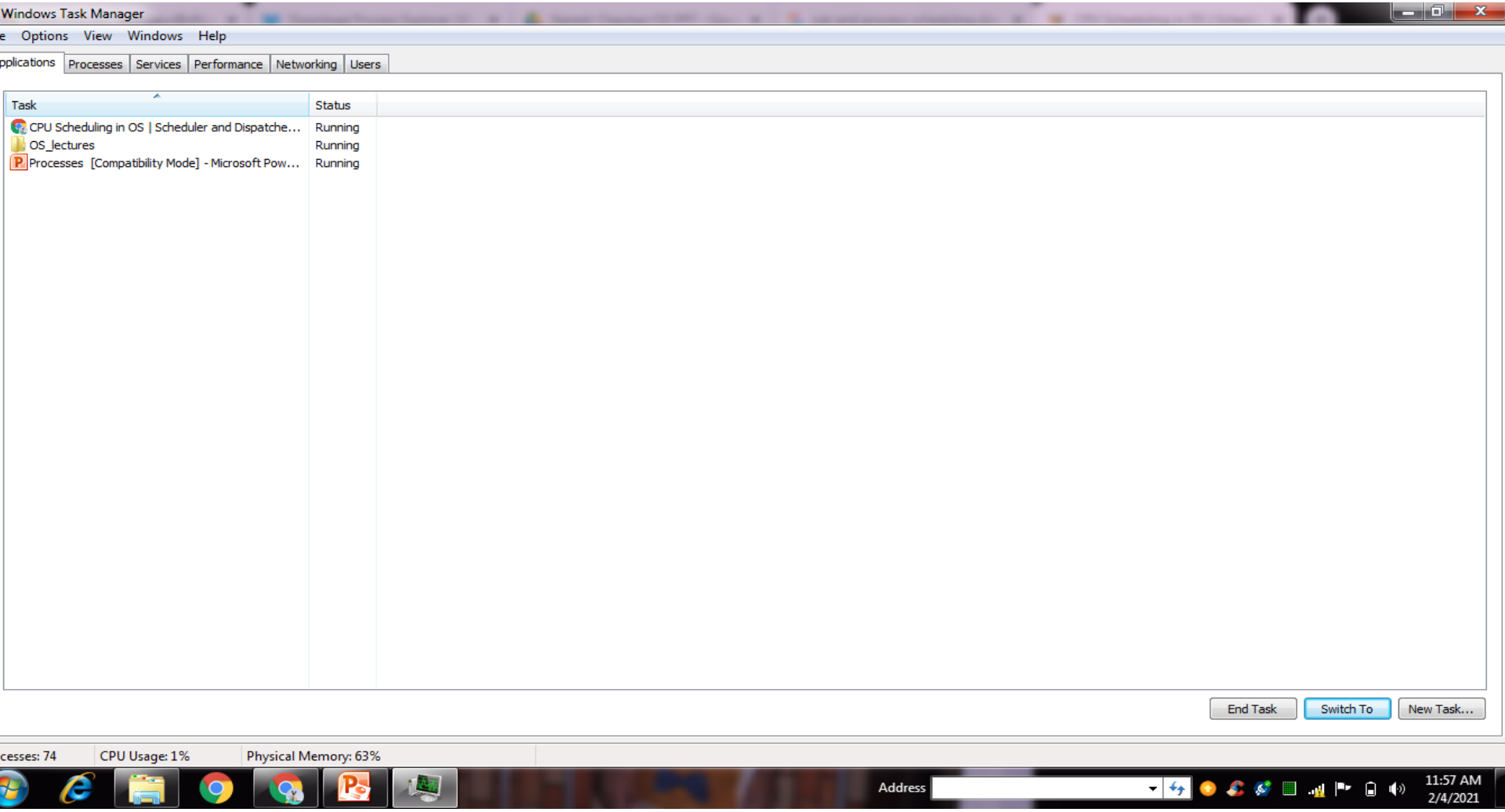
When program is ready for execution it becomes active and is known as process.

Program does not compete for resources.

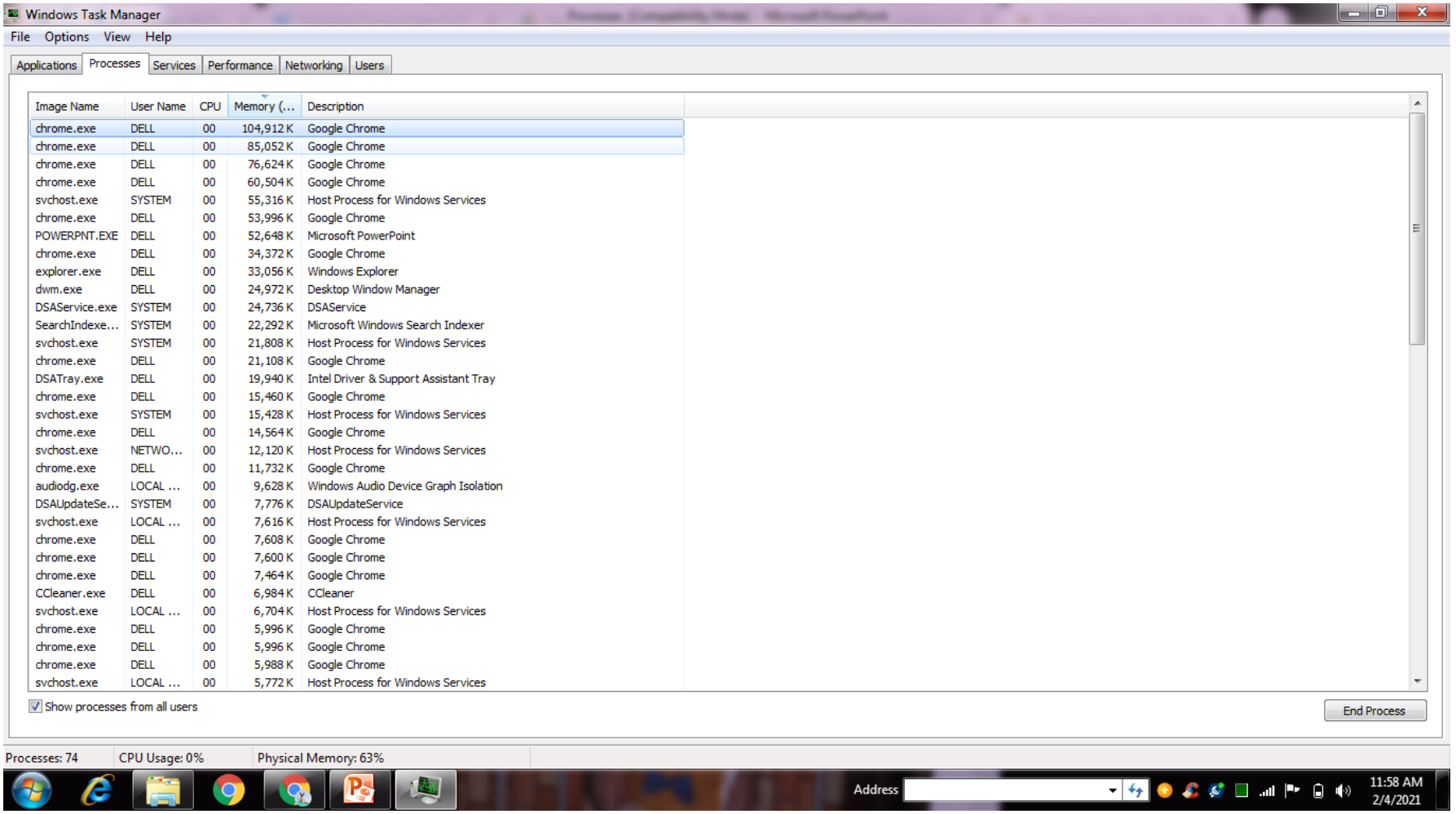
Process vs. Program

- A process invokes or initiates a program. It is an instance of a program that can be multiple and running the same application.
- Example:- Notepad is one program and can be opened twice
- A process competes for resources.
- A process is termed as an 'active entity' since it is always stored in the main memory.

WINDOWS TASK MANAGER

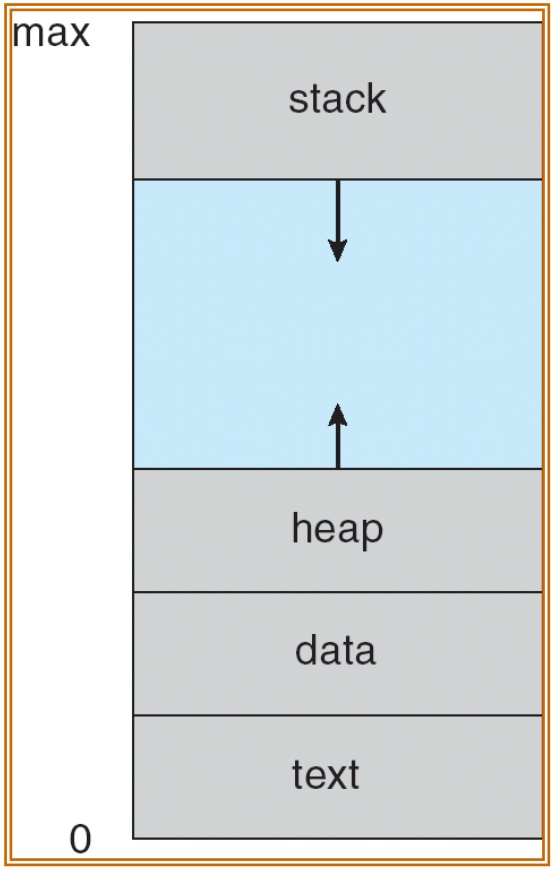


PROCESS EXPLORER



Process concept

- A process includes:
  - program counter
  - stack
  - data section
  - Code section



Life cycle of a process

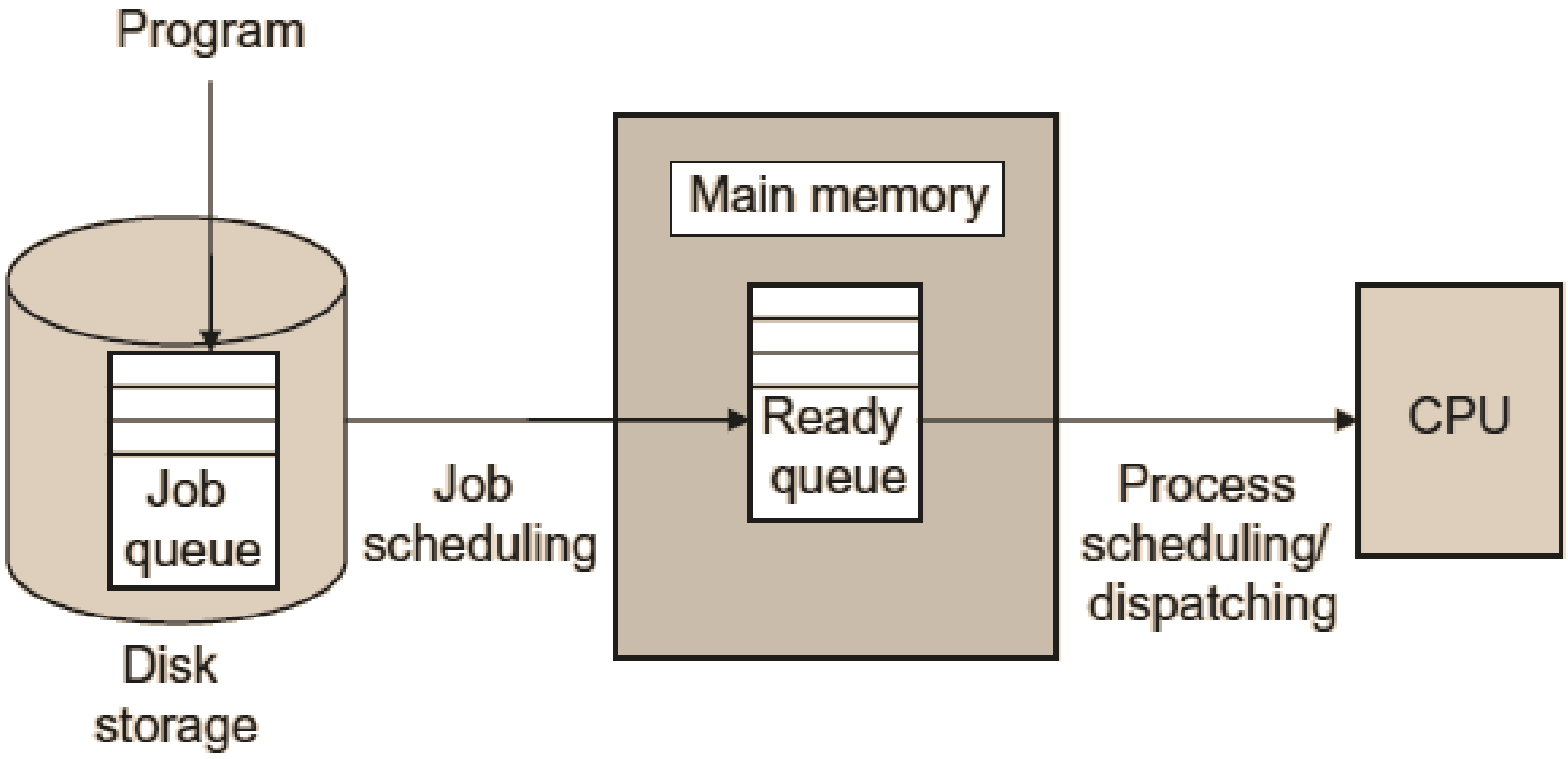
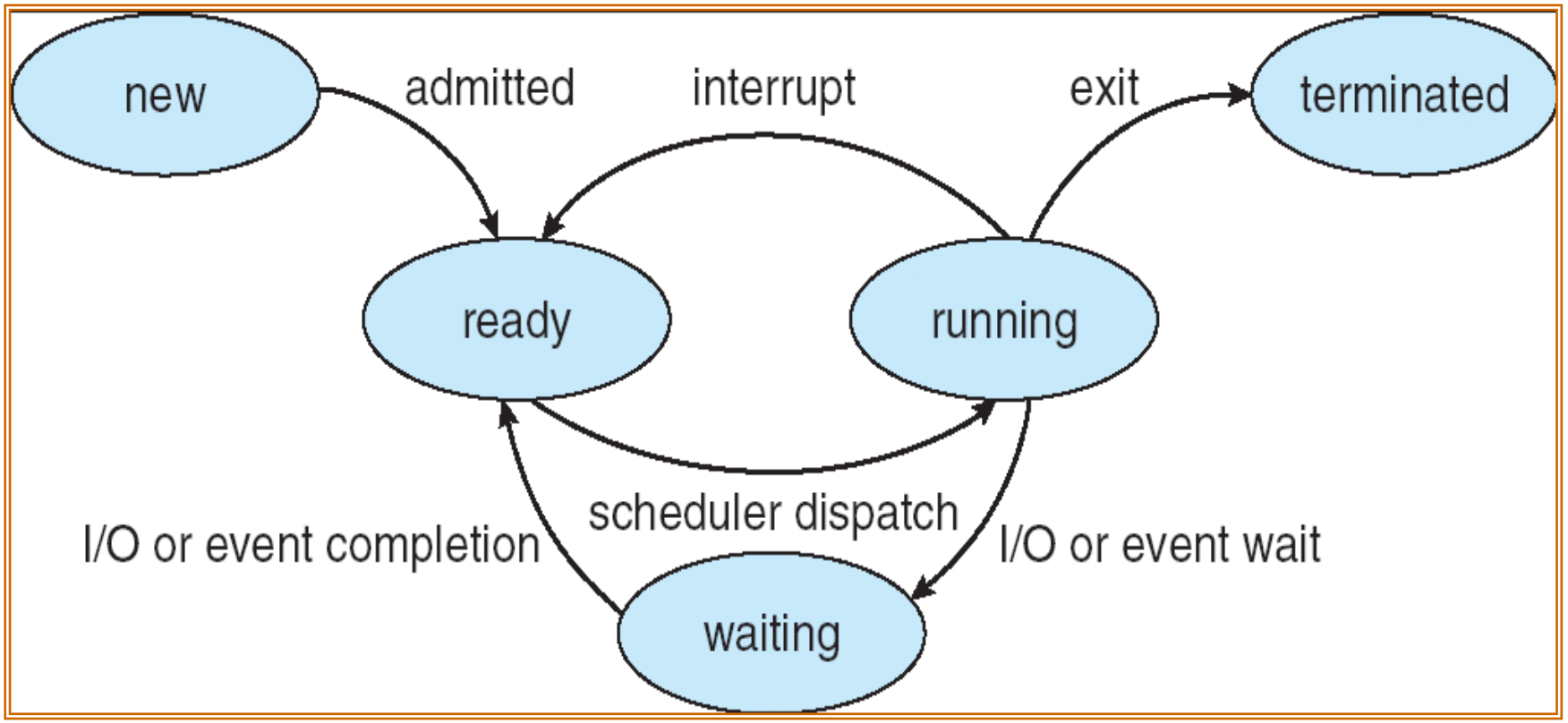


Diagram of Process State



Process State

As a process executes, it changes *state*

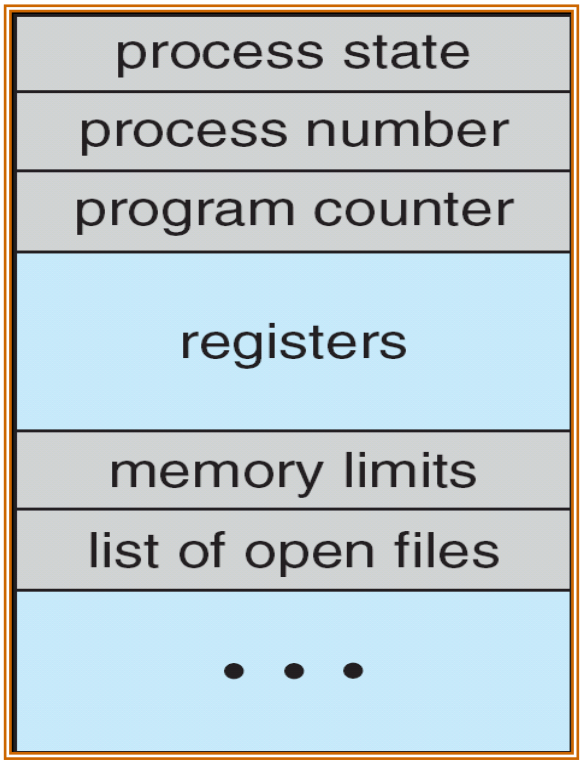
- **new**: The process is being created
- **running**: Instructions are being executed
- **waiting**: The process is waiting for some event to occur
- **ready**: The process is waiting to be assigned to a processor
- **terminated**: The process has finished execution

Process Control Block

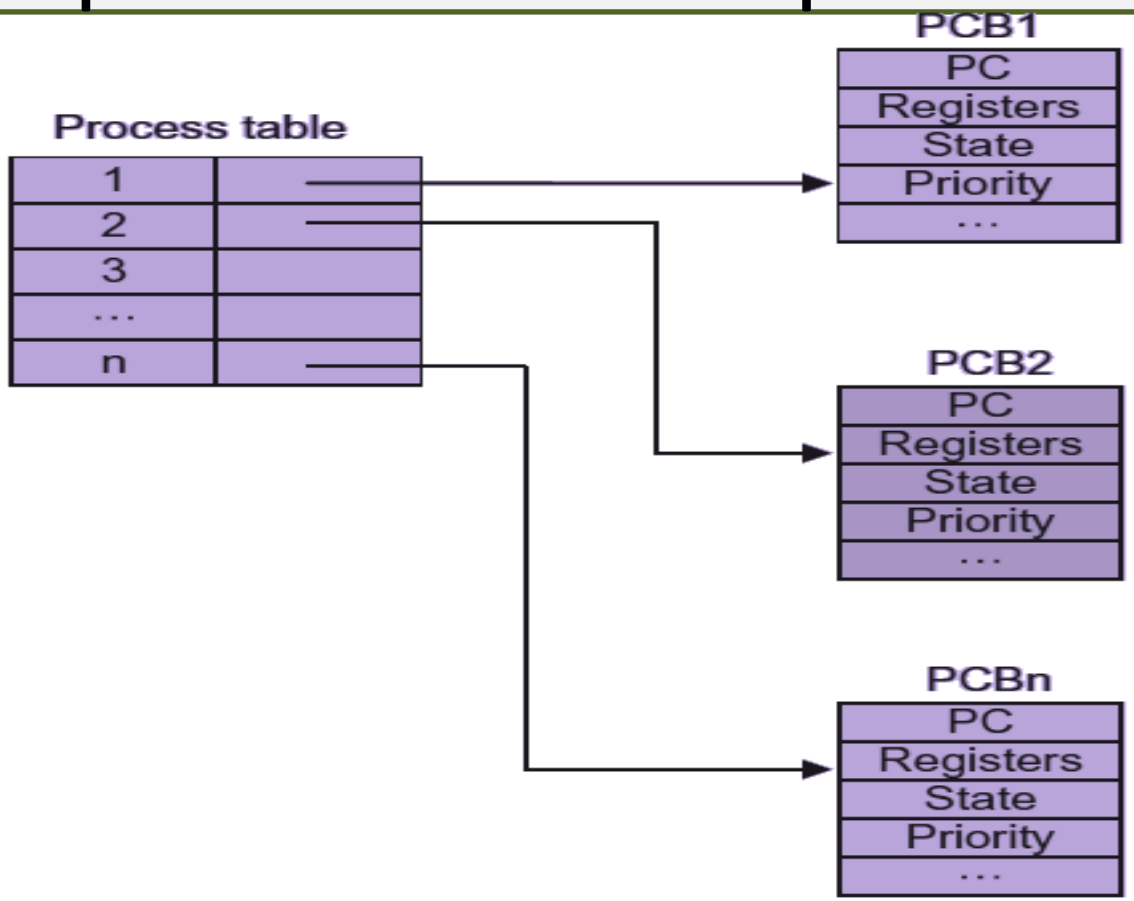
The following are the fields associated with a PCB:

- PID
- PC
- Registers
- State
- Priority
- Event information
- Memory related information
- Scheduling related information
- Pointer to parent process
- Pointer to child process
- Pointer to address space of the process

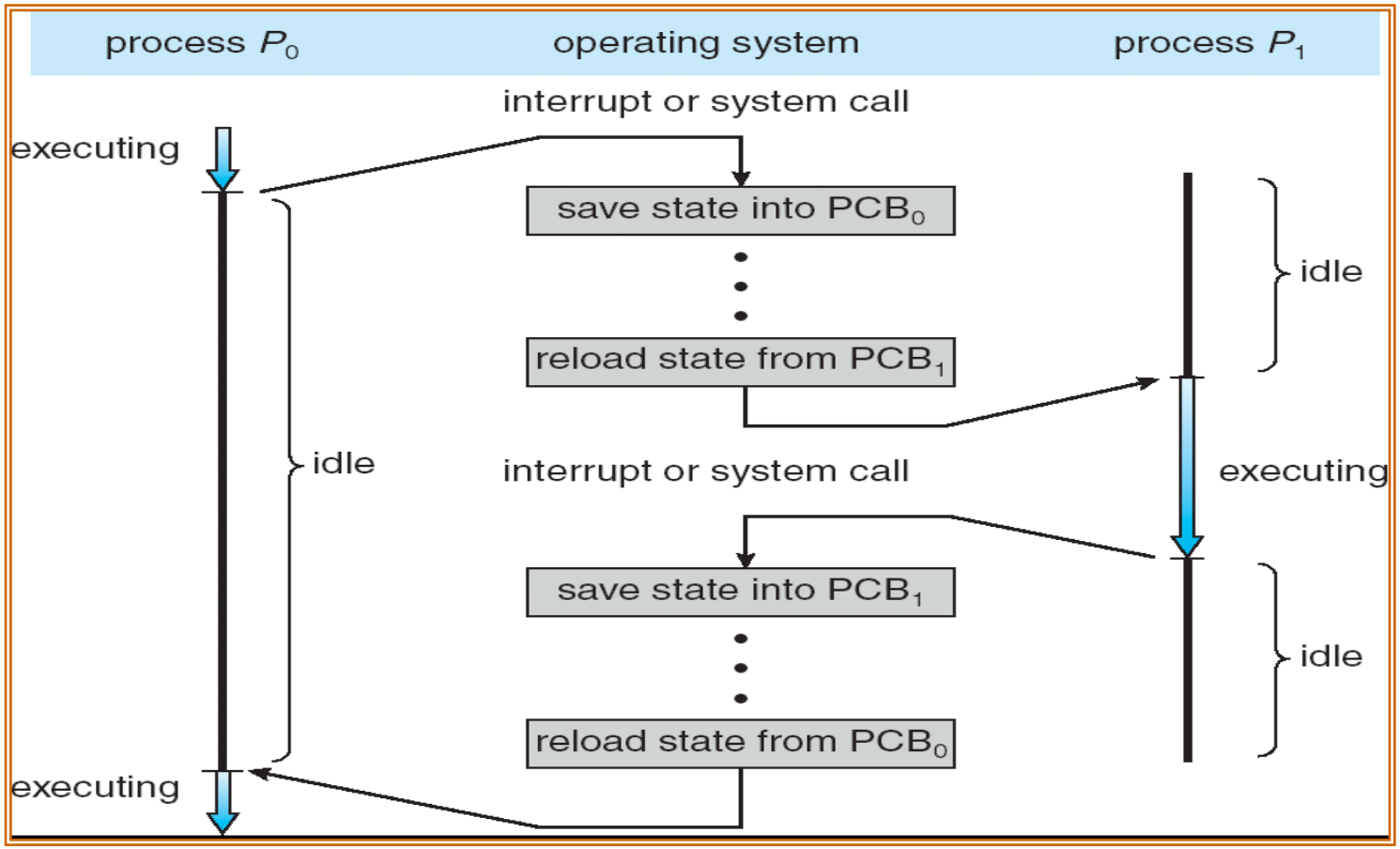
Process Control Block (PCB)



Implementation of processes



CPU Switch From Process to Process



Context Switch

- When CPU switches to another process, the system must save the state of the old process and load the saved state for the new process
- Context-switch time is overhead; the system does no useful work while switching

Process Scheduling Queues

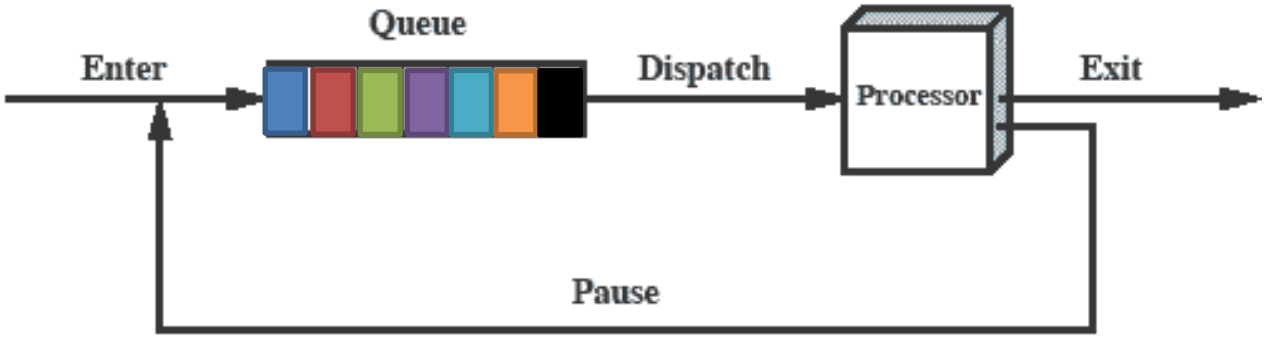
Job queue – set of all processes in the system

Ready queue – set of all processes residing in main memory, ready and waiting to execute

Device queues – set of processes waiting for an I/O device

Processes migrate among the various queues

Queuing Diagram



(b) Queuing diagram

Etc … processes moved by the dispatcher of the OS to the CPU then back to the queue until the task is competed

Schedulers

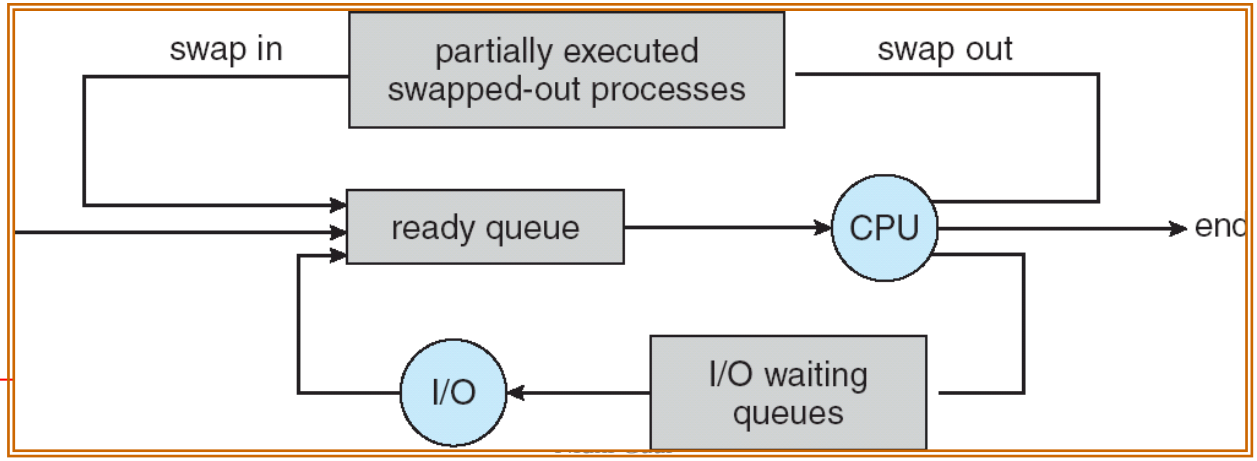
- **Long-term scheduler** (or job scheduler) – selects which processes should be brought into the ready queue
- **Short-term scheduler** (or CPU scheduler) – selects which process should be executed next and allocates CPU
- **Mid term scheduler** which determines when processes are to be suspended and resumed;

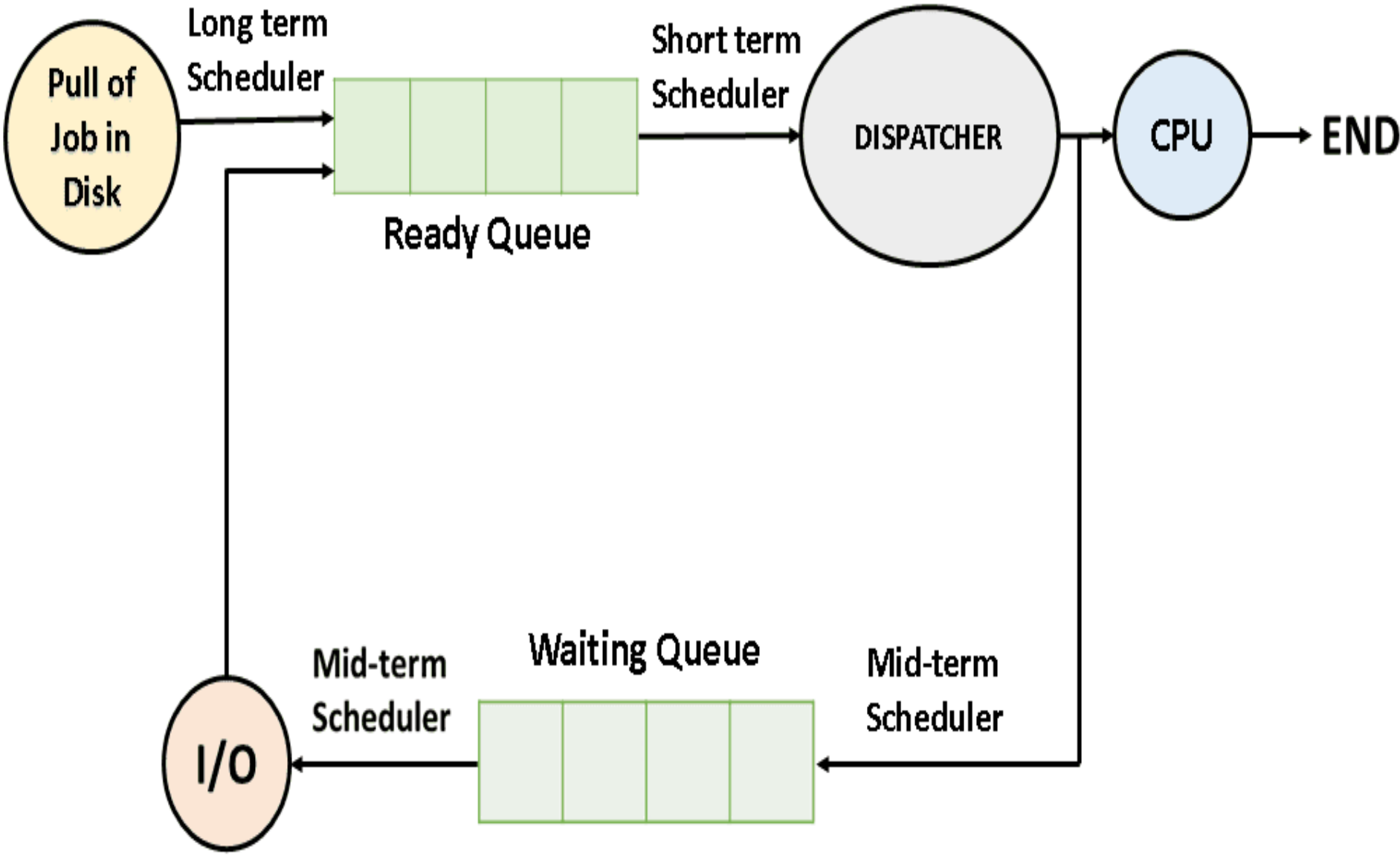
Schedulers

Medium term Scheduler

The ***medium-term scheduler*** temporarily removes processes from main memory and places them in secondary memory or vice-versa, which is commonly referred to **as "swapping out" or "swapping in"**

The medium-term scheduler may decide to swap out a process which has not been active for some time, or a process which has a low priority, or a process which is page faulting frequently

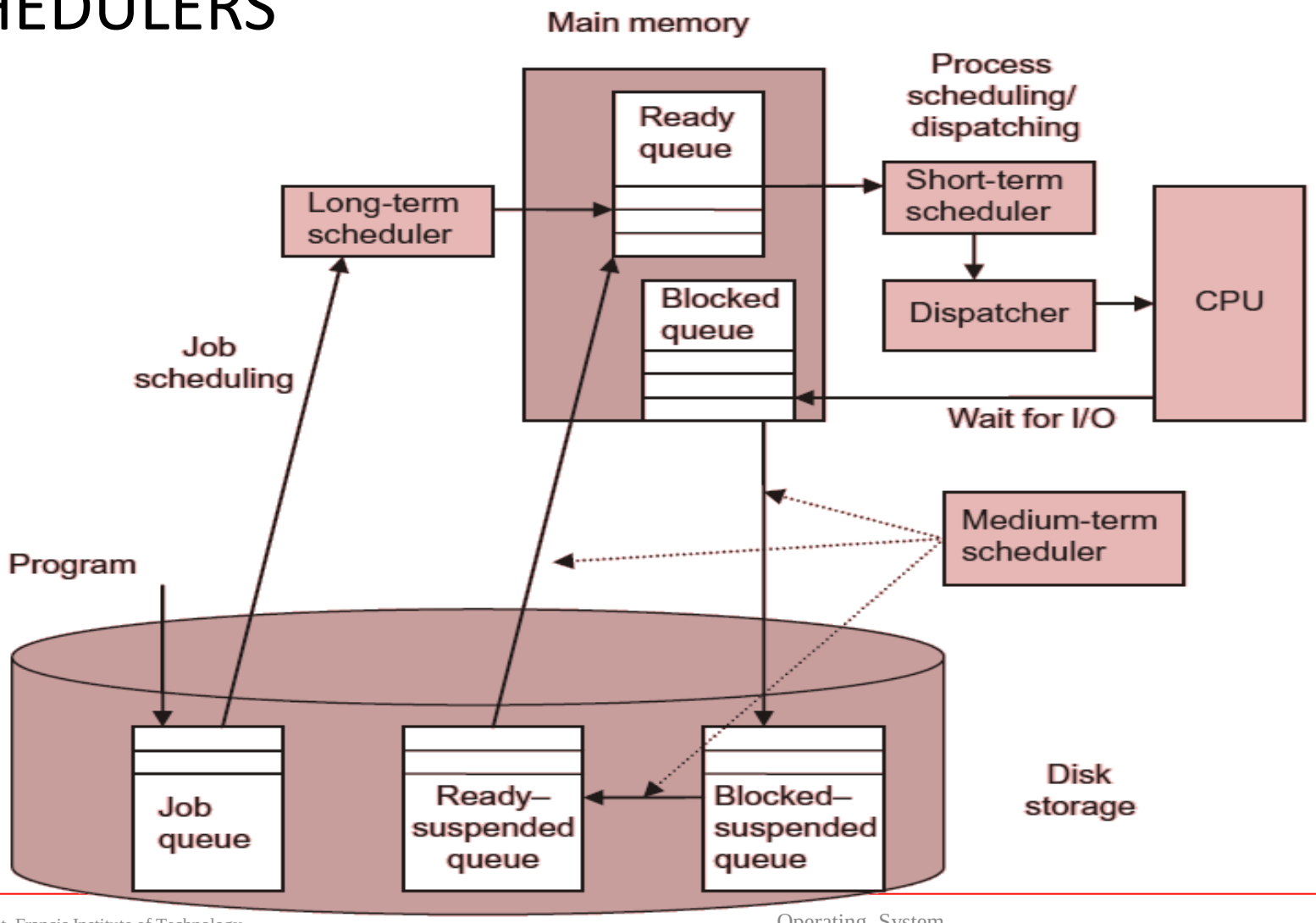



Pull of Job in Disk
Long term Scheduler
Ready Queue
Short term Scheduler
DISPATCHER
CPU
END
Mid-term Scheduler
I/O
Waiting Queue
Mid-term Scheduler

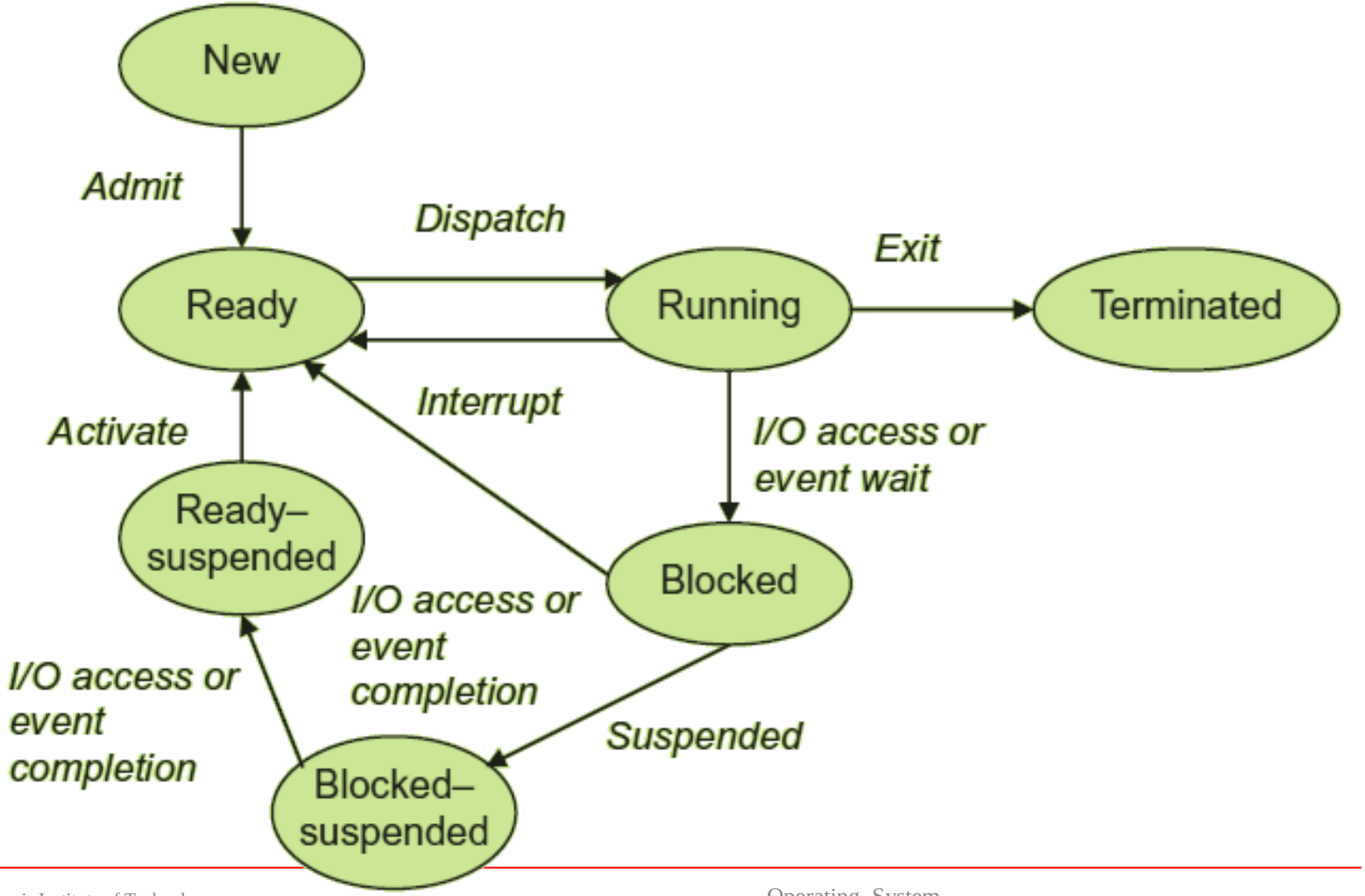
Schedulers (Cont.)

- Short-term scheduler is invoked very frequently (milliseconds) ⇒ (must be fast)
- Long-term scheduler is invoked very infrequently (seconds, minutes) ⇒ (may be slow)
- The long-term scheduler controls the *degree of multiprogramming*

SCHEDULERS



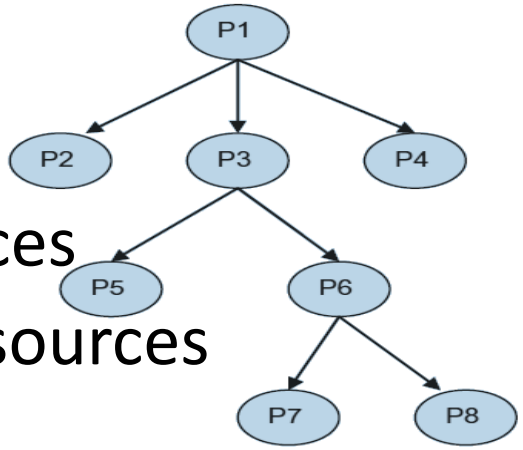
Process State diagram with suspended states



- Processes can be described as either:
  - **I/O-bound process** – spends more time doing I/O than computations, many short CPU bursts
  - **CPU-bound process** – spends more time doing computations; few very long CPU bursts

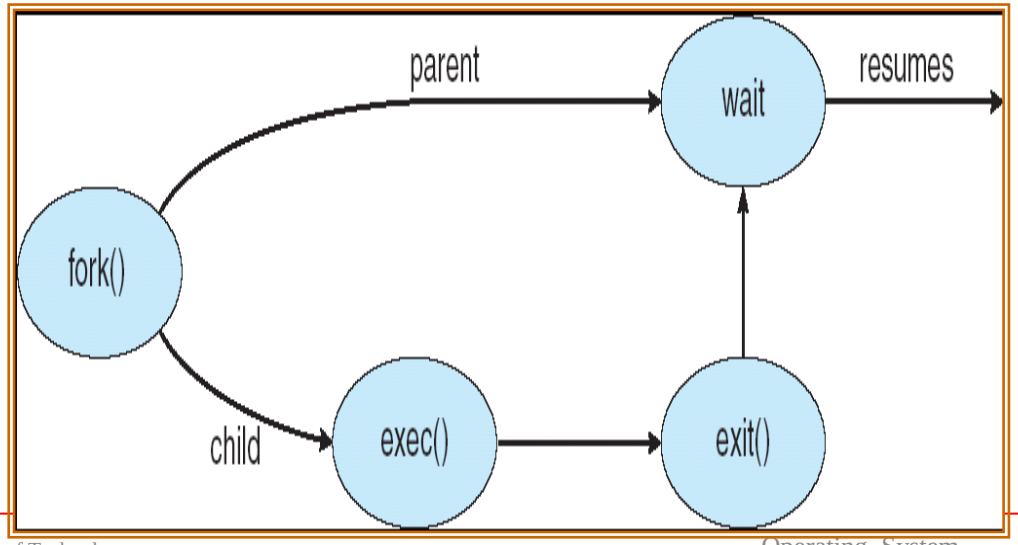
Process Creation

- Parent process create children processes, which, in turn create other processes, forming a tree of processes
- Resource sharing
  - Parent and children share all resources
  - Children share subset of parent's resources
- Execution
  - Parent and children execute concurrently
  - Parent waits until children terminate



Process Creation (Cont.)

- UNIX examples
  - **fork** system call creates new process
  - **exec** system call used after a **fork** to replace the process's memory space with a new program



Process Termination

- Process executes last statement and asks the operating system to delete it (**exit**)
  - O/P data from child to parent (**wait**)
  - Process' resources are de allocated by operating system
- Parent may terminate execution of children processes (**abort**)
  - Child has exceeded allocated resources
  - Task assigned to child is no longer required
  - If parent is exiting
    - Some operating system do not allow child to continue if its parent terminates
      - All children terminated - ***cascading termination***

End of Chapter