LECTURE 11: PROCESS SCHEDULING

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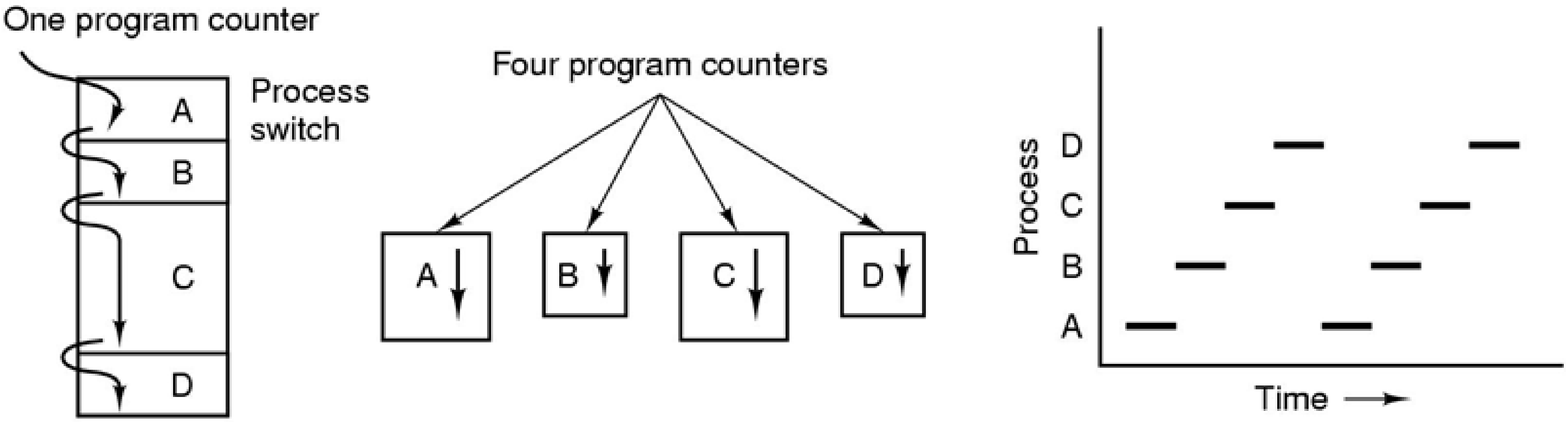
Chapter 7 of OSTEP

Session Outline

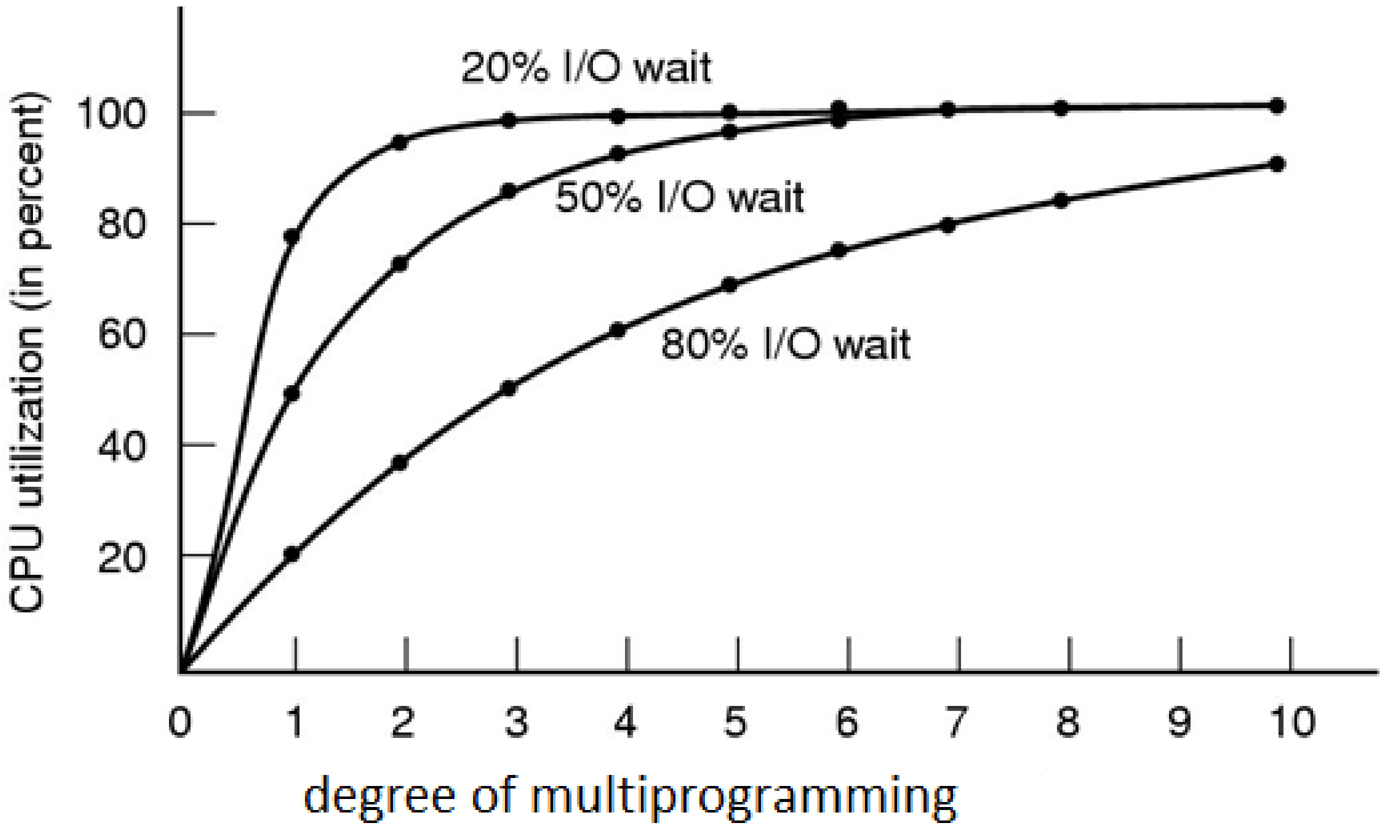
- Concept of Multiprogramming
- CPU vs I/O bound Processes
- CPU vs Job Schedulers
- CPU Scheduling
- Dispatcher
- Preemptive vs Non-preemptive Scheduling
- Scheduling Criteria

Multiprogramming

- In a uni-processor system, CPU is running only one process.
- In a multiprogramming system, CPU switches from processes quickly.

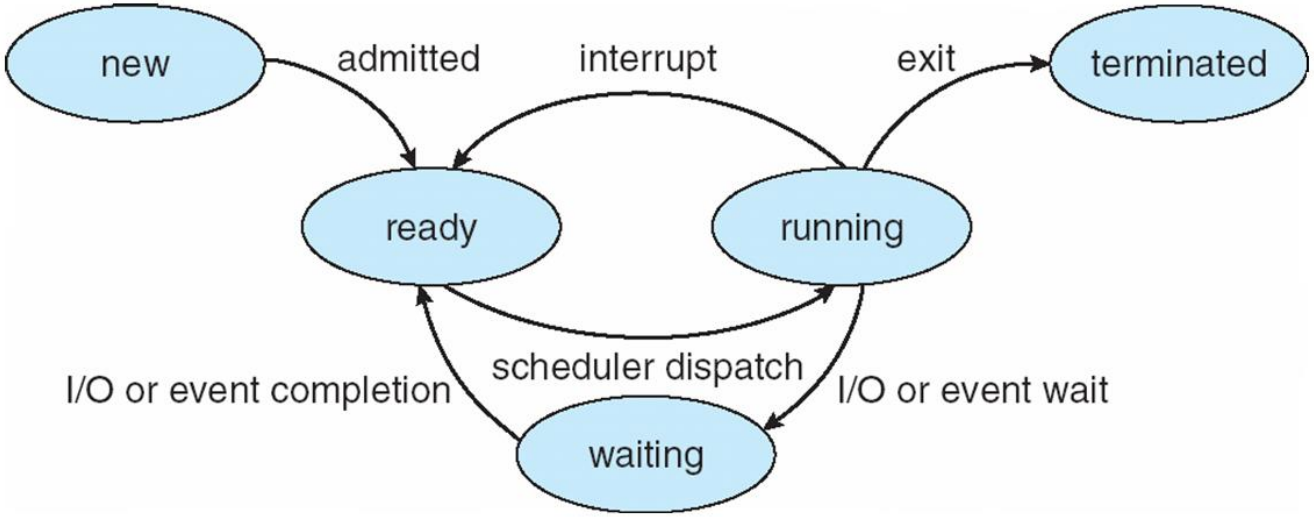


Modeling Multiprogramming



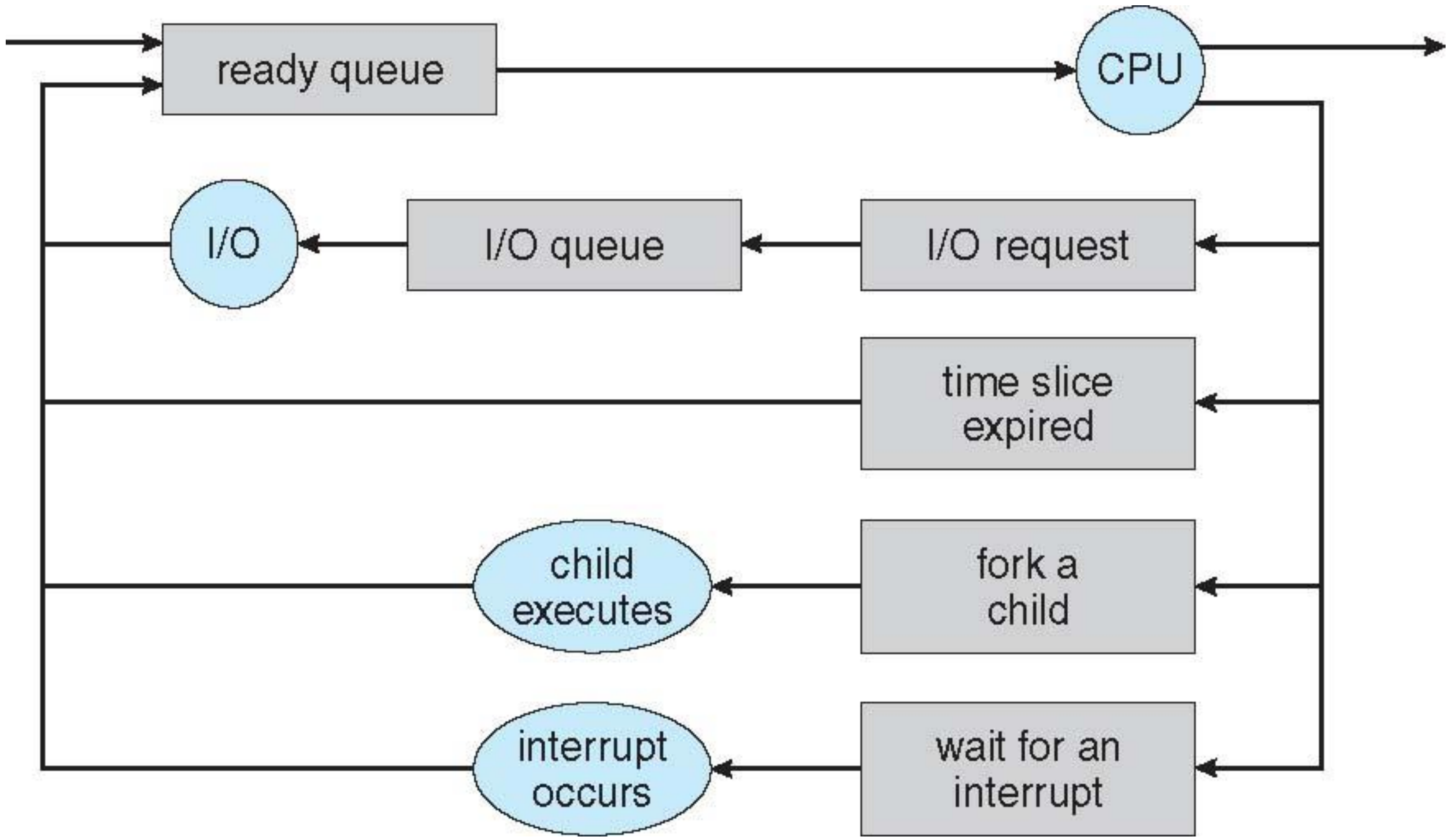
CPU utilization as a function of the number of processes in memory.

Process State Diagram

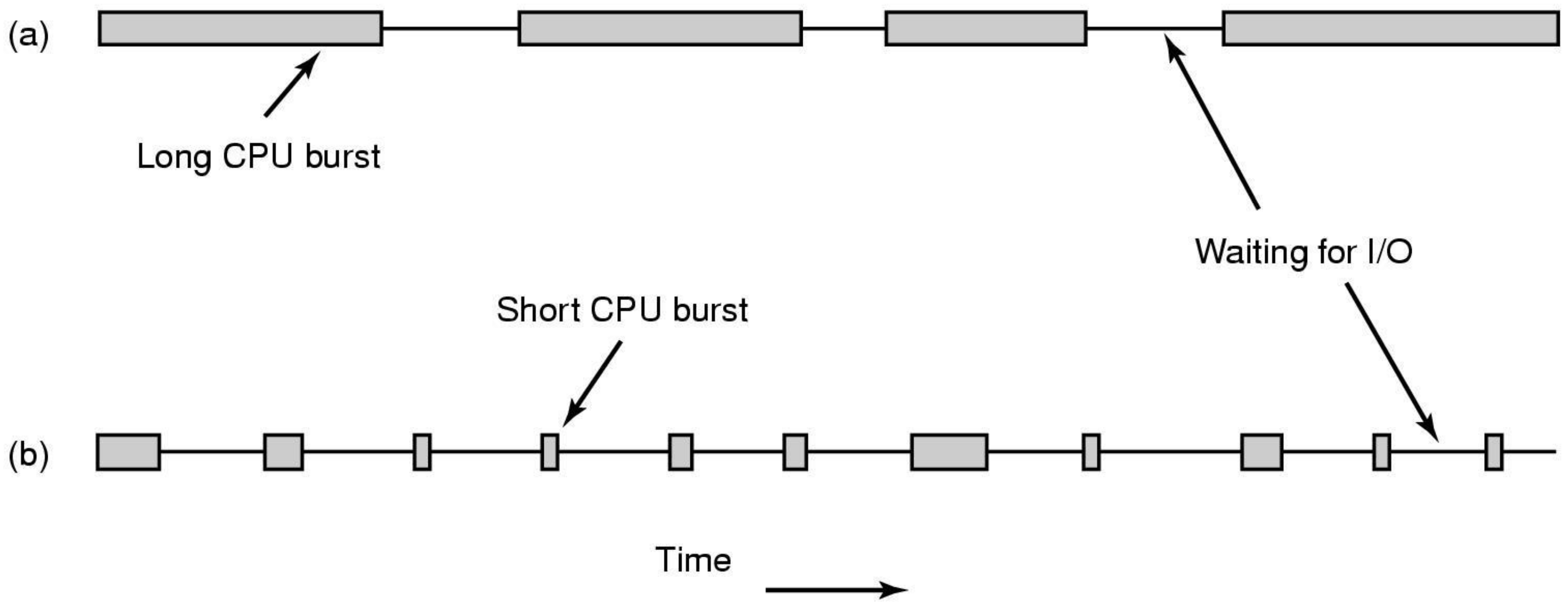


- **new**: The process is being created
- **running**: Instructions are being executed
- **waiting**: The process is waiting for some event to occur
- **ready**: The process is waiting to processor assignment
- **terminated**: The process has finished execution

Representation of Process Scheduling



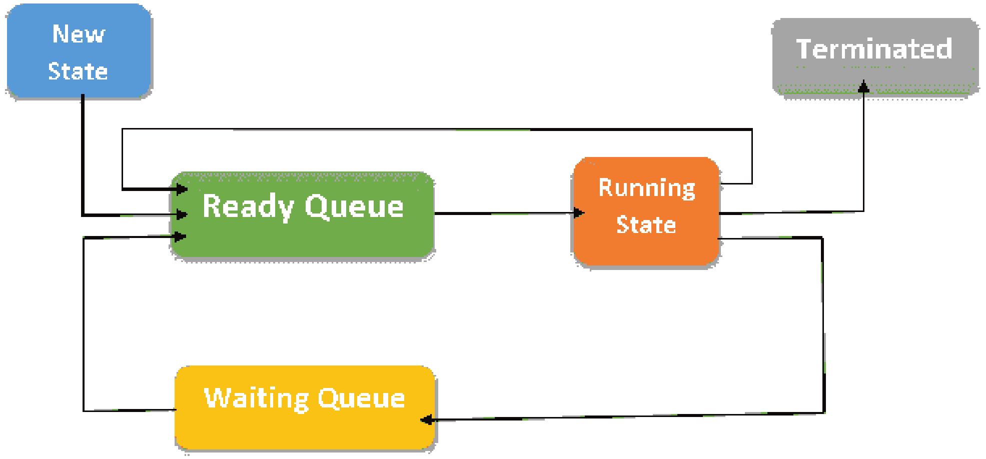
CPU vs I/O Bound Processes



Bursts of CPU usage alternate with periods of waiting for I/O. (a) A CPU-bound process. (b) An I/O-bound process.

CPU vs Job Schedulers

- **Short-term scheduler (CPU scheduler)** selects from among the processes that are ready to execute and allocates the CPU to one of them.
  - Selection from Ready state to Running state
  - Short-term scheduler is invoked frequently



- **Long-term scheduler (Job scheduler)** – selects which processes should be brought into the ready queue from the job queue
  - Long-term scheduler is invoked less frequently
  - It controls the **degree of multiprogramming**

CPU Scheduler

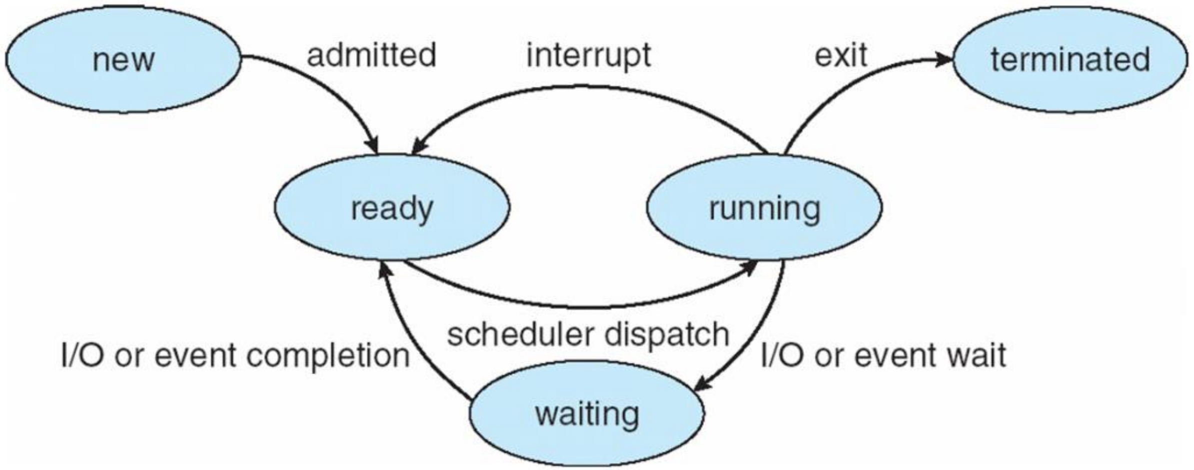
- Whenever the CPU becomes idle, the OS must select one of the processes in the ready queue to be executed.
- The selection process is carried out by the **CPU scheduler** of the OS.
- The scheduler selects a process that is in ready state and allocates the CPU to that process.
- Ready queue can be implemented as
  - FIFO queue
  - Priority queue
  - Tree
  - Unordered linked list

Dispatcher

- The **dispatcher** is the module that gives control of the CPU to the process selected by the CPU scheduler.
- Function of dispatcher involves the following:
  - Switching context
  - Switching to user mode
  - Initiate restarting/ resumption of selected user program
- Dispatcher should be as fast as possible, since it is invoked during every process switch.
- The time it takes for the dispatcher to stop one process and start another running is known as the dispatch latency.

Preemptive vs Non-preemptive Scheduling

❖ CPU-scheduling decisions happen during the four circumstances:



1. When a process switches from the running state to the waiting state
2. When a process switches from the running state to the ready state
3. When a process switches from the waiting state to the ready state
4. When a process terminates

Preemptive vs Non-preemptive Scheduling

- CPU-scheduling decisions happen during the four circumstances:
  1. When a process switches from the running state to the waiting state
  2. When a process switches from the running state to the ready state
  3. When a process switches from the waiting state to the ready state
  4. When a process terminates
- 1 & 4, the scheduling is **non-preemptive** (cooperative)
- A running process keeps the CPU until it releases the CPU (terminating or by switching to the waiting state).
- 2 & 3, the scheduling is **pre-emptive**
- The process is removed from running state forcefully.

Scheduling Criteria

- Different CPU-scheduling algorithms have different properties.
- Certain characteristics/criteria are used for comparing various CPU scheduling algorithms.
  - CPU Utilization
  - Throughput
  - Turnaround time
  - Waiting Time
  - Response Time

Scheduling Criteria

- CPU Utilization – Percentage time CPU is busy executing process.
- Throughput - Number of processes that are completed per time unit.
- Turnaround time - The interval from the time of submission of a process to the time of completion.
- Waiting Time - Amount of time that a process spends waiting in the ready queue.
- Response Time - Time from the submission of a request until the first response is produced.

Thank You