

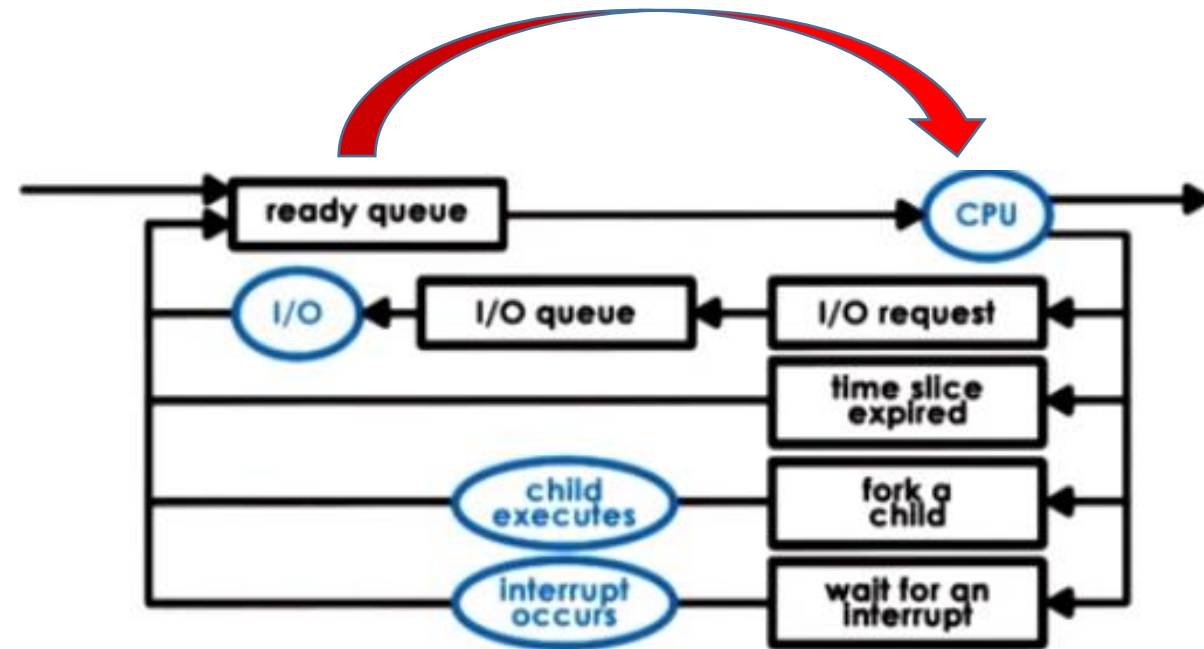
CPU – Scheduling –Part1

CS3600

Spring 2022

CPU Scheduler

- When the operating system selects one of the processes in the ready queue to be executed. The selection process is carried out by the **CPU scheduler**, which selects a process from the processes in memory that are ready to execute and allocates the CPU to that process.

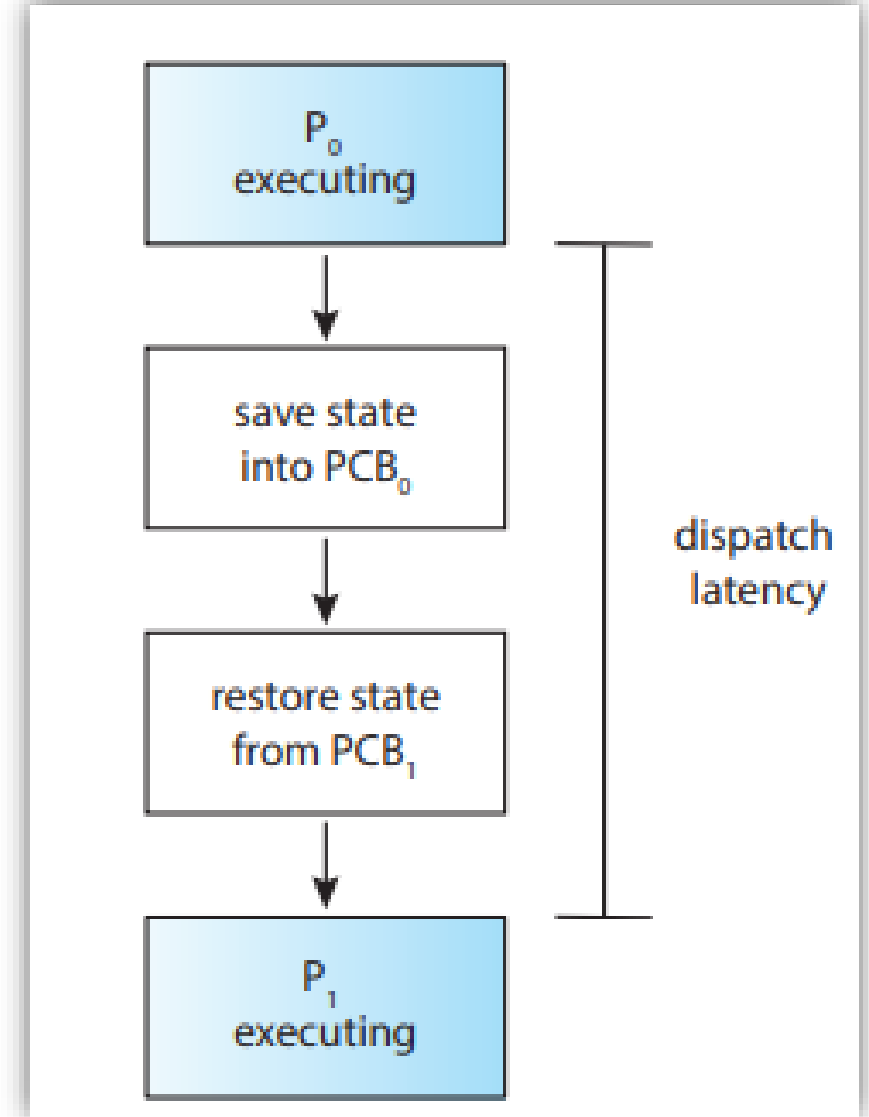


Preemptive /Non-preemptive scheduling

- A ***non-preemptive*** scheduling algorithm allows a running process to continue until the process terminates or blocks on a resource.
- A ***preemptive*** scheduling algorithm may stop the currently running process and choose another process to run.

Dispatcher

- Module that gives control of the CPU's core to the process selected by the CPU scheduler
 - Switching context from one process to another
 - Switching to user mode
 - Jumping to the proper location in the user program to resume that program



Criteria – Scheduling algorithms

CPU Utilization:

keep the CPU as busy as possible

Throughput :

No. of processes that complete their execution per time unit.

Average Job completion Time :

Average time to execute the processes (turnaround time)

Avg. Job wait time:

Average time a processes has been waiting in the ready queue

Response time :

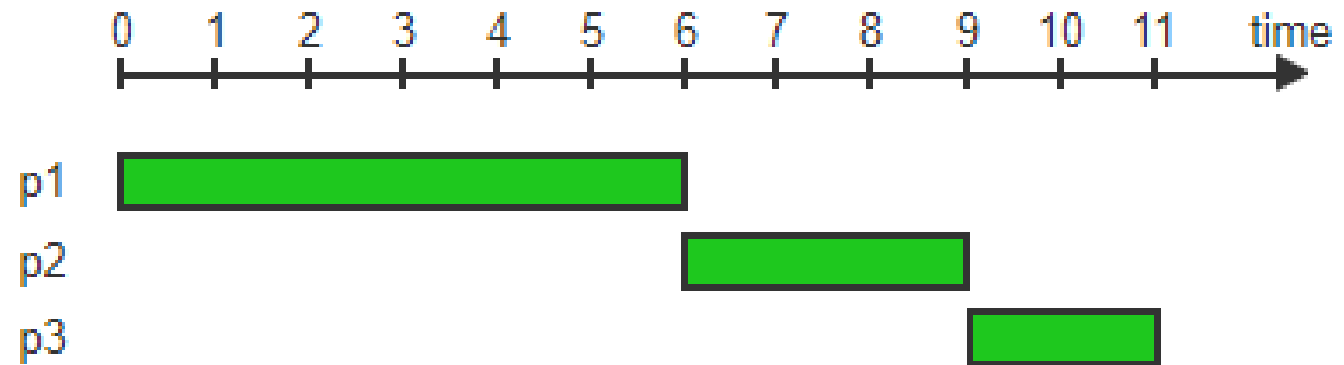
amount of time it taken for the first response, when a request was submitted.

Scheduling Algorithms – for batch process

- The ***FIFO (First-In-First-Out) algorithm***,
- Aka **FCFS (First-Come-First-Served)**,
 - Schedules processes strictly according to the process arrival time. The earlier the arrival, the higher the priority.

First Come First Serve (FCFS)

- Three processes need to be scheduled.
 - p1 arrives at $t = 0$ and will need 6 units of CPU burst time.
 - p2 arrives at $t = 1$ and will need 3 units of CPU burst time.
 - p3 arrives at $t = 3$ and will need 2 units of CPU burst time.



FCFS Q 1

Time	Process	Burst Time
0	P1	22
1	P2	4
2	P3	4

Draw a Gantt Chart and calculate the average waiting time.
If the processes arrive in the same order.

FCFS Q 2

Process	Burst Time
P1	22
P2	4
P3	4

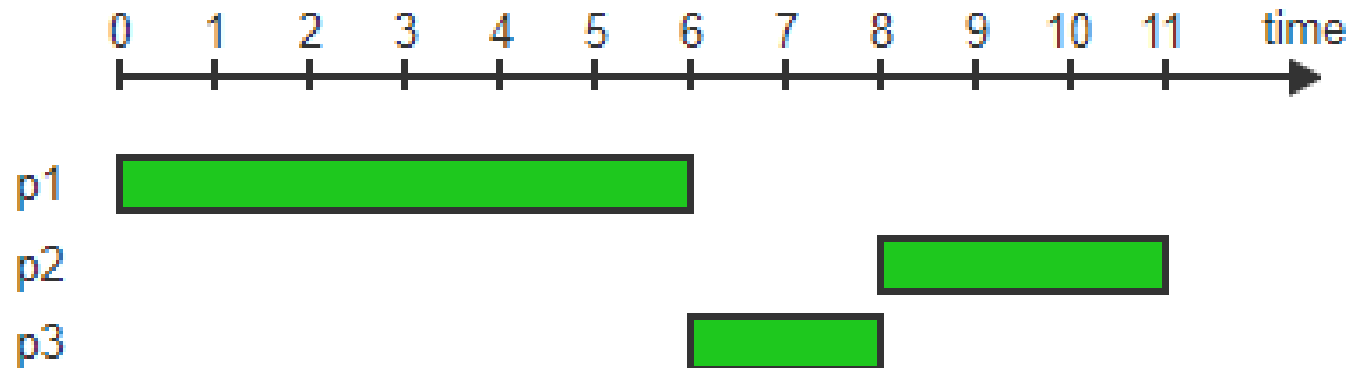
Draw a Gantt Chart and calculate the average waiting time.
If the process comes in the order **P2,P3,P1**

SJF scheduling algorithm

- The *SJF (Shortest Job First) algorithm* or SJN (Shortest Job Next)
- Schedules processes according to the total CPU time requirements.
- The shorter the required CPU time, the higher the priority.
- If multiple processes have the same CPU time requirement, then the arbitration rule can select a process based on the arrival times.

SJF Example

- Three processes need to be scheduled.
 - p1 arrives at $t = 0$ and will need 6 units of CPU burst time.
 - p2 arrives at $t = 1$ and will need 3 units of CPU burst time.
 - p3 arrives at $t = 3$ and will need 2 units of CPU burst time.



SJF Q1

Process	Burst Time
P1	6
P2	8
P3	7
P4	3

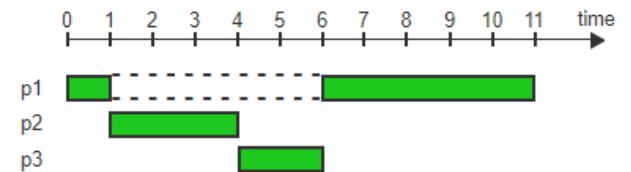
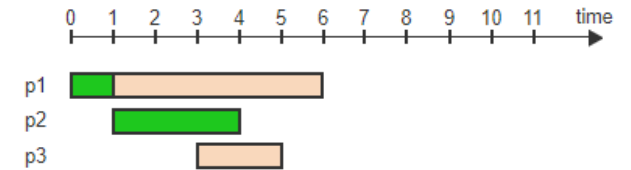
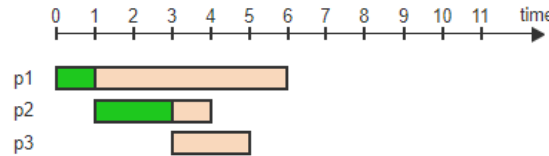
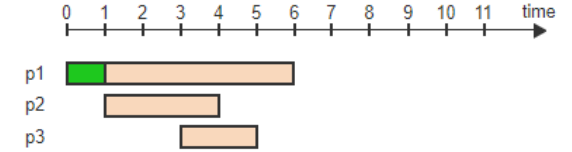
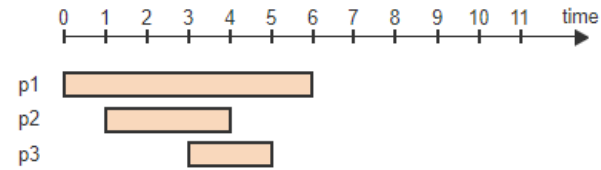
Draw a Gantt Chart and calculate the average waiting time.
If all process are in ready state already .
Compare with FCFS.

SRT scheduling algorithm

- The ***SRT (Shortest Remaining Time) algorithm*** .
- Schedules processes according to the remaining CPU time needed to complete the work.
- The shorter the remaining CPU time, the higher the priority.
- If multiple processes have the same remaining time requirement, then the arbitration rule can select a process based on the arrival times.

SRT Example

- Three processes need to be scheduled.
- p1 arrives at $t = 0$ and will need 6 units of CPU time.
- p2 arrives at $t = 1$ and will need 3 units.
- p3 arrives at $t = 3$ and will need 2 units.



SRT Q1

Process	Arrival time	Burst Time
P1	0	8
P2	1	4
P3	2	9
P4	3	5

Performance Metrics

- Arrival Time (AT)
- Burst Time (BT)
- Completion Time (CT)

- Turn Around Time (TT) = $CT - AT$
- Waiting Time (WT) = $TT - BT$
- Response Time (RT) = First Instance of CPU - AT

FCFS, SJF, SRT Q1

Process	Arrival time	Burst Time
P1	0	8
P2	1	4
P3	2	9
P4	3	5

- Arrival Time (AT)
- Burst Time (BT)
- Completion Time (CT)
- Turn Around Time (TT) = $CT - AT$
- Waiting Time (WT) = $TT - BT$

Using the formula calculate the average waiting time, Compare with FCFS, SJF, SRT

Performance of the algorithms

- Objective:
 - Maximize the number of processes completed per unit of time.
 - Minimise waiting Time.
- Compare algorithms
 - We take average Turn Around Time (TT) for each Algorithm .
- Another important objective is to guarantee fairness.
- **Starvation** is the indefinite postponement of a process while other processes are allowed to proceed. Both SJF and SRT can lead to starvation.