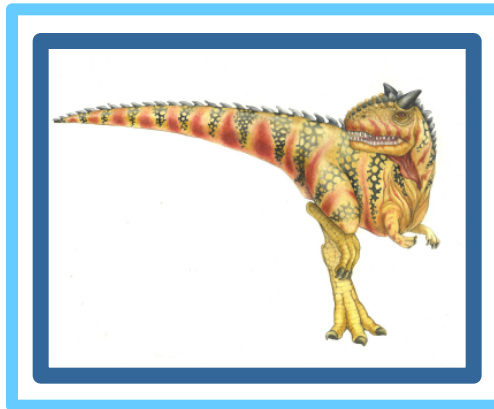


Chapter 5: CPU Scheduling





Chapter 5: CPU Scheduling

- ❑ Basic Concepts
- ❑ Scheduling Criteria
- ❑ Scheduling Algorithms
- ❑ Thread Scheduling
- ❑ Multiple-Processor Scheduling
- ❑ Real-Time CPU Scheduling
- ❑ Operating Systems Examples
- ❑ Algorithm Evaluation





Objectives

- ❑ To introduce CPU scheduling, which is the basis for multiprogrammed operating systems
- ❑ To describe various CPU-scheduling algorithms
- ❑ To discuss evaluation criteria for selecting a CPU-scheduling algorithm for a particular system
- ❑ To examine the scheduling algorithms of several operating systems





Priority Scheduling

- ❑ A priority number (integer) is associated with each process
- ❑ The CPU is allocated to the process with the highest priority (smallest integer \equiv highest priority)
 - ❑ Preemptive
 - ❑ Nonpreemptive
- ❑ SJF is priority scheduling where priority is the inverse of predicted next CPU burst time
- ❑ Problem \equiv **Starvation** – low priority processes may never execute
- ❑ Solution \equiv **Aging** – as time progresses increase the priority of the process

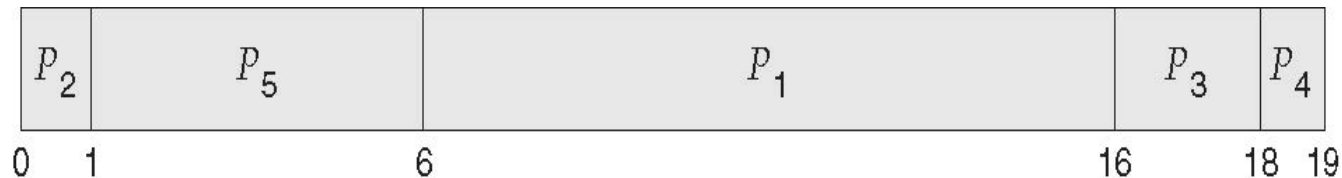




Example of Priority Scheduling

<u>Process</u>	<u>Burst Time</u>	<u>Priority</u>
P_1	10	3
P_2	1	1
P_3	2	4
P_4	1	5
P_5	5	2

Priority scheduling Gantt Chart



 Average waiting time = 8.2 msec





Shortest-Job-First (SJF) Scheduling

- ❓ Associate with each process the length of its next CPU burst
 - ❓ Use these lengths to schedule the process with the shortest time
- ❓ SJF is optimal – gives minimum average waiting time for a given set of processes
 - ❓ The difficulty is knowing the length of the next CPU request
 - ❓ Could ask the user

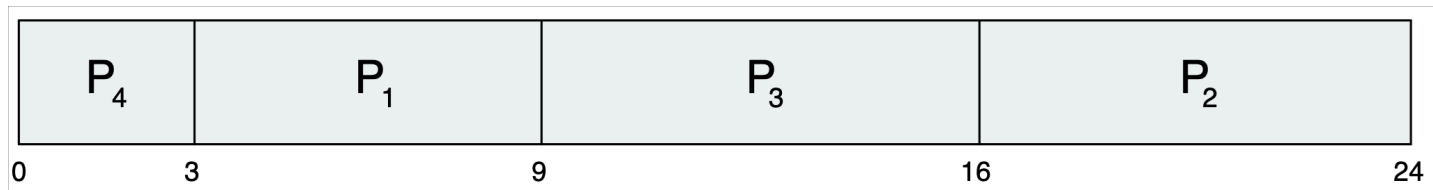




Example of SJF

<u>Process</u>	<u>Burst Time</u>
P_1	6
P_2	8
P_3	7
P_4	3

? SJF scheduling chart



? Average waiting time = $(3 + 16 + 9 + 0) / 4 = 7$



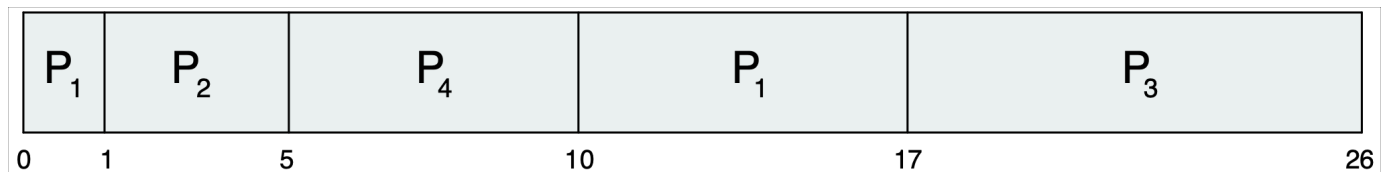


Example of Shortest-remaining-time-first

❓ Now we add the concepts of varying arrival times and preemption to the analysis

<u>Process</u>	<u>Arrival Time</u>	<u>Burst Time</u>
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

❓ *Preemptive* SJF Gantt Chart



❓ Average waiting time = $[(10-1)+(1-1)+(17-2)+5-3]/4 = 26/4 = 6.5$ msec



Apply SJF and calculate the average waiting time.

PROCESS	BURST TIME
P1	21
P2	3
P3	6
P4	2

The gantt chart is:



$$\text{average waiting time} = (0 + 2 + 5 + 11)/4 = 4.5 \text{ ms}$$