CMSC 125

Laboratory Activity 3B

**Problems with Solutions for the CPU Scheduling Algorithms**

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***Problem****:* Consider the following processes along with their burst time (in milliseconds):

|  |  |
| --- | --- |
| **Process** | **Burst Time (in *ms*)** |
| P1 | 12 |
| P2 | 8 |
| P3 | 4 |

Using first come first served scheduling, calculate the average waiting time if the processes arrive in the following order:

(i) P1, P2, P3

(ii) P3, P1, P2

***Solution****:*

1. **Case 1**: Processes P1, P2, and P3 arrive at the same time (0 *ms*) in the order P1, P2, P3.

**Gantt Chart**

|  |  |  |
| --- | --- | --- |
| **P1** | **P2** | **P3** |

0 12 20 24

From the Gantt chart, the waiting time is calculated as:

|  |  |
| --- | --- |
| **Process** | **Waiting Time (in *ms*)** |
| P1 | 0 |
| P2 | 12 |
| P3 | 20 |

**Average waiting time:**

1. **Case 2**: Processes arrive in the order P3, P1, P2, all at 0 *ms*.

**Gantt Chart**

|  |  |  |
| --- | --- | --- |
| **P3** | **P1** | **P2** |

0 4 16 24

From the Gantt chart, the waiting time is calculated as:

|  |  |
| --- | --- |
| **Process** | **Waiting Time (in *ms*)** |
| P1 | 0 |
| P2 | 4 |
| P3 | 16 |

**Average waiting time:**

**II.**

***Problem****:* Consider the following processes along with their burst time, arrival time, and priority list:

|  |  |  |  |
| --- | --- | --- | --- |
| **Process** | **Burst Time (in *ms*)** | **Priority** | **Arrival Time (in *ms*)** |
| P1 | 12 | 3 | 0 |
| P2 | 8 | 1 | 2 |
| P3 | 4 | 4 | 4 |
| P4 | 6 | 2 | 3 |

Calculate the average waiting time using priority scheduling.

***Solution:***

* At T = 0 *ms*, only **P1** is in the ready queue with a burst time of 12 *ms* and priority 3. Begin execution of **P1**.
* At T = 2 *ms*, **P2** arrives in the ready queue with a burst time of 8 *ms* and priority 1. Since the priority of **P2** is higher than **P1** (priority 1 < priority 3), **P1** is preempted, and **P2** starts execution.
* At T = 3 *ms*, **P4** arrives with a burst time of 6 *ms* and priority 2. Since the priority of **P2** is higher than **P4**, **P2** continues execution until completion at T = 11 *ms*.
* **P4** has the next highest priority, so it executes from T = 11 *ms* to 17 *ms*.
* At T = 4 *ms*, **P3** arrives in the ready queue with a burst time of 4 ms and priority 4. Since **P1** has a higher priority than **P3**, **P1** resumes execution and runs from T = 17 *ms* to 29 *ms*.
* Finally, **P3** runs from T = 29 *ms* to 33 *ms*.

**Gantt Chart**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **P1** | **P2** | **P4** | **P1** | **P3** |

0 2 11 17 29 33

**Waiting Time Calculation:**

**Average Waiting Time:**

***Problem****:* Consider the following processes along with their burst times:

|  |  |
| --- | --- |
| **Process** | **Burst Time (in *ms*)** |
| P1 | 10 |
| P2 | 7 |
| P3 | 5 |
| P4 | 8 |

Calculate the average waiting time and turnaround time using round-robin scheduling, where the time quantum .

***Solution:***

According to the Round Robin algorithm, the processes are executed as shown in the Gantt chart below.

**Gantt Chart**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **P1** | **P2** | **P3** | **P4** | **P1** | **P2** | **P4** | **P1** | **P2** | **P4** |

0 3 6 9 12 15 18 21 22 24 26

**Explanation:**

1. **P1** executes for 3 ms, then moves to the end of the queue. (Remaining: 7 ms)
2. **P2** executes for 3 ms, then moves to the end of the queue. (Remaining: 4 ms)
3. **P3** executes for 3 ms, then moves to the end of the queue. (Remaining: 2 ms)
4. **P4** executes for 3 ms, then moves to the end of the queue. (Remaining: 5 ms)
5. **P1** resumes and executes for another 3 ms. (Remaining: 4 ms)
6. **P2** resumes and executes for another 3 ms. (Remaining: 1 ms)
7. **P4** resumes and executes for another 3 ms. (Remaining: 2 ms)
8. **P1** resumes and executes for another 3 ms. (Remaining: 1 ms)
9. **P2** completes its remaining 1 ms.
10. **P4** completes its remaining 2 ms.
11. **P1** finishes its last 1 ms.
12. Finally, **P3** finishes its last 2 ms.

**Waiting Time Calculation:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Process** | **Burst Time (in *ms*)** | **Completion Time** | **Turnaround Time** | **Waiting Time** |
| P1 | 10 | 26 | 26 | 26 – 10 = 16 |
| P2 | 7 | 22 | 22 | 22 – 7 = 15 |
| P3 | 5 | 24 | 24 | 24 - 5 = 19 |
| P4 | 8 | 26 | 26 | 26 - 8 = 18 |

**Average Waiting Time:**

**Average Turnaround Time:**