**CPU-scheduling Exercises**

**Exercises 2.**

|  |  |  |
| --- | --- | --- |
| Process | Arrival Time | Burst Time |
| *P*1 | 0.0 | 8 |
| *P*2 | 0.4 | 4 |
| *P*3 | 1.0 | 1 |

a. What is the average turnaround time for these processes with the FCFS scheduling algorithm?

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

0 8 12 13

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Process | Arrival Time | Burst Time | Turnaround | Waitting |
| *P*1 | 0.0 | 8 | 8-0=8 | 0 |
| *P*2 | 0.4 | 4 | 12-0.4=11.6 | 7.6 |
| *P*3 | 1.0 | 1 | 13-1=12 | 11 |

Average turnaround time =

turnaround time = Finish – Arrival/ Waiting = turnaround - Burst

b. What is the average turnaround time for these processes with the  
SJF scheduling algorithm?

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

0(P1) 8(P2,P3) 9(P2) 13

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Process | Arrival Time | Burst Time | Turnaround | Waitting |  |
| *P*1 | 0.0 | 8 | 8 | 0 |  |
| *P*2 | 0.4 | 4 | 13-0.4=12.6 | 8.6 |  |
| *P*3 | 1.0 | 1 | 8 | 7 |  |

c. The SJF algorithm is supposed to improve performance, but notice that we chose to run process *P1* at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes *P1* and *P*2 are waiting during this idle time, so their waiting time may increase. This algorithm could be called future-knowledge scheduling.

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

0(W) 1(P3,P2,P1) 2(P2,P1) 6(P1) 13

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Process | Arrival Time | Burst Time | Turnaround | Waitting |  |
| *P*1 | 0.0 | 8 | 13 | 6 |  |
| *P*2 | 0.4 | 4 | 6-0.4=5.6 | 1.6 |  |
| *P*3 | 1.0 | 1 | 2-1=1 | 0 |  |

**Exercises 3.**

|  |  |  |
| --- | --- | --- |
| Process | Burst Time | Priority |
| *P*1 | 2 | 2 |
| *P*2 | 1 | 1 |
| *P*3 | 8 | 4 |
| *P*4 | 4 | 2 |
| *P*5 | 5 | 3 |

The processes are assumed to have arrived in the order *P*1, *P*2, *P*3, *P*4, *P*5,  
all at time 0.

a. FCFS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P1 | P2 | P3 | P4 | P5 |  |  |  |  |

0 2 3 11 15 20

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Process | Burst Time | Priority | Turnaround | Waiting |
| *P*1 | 2 | 2 | 2 | 0 |
| *P*2 | 1 | 1 | 3 | 2 |
| *P*3 | 8 | 4 | 11 | 3 |
| *P*4 | 4 | 2 | 15 | 11 |
| *P*5 | 5 | 3 | 20 | 15 |

b. SJF

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P2 | P1 | P4 | P5 | P3 |  |  |  |  |

0 1 3 7 12 20

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Process | Burst Time | Priority | Finish | Turnaround | Waiting |
| *P*1 | 2 | 2 | 3 | 3-0 | 3-2=1 |
| *P*2 | 1 | 1 | 1 | 1-0 | 1-1=0 |
| *P*3 | 8 | 4 | 20 | 20 | 20-8=12 |
| *P*4 | 4 | 2 | 7 | 7-0 | 7-4=3 |
| *P*5 | 5 | 3 | 12 | 12 | 12-5=7 |

c. Nonpreemptive priority (a larger priority number implies a higher priority)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P3 | P5 | P1 | P4 | P2 |  |  |  |  |

0 8 13 15 19 20

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Process | Burst Time | Priority | Finish | Turnaround | Waiting |
| *P*1 | 2 | 2 | 15 | 15-0 | 15-2 |
| *P*2 | 1 | 1 | 20 | 20-0 | 20-1 |
| *P*3 | 8 | 4 | 8 | 8-0 | 8-8 |
| *P*4 | 4 | 2 | 19 | 19-0 | 19-4 |
| *P*5 | 5 | 3 | 13 | 13-0 | 13-5 |

d. RR (quantum = 2).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P1 | P2 | P3(8) | P4 | P5 | P3(6) | P4(2) | P5(3) | P3(4) |

0 2 3 5 7 9(P3,p4,p5) 11 13 15(P3,P5) 17

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P5(1) | P3(2) |  |  |  |  |  |  |  |

17 18(P3)20

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Process | Burst Time | Priority | Finish | Turnaround | Waiting |
| *P*1 | 2 | 2 | 2 |  | 0 |
| *P*2 | 1 | 1 | 3 |  | 2 |
| *P*3 | 8 | 4 | 20 |  | 12 |
| *P*4 | 4 | 2 | 13 |  | 9 |
| *P*5 | 5 | 3 | 18 |  | 13 |

**Exercises 4.**

The following processes are being scheduled using a preemptive, roundrobin scheduling algorithm. Each process is assigned a numerical priority, with a higher number indicating a higher relative priority. In addition to the processes listed below, the system also has an ***idle task*** (which consumes no CPU resources and is identified as *Pidle*). This task has priority 0 and is scheduled whenever the system has no other available processes to run. The length of a time quantum is 10 units. If a process is preempted by a higher-priority process, the preempted process is placed at the end of the queue.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Thread | Priority | Burst | Arrival | Finish | Turnaround | Waiting |
| *P*1 | 40 | 20 | 0 |  |  |  |
| *P*2 | 30 | 25 | 25 |  |  |  |
| *P*3 | 30 | 25 | 30 |  |  |  |
| *P*4 | 35 | 15 | 60 |  |  |  |
| *P*5 | 5 | 10 | 100 |  |  |  |
| *P*6 | 10 | 10 | 105 |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P1 | P1 | Wait | P2 | P3 | P2(15) | P3(15) | P4 | P4(5) |

0(P1) 10(P1) 20 25(P2) 35(P2,P3)45 55(p2,P3)60(P2,P3,P4)70 75

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P2(5) | P3(10) | Wait | P5 | P6 | P5(5) |  |  |  |  |

75(P2,P3)80 90 100 105(P5,P6)115 120