Homework #4

9.1 a)

SRT

1. P1 arrives first
2. P1 starts executed. It is preempted after 20 ms since P2 arrives at 20 ms (it has smaller burst time than the remaining time of P1).
3. Since P1 is preempted, P2 runs to completion.
4. At t=40 ms, P3 arrives, but P1 burst time is shorter so it will run first.
5. At t=60 ms, P4 arrives.
6. P1 remaining burst time is 10 ms. This is smaller than P4, so P1 will run to completion.
7. P4 starts run to completion after P1.
8. P3 runs to completion.

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

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Nonpreemptive Priority

1. P1 arrives first (arrival time = 0 ms). P1 starts execution and completes the 50 ms time (t=50).
2. P2 and P3 arrive. P2 has higher priority, so it will execute and complete the 20 ms (t=70).
3. P4 starts execution as it has highest priority. P4 runs to completion.
4. P3 runs to completion.

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

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

RR

1. P1 arrives first, it will get 30 ms to run since quantum = 30 ms.
2. Since P2 arrives at 20 ms, it will be added to ready queue while P1 is running.
3. P1 requires 50 ms, but quantum is 30 ms, so it will be preempted by P2. P1 is added to ready queue.
4. P2 runs to completion (20 ms < 30 ms). P3 is added to ready queue while P2 is running as it’s arrival time is 40 ms.
5. P1 runs to completion (50 – 30 = 20 ms remaining) as 20 ms is less than the quantum. P4 is added to ready queue while P1 runs to completion as its arrival time is 60 ms.
6. P3 arrives and runs for 30 ms. Its suspended as P3 time is greater than quantum and is added to ready queue.
7. P4 arrives and runs for 30 ms. It’s added back to ready queue.
8. P3 arrives and runs for 30 ms. Its suspended as P3 time is greater than quantum and is added to ready queue.
9. P4 runs to completion (10 ms < 30 ms).
10. P3 runs to completion.

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

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

9.1 b)

Waiting time = Finish time – (arrival time + burst time)

Avg = Sum of waiting times / total # of processes

SRT

Waiting time P1 = 70 – (0 + 50) = 20 ms

Waiting time P2 = 40 – (20 + 20) = 0 ms

Waiting time P3 = 210 – (40 + 100) = 70 ms

Waiting time P4 = 110 – (60 + 40) = 10 ms

Avg = (20 + 0 + 70 + 10) / 4 = 25 ms

Nonpreemptive Priority

Waiting time P1 = 50 – (0 + 50) = 0 ms

Waiting time P2 = 70 – (20 + 20) = 30 ms

Waiting time P3 = 210 – (40 + 100) = 70 ms

Waiting time P4 = 110 – (60 + 40) = 10 ms

Avg = (0 +3 0 + 70 + 10) / 4 = 27.5 ms

RR

Waiting time P1 = 70 – (0 + 50) = 20 ms

Waiting time P2 = 50 – (20 + 20) = 10 ms

Waiting time P3 = 210 – (40 + 100) = 70 ms

Waiting time P4 = 170 – (60 + 40) = 70 ms

Avg = (20 + 10 + 70 + 70) / 4 = 42.5 ms

9.2 FCFS

0 5 10 15 20

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

RR (Q = 1)

0 5 10 15 20

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

RR (Q=4)

0 5 10 15 20

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

SPN

0 5 10 15 20

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

SRT

0 5 10 15 20

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

HRRN

0 5 10 15 20

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Process | A | B | C | D | E |  |
| Arrival Time | 0 | 1 | 3 | 9 | 12 |  |
| Service Time | 3 | 5 | 2 | 5 | 5 | Mean |

FCFS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Finish Time | 3 | 8 | 10 | 15 | 20 |  |
| Turnaround Time | 3 | 7 | 7 | 6 | 8 | 6.2 |
| Tr / Ts | 1 | 1.4 | 3.5 | 1.2 | 1.6 | 1.74 |

RR (Q=1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Finish Time | 5 | 11 | 7 | 18 | 20 |  |
| Turnaround Time | 5 | 10 | 4 | 9 | 8 | 7.4 |
| Tr / Ts | 1.7 | 2 | 2 | 1.8 | 1.6 |  |

RR (Q=4)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Finish Time | 3 | 18 | 9 | 19 | 20 |  |
| Turnaround Time | 3 | 17 | 6 | 10 | 8 | 8.8 |
| Tr / Ts | 1 | 3.4 | 3 | 2 | 1.6 | 2.2 |

SPN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Finish Time | 3 | 10 | 5 | 15 | 20 |  |
| Turnaround Time | 3 | 9 | 2 | 6 | 8 | 5.6 |
| Tr / Ts | 1 | 1.8 | 1 | 1.2 | 1.6 | 1.12 |

SRN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Finish Time | 3 | 10 | 5 | 13 | 20 |  |
| Turnaround Time | 3 | 9 | 2 | 6 | 8 | 5.6 |
| Tr / Ts | 1 | 1.8 | 1 | 1.2 | 1.6 | 1.12 |

HRRN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Finish Time | 3 | 8 | 10 | 15 | 20 |  |
| Turnaround Time | 3 | 7 | 7 | 6 | 8 | 6.2 |
| Tr / Ts | 1 | 1.4 | 3.5 | 1.2 | 1.6 | 1.74 |