Q1: (1) FCFS:

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

0 2 3 11 15 20

P1: 0 P2: 2 P3: 3 P4: 11 P5: 15

Average waiting time: (0 + 2 + 3 + 11 + 15) / 5 = 31/5 = 6.2

1. Nonpreemptive SJF

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

0 1 3 7 12 20

P2: 0 P1: 1 P4: 3 P5: 7 P3: 12

Average waiting time: (1 + 3 + 7 + 12) / 5 = 23 / 5 = 4.6

1. Nonpreemptive priority

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

0 8 13 15 19 20

P3: 0 P5: 8 P1: 13 P4: 15 P2: 19

Average waiting time: (0 + 8 + 13 + 15 + 19) / 5 = 55 / 5 = 11

1. RR (quantum = 2)

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

0 2 3 5 7 9 11 13 15 17 18 20

Average waiting time:

P1: 0 P2: 2 P3: 3 + (9 - 5) + (15 - 11) + (18 - 17) = 12

P4: 5 + (11 - 7) = 9 P5: 7 + (13 - 9) + (17 - 15) = 13

Average waiting time: (0 + 2 + 12 + 9 + 13) / 5 = 7.2

Q2:

The mutex\_lock is to protect global variable waiting\_students. The semaphore students\_sem and ta\_sem are used to control sequence of execution.

|  |  |
| --- | --- |
| Student thread: | In TA thread: |
| 1. Programming 1-3 seconds | 1 sem\_wait(&students\_sem):  Wait for students to appear |
| 1. Lock mutex\_lock to check value of waiting\_students: 2. If waiting\_students >= 2:   Unlock mutex\_lock  Print try later and go to 1.   1. if waiting\_students < 2:   waiting\_students++; print taks a seat; unlock mutex\_lock | 2 lock mutex\_lock  Print help a student, update waiting\_students  Unlock mutex\_lock |
| 1. sem\_post(&students\_sem):   notify ta students arrived | 1. sem\_post(&ta\_sem): notify a student that he receives help now |
| 1. sem\_wait(&ta\_sem):   wait for ta to start help me  print receive help | 1. lock waiting\_students to check if it equals 0, if yes, go to 1 to wait for new students to appear.   Otherwise, go to 2 to help waiting students sitting in the hall way. |

Screenshots: (too long to keep in one page in Ubuntu terminal)



