King Saud University
College of Computer and Information Sciences
Department of Information Technology

CSC 227 Course Project
Term-2, 1445H

# Operating system Project report

| | | |
|---|---|---|
| **Group#:** | 3 | |
| **Section#:** | 44073 | |
| **Group members** | **Name** | **ID** |
| | Rana AlSayyari | 443200565 |
| | Bashair Alsadhan | 443200668 |
| | Noura Alwohaibi | 443200415 |
| | Rama Alshebel | 443200929 |
| | Reema Aljalajel | 443201121 |

Survived by L.Abeer Alshaya

## Task distribution:

| Student name | Tasks |
|---|---|
| Rana AlSayyari | Prompt for process's information – creating process – add it to the queue |
| Bashair Alsadhan | Creating PCB class and driver class- Creating 2 arrays and prompt for the number of processes |
| Noura Alwohaibi | Prompt a menu for the user - Prompt for process's information |
| Rama Alshebel | Scheduling the processes execution in the CPU |
| Reema Aljalajel | Displaying the scheduling order and on the console and an output file – Exiting the program |

**Student peer Evaluation:**

| Criteria | Rana | Bashair | Noura | Rama | Reema |
|---|---|---|---|---|---|
| Work division: Contributed equally to the work | 1 | 1 | 1 | 1 | 1 |
| Peer evaluation: Level of commitments (Interactivity with other team members), and professional behavior towards team & TA | 1 | 1 | 1 | 1 | 1 |
| Project Discussion: Accurate answers, understanding of the presented work, good listeners to questions | 1 | 1 | 1 | 1 | 1 |
| Time management: Attending on time, being ready to start the demo, good time management in discussion and demo. | 1 | 1 | 1 | 1 | 1 |
| Total/4 | 4 | 4 | 4 | 4 | 4 |

## Screen shots (Output):

**Test Case 1: Round-Robin with burst time equal to quantum (3 ms).**
Expected behavior: Each process should complete in one quantum without preemption.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 3

 Enter details for process P1:
Priority (1 or 2): 1
Arrival Time: 0
CPU Burst Time: 3

 Enter details for process P2:
Priority (1 or 2): 1
Arrival Time: 2
CPU Burst Time: 3

 Enter details for process P3:
Priority (1 or 2): 1
Arrival Time: 4
CPU Burst Time: 3
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P2 | P3 |

Process ID: P1
Priority: 1
Arrival time: 0
CPU burst time: 3
Start time: 0
Termination time: 3
Turnaround time: 3.0
Waiting time: 0.0
Response time: 0.0

Process ID: P2
Priority: 1
Arrival time: 2
CPU burst time: 3
Start time: 3
Termination time: 6
Turnaround time: 4.0
Waiting time: 1.0
Response time: 1.0

Process ID: P3
Priority: 1
Arrival time: 4
CPU burst time: 3
Start time: 6
Termination time: 9
Turnaround time: 5.0
Waiting time: 2.0
Response time: 2.0

Average Turnaround Time: 4.0
Average Waiting Time: 1.0
Average Response Time: 1.0
Menu:
```

**Test Case 2: Round-Robin with burst time less than quantum (3 ms).**
Expected behavior: P1 completes in 2ms, CPU is idle for 1ms, then P2 starts immediately and completes in 1ms.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 2

 Enter details for process P1:
Priority (1 or 2): 1
Arrival Time: 0
CPU Burst Time: 2

 Enter details for process P2:
Priority (1 or 2): 1
Arrival Time: 3
CPU Burst Time: 1
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P2 |

Process ID: P1
Priority: 1
Arrival time: 0
CPU burst time: 2
Start time: 0
Termination time: 2
Turnaround time: 2.0
Waiting time: 0.0
Response time: 0.0

Process ID: P2
Priority: 1
Arrival time: 3
CPU burst time: 1
Start time: 3
Termination time: 4
Turnaround time: 1.0
Waiting time: 0.0
Response time: 0.0

Average Turnaround Time: 1.5
Average Waiting Time: 0.0
Average Response Time: 0.0
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice:
```

**Test Case 3: Round-Robin with burst time more than quantum (3 ms).**
Expected behavior: process P1 should be preempted every 3ms until completion.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 1

 Enter details for process P1:
Priority (1 or 2): 1
Arrival Time: 0
CPU Burst Time: 10
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P1 | P1 | P1 |

Process ID: P1
Priority: 1
Arrival time: 0
CPU burst time: 10
Start time: 0
Termination time: 10
Turnaround time: 10.0
Waiting time: 0.0
Response time: 0.0

Average Turnaround Time: 10.0
Average Waiting Time: 0.0
Average Response Time: 0.0
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice:
```

**Test Case 4: Round-Robin with two processes arriving at the same time.**
Process P1 (8ms) and P2(5ms) both arrive at time 0ms.
Expected behavior: process P1 and P2 should be preempted every 3ms until completion.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 2

 Enter details for process P1:
Priority (1 or 2): 1
Arrival Time: 0
CPU Burst Time: 8

 Enter details for process P2:
Priority (1 or 2): 1
Arrival Time: 0
CPU Burst Time: 5
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P2 | P1 | P2 | P1 |

Process ID: P2
Priority: 1
Arrival time: 0
CPU burst time: 5
Start time: 3
Termination time: 11
Turnaround time: 11.0
Waiting time: 5.0
Response time: 0.0

Average Turnaround Time: 12.0
Average Waiting Time: 5.5
Average Response Time: 1.5
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice:
```

**Test Case 5: Shortest Job First – Non Preemptive.**

Processes P1 (8ms), P2 (3ms), P3 (5ms), arriving at times 0ms, 1ms, and 2ms.
Expected behavior: P1 will run without any preemption, then P2 will run before P3, since its burst time is less than P3.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 3

 Enter details for process P1:
Priority (1 or 2): 2
Arrival Time: 0
CPU Burst Time: 8

 Enter details for process P2:
Priority (1 or 2): 2
Arrival Time: 1
CPU Burst Time: 3

 Enter details for process P3:
Priority (1 or 2): 2
Arrival Time: 2
CPU Burst Time: 5
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P2 | P3 |

Process ID: P1
Priority: 2
Arrival time: 0
CPU burst time: 8
Start time: 0
Termination time: 8
Turnaround time: 8.0
Waiting time: 0.0
Response time: 0.0

Process ID: P2
Priority: 2
Arrival time: 1
CPU burst time: 3
Start time: 8
Termination time: 11
Turnaround time: 10.0
Waiting time: 7.0
Response time: 7.0

Process ID: P3
Priority: 2
Arrival time: 2
CPU burst time: 5
Start time: 11
Termination time: 16
Turnaround time: 14.0
Waiting time: 9.0
Response time: 9.0

Average Turnaround Time: 10.666666666666666
Average Waiting Time: 5.333333333333333
Average Response Time: 5.333333333333333
Menu:
1. Enter process' information
```

**Test Case 6: Shortes Job First – Non Preemptive.**

Processes P1 (5ms), P2 (2ms), P3 (1ms), arriving at times 0ms, 1ms, and 4ms.

Expected behavior: P1 will run without any preemption, then P3 will run before P2, since its burst time is less than P2.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 3

 Enter details for process P1:
Priority (1 or 2): 2
Arrival Time: 0
CPU Burst Time: 5

 Enter details for process P2:
Priority (1 or 2): 2
Arrival Time: 1
CPU Burst Time: 2

 Enter details for process P3:
Priority (1 or 2): 2
Arrival Time: 4
CPU Burst Time: 1
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P3 | P2 |

Process ID: P1
Priority: 2
Arrival time: 0
CPU burst time: 5
Start time: 0
Termination time: 5
Turnaround time: 5.0
Waiting time: 0.0
Response time: 0.0

Process ID: P3
Priority: 2
Arrival time: 4
CPU burst time: 1
Start time: 5
Termination time: 6
Turnaround time: 2.0
Waiting time: 1.0
Response time: 1.0

Process ID: P2
Priority: 2
Arrival time: 1
CPU burst time: 2
Start time: 6
Termination time: 8
Turnaround time: 7.0
Waiting time: 5.0
Response time: 5.0

Average Turnaround Time: 4.666666666666667
Average Waiting Time: 2.0
Average Response Time: 2.0
Menu:
1. Enter process' information
```

**Test Case 7: Shortes Job First – Non Preemptive.**

Processes P1 (10ms) and P2 (7ms), arriving at the same time.

Expected behavior: P2 will run without any preemption, then P1 will run after, since its burst time is larger than P2.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 2

 Enter details for process P1:
Priority (1 or 2): 2
Arrival Time: 0
CPU Burst Time: 10

 Enter details for process P2:
Priority (1 or 2): 2
Arrival Time: 0
CPU Burst Time: 7
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P2 | P1 |

Process ID: P2
Priority: 2
Arrival time: 0
CPU burst time: 7
Start time: 0
Termination time: 7
Turnaround time: 7.0
Waiting time: 0.0
Response time: 0.0

Process ID: P1
Priority: 2
Arrival time: 0
CPU burst time: 10
Start time: 7
Termination time: 17
Turnaround time: 17.0
Waiting time: 7.0
Response time: 7.0

Average Turnaround Time: 12.0
Average Waiting Time: 3.5
Average Response Time: 3.5
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice:
```

**Test Case 8: Preemption across queues.**

Processes P1 in Q2(10ms) and P2 in Q1(4ms), arriving at times 0ms and 1ms respectively. Expected behavior: P1 will run for 1ms than gets preempted by P2 since it has a higher priority, P2 will run in 2 quanta, then P1 will resume.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 2

 Enter details for process P1:
Priority (1 or 2): 2
Arrival Time: 0
CPU Burst Time: 10

 Enter details for process P2:
Priority (1 or 2): 1
Arrival Time: 1
CPU Burst Time: 4
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P2 | P2 | P1 |

Process ID: P2
Priority: 1
Arrival time: 1
CPU burst time: 4
Start time: 1
Termination time: 5
Turnaround time: 4.0
Waiting time: 0.0
Response time: 0.0

Process ID: P1
Priority: 2
Arrival time: 0
CPU burst time: 10
Start time: 0
Termination time: 14
Turnaround time: 14.0
Waiting time: 4.0
Response time: 0.0

Average Turnaround Time: 9.0
Average Waiting Time: 2.0
Average Response Time: 0.0
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice:
```

**Test Case 9: Preemption across queues.**

Processes P1 in Q2(3ms), P2 in Q2(3ms) and P3 in Q1(4ms), arriving at times 0ms, 3ms and 3ms respectively.

Expected behavior: P1 will run without preemption, then P3 will start running before P1 since it is a higher priority.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 3

 Enter details for process P1:
Priority (1 or 2): 2
Arrival Time: 0
CPU Burst Time: 3

 Enter details for process P2:
Priority (1 or 2): 2
Arrival Time: 3
CPU Burst Time: 3

 Enter details for process P3:
Priority (1 or 2): 1
Arrival Time: 3
CPU Burst Time: 4
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P3 | P3 | P2 |

Process ID: P1
Priority: 2
Arrival time: 0
CPU burst time: 3
Start time: 0
Termination time: 3
Turnaround time: 3.0
Waiting time: 0.0
Response time: 0.0

Process ID: P3
Priority: 1
Arrival time: 3
CPU burst time: 4
Start time: 3
Termination time: 7
Turnaround time: 4.0
Waiting time: 0.0
Response time: 0.0

Process ID: P2
Priority: 2
Arrival time: 3
CPU burst time: 3
Start time: 7
Termination time: 10
Turnaround time: 7.0
Waiting time: 4.0
Response time: 4.0

Average Turnaround Time: 4.666666666666667
Average Waiting Time: 1.3333333333333333
Average Response Time: 1.3333333333333333
Menu:
1. Enter process' information
```

**Test Case 10: Preemption across queues.**

Processes P1 in Q2(2ms), P2 in Q2(4ms) and P3 in Q1(3ms), arriving at times 0ms, 4ms and 8ms respectively.

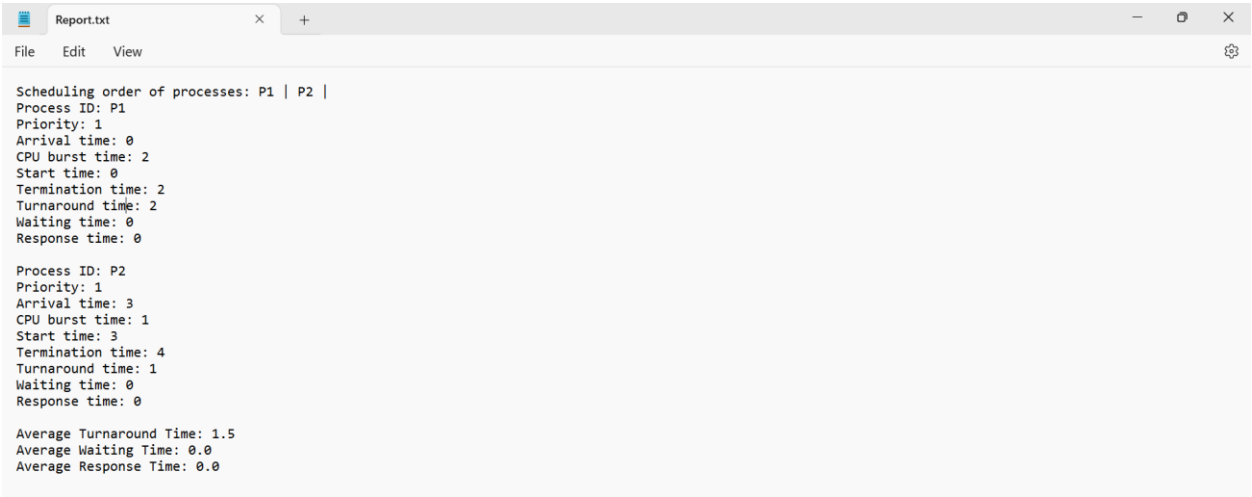
Expected behavior: P1 will run without preemption, then P2 will also run without preemption, then P3 will run last.

```
PS C:\Users\Royna\Documents\OSProject_2>  & 'C:\Program Files\Java\jdk-18.0.2.1\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages'
'-cp' 'C:\Users\Royna\AppData\Roaming\Code\User\workspaceStorage\9497fdd26ddd3e9a226cd7467f900502\redhat.java\jdt_ws\OSProject_2_60d0dd1
2\bin' 'driver'
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 1
Enter the number of processes: 3

 Enter details for process P1:
Priority (1 or 2): 2
Arrival Time: 0
CPU Burst Time: 2

 Enter details for process P2:
Priority (1 or 2): 2
Arrival Time: 4
CPU Burst Time: 4

 Enter details for process P3:
Priority (1 or 2): 1
Arrival Time: 8
CPU Burst Time: 3
Menu:
1. Enter process' information
2. Report detailed information about each process and different scheduling criteria
3. Exit the program
Enter your choice: 2
Scheduling order of processes: P1 | P2 | P3 |

Process ID: P1
Priority: 2
Arrival time: 0
CPU burst time: 2
Start time: 0
Termination time: 2
Turnaround time: 2.0
Waiting time: 0.0
Response time: 0.0

Process ID: P2
Priority: 2
Arrival time: 4
CPU burst time: 4
Start time: 4
Termination time: 8
Turnaround time: 4.0
Waiting time: 0.0
Response time: 0.0

Process ID: P3
Priority: 1
Arrival time: 8
CPU burst time: 3
Start time: 8
Termination time: 11
Turnaround time: 3.0
Waiting time: 0.0
Response time: 0.0

Average Turnaround Time: 3.0
Average Waiting Time: 0.0
Average Response Time: 0.0
Menu:
1. Enter process' information
```

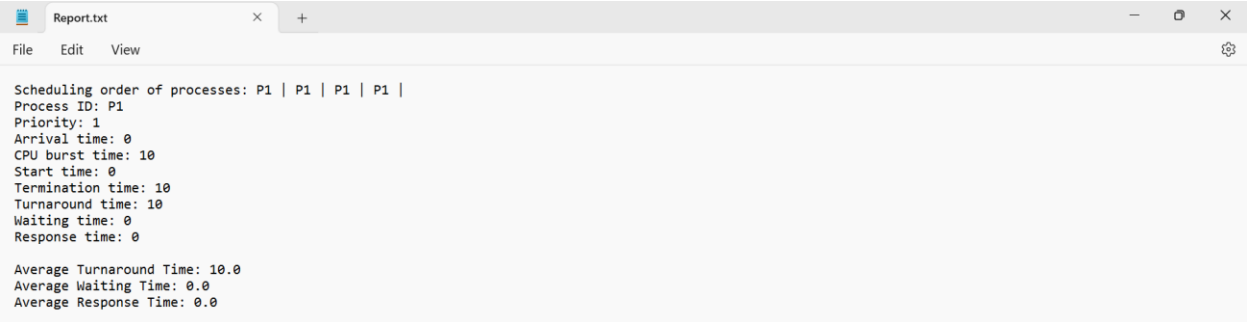
## Screen Shots (Report File):

**Test Case 1: Round-Robin with burst time equal to quantum (3 ms).**
Expected behavior: Each process should complete in one quantum without preemption.

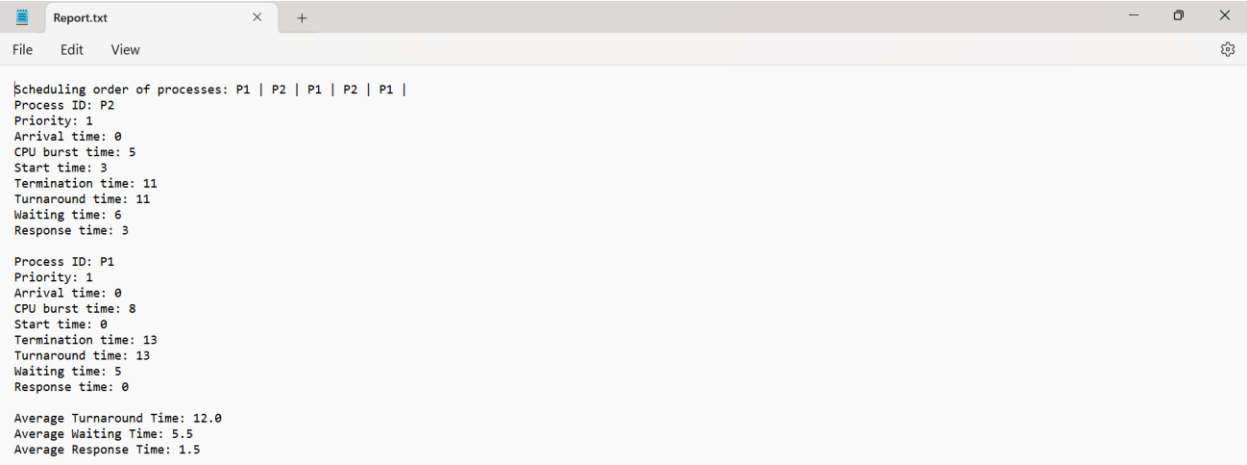

**Test Case 2: Round-Robin with burst time less than quantum (3 ms).**
Expected behavior: P1 completes in 2ms, CPU is idle for 1ms, then P2 starts immediately and completes in 1ms.



**Test Case 3: Round-Robin with burst time more than quantum (3 ms).**
Expected behavior: process P1 should be preempted every 3ms until completion.

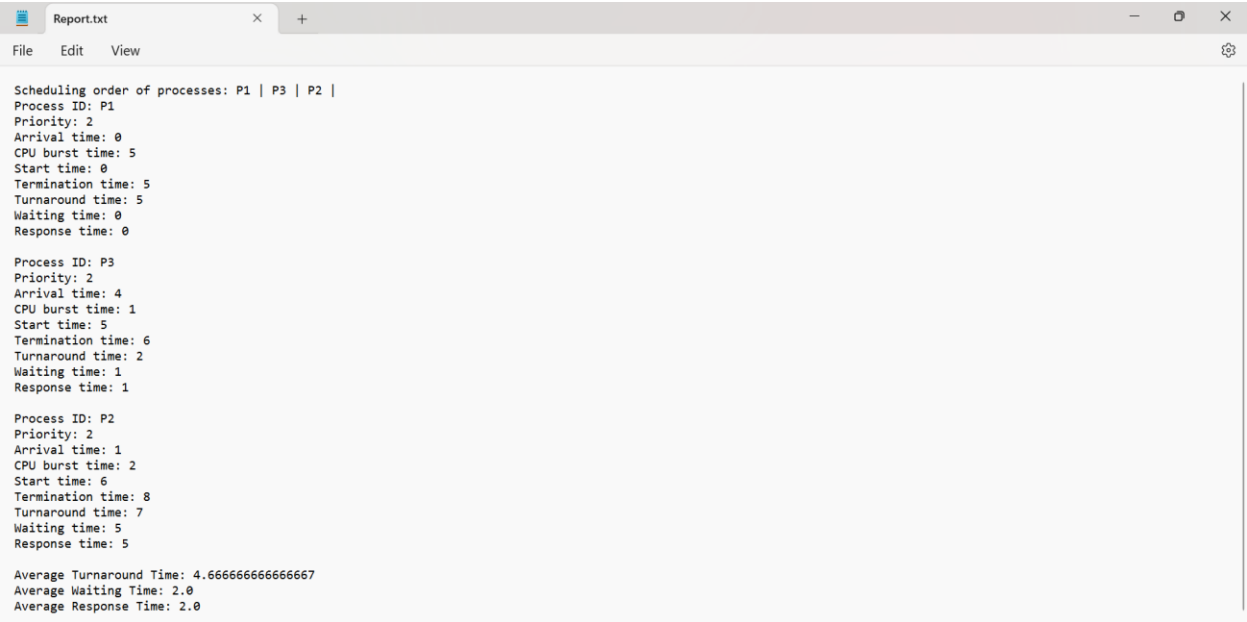



**Test Case 4: Round-Robin with two processes arriving at the same time.**
Process P1 (8ms) and P2(5ms) both arrive at time 0ms.
Expected behavior: process P1 and P2 should be preempted every 3ms until completion.

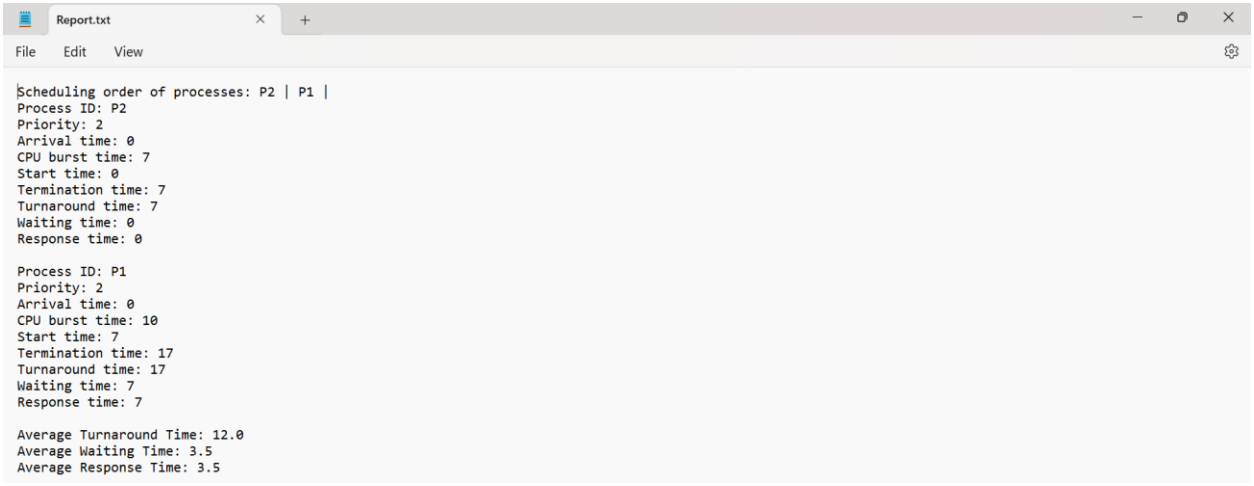


**Test Case 5: Shortest Job First – Non Preemptive.**
Expected behavior: P1 will run without any preemption, then P2 will run before P3, since its burst time is less than P3.


**Test Case 6: Shortes Job First – Non Preemptive.**
Processes P1 (5ms), P2 (2ms), P3 (1ms), arriving at times 0ms, 1ms, and 4ms.
Expected behavior: P1 will run without any preemption, then P3 will run before P2, since its burst time is less than P2.



**Test Case 7: Shortes Job First – Non Preemptive.**
Processes P1 (10ms) and P2 (7ms), arriving at the same time.
Expected behavior: P2 will run without any preemption, then P1 will run after, since its burst time is larger than P2.




**Test Case 8: Preemption across queues.**
Processes P1 in Q2(10ms) and P2 in Q1(4ms), arriving at times 0ms and 1ms respectively.
Expected behavior: P1 will run for 1ms than gets preempted by P2 since it has a higher priority, P2 will run in 2 quanta, then P1 will resume.

**Test Case 9: Preemption across queues.**

Processes P1 in Q2(3ms), P2 in Q2(3ms) and P3 in Q1(4ms), arriving at times 0ms, 3ms and 3ms respectively.

Expected behavior: P1 will run without preemption, then P3 will start running before P1 since it is a higher priority.


**Test Case 10: Preemption across queues.**

Processes P1 in Q2(2ms), P2 in Q2(4ms) and P3 in Q1(3ms), arriving at times 0ms, 4ms and 8ms respectively.

Expected behavior: P1 will run without preemption, then P2 will also run without preemption, then P3 will run last.