1174066

Multilevel Queue for CPU scheduling Implementation

MLQ Output(FIFO Only)

```
"D:\Program Files\Python310\python.exe" "E:\2.Online MS CS\2nd Year\repo\dev-cs\CPSC_503_OS\assignment_01\CPU
Enter Context Switching Time(should be integer): 0
Enter Switch type (1 for Non Pre-emptive , 2 for Pre-emptive): 1
---------------------------------FIFO START HERE-----------------------------------------------
At time 0: -----------------starting JOB 1-----------------
Job status Running
At time 1: Running Job 1, 9 time units remaining.
At time 1: CPU available: False, Ready queue: []
At time 2: Running Job 1, 8 time units remaining.
At time 2: CPU available: False, Ready queue: []
At time 2: Job 2 arrived and added to ready queue.
Ready queue: [2]
At time 3: CPU available: False, Ready queue: [2]
At time 4: CPU available: False, Ready queue: [2]
At time 4: Job 3 arrived and added to ready queue.
Ready queue: [2, 3]
At time 5: CPU available: False, Ready queue: [2, 3]
At time 6: CPU available: False, Ready queue: [2, 3]
At time 7: CPU available: False, Ready queue: [2, 3]
At time 8: CPU available: False, Ready queue: [2, 3]
At time 8: Job 4 arrived and added to ready queue.
Ready queue: [2, 3, 4]
At time 9: CPU available: False, Ready queue: [2, 3, 4]
Job status exit
-----------------finishing JOB 1-----------------
At time 10: CPU available: True, Ready queue: [2, 3, 4]
At time 10: switching to Job 2
-----------------starting JOB 2-----------------
Job status Running
At time 11: Running Job 2, 0 time units remaining.
Job status exit
-----------------finishing JOB 2-----------------
At time 11: CPU available: True, Ready queue: [3, 4]
At time 11: switching to Job 3
-----------------starting JOB 3-----------------
Job status Running
At time 12: Running Job 3, 2.0 time units remaining.
At time 12: CPU available: False, Ready queue: [4]
At time 12: Job 5 arrived and added to ready queue.
Ready queue: [4, 5]
At time 13: Running Job 3, 1.0 time units remaining.
At time 13: CPU available: False, Ready queue: [4, 5]
Job status exit
-----------------finishing JOB 3-----------------
At time 14: CPU available: True, Ready queue: [4, 5]
At time 14: switching to Job 4
-----------------starting JOB 4-----------------
Job status Running
At time 15: Running Job 4, 4 time units remaining.
At time 15: CPU available: False, Ready queue: [5]
At time 16: Running Job 4, 3 time units remaining.
At time 16: CPU available: False, Ready queue: [5]
At time 17: CPU available: False, Ready queue: [5]
At time 18: CPU available: False, Ready queue: [5]
Job status exit
-----------------finishing JOB 4-----------------
At time 19: CPU available: True, Ready queue: [5]
At time 19: switching to Job 5
-----------------starting JOB 5-----------------
Job status Running
At time 20: Running Job 5, 1 time units remaining.
At time 20: CPU available: False, Ready queue: []
At time 21: Running Job 5, 0 time units remaining.
Job status exit
-----------------finishing JOB 5-----------------
---------------------------------FIFO ENDS HERE-----------------------------------------------
Total time is: 21
```

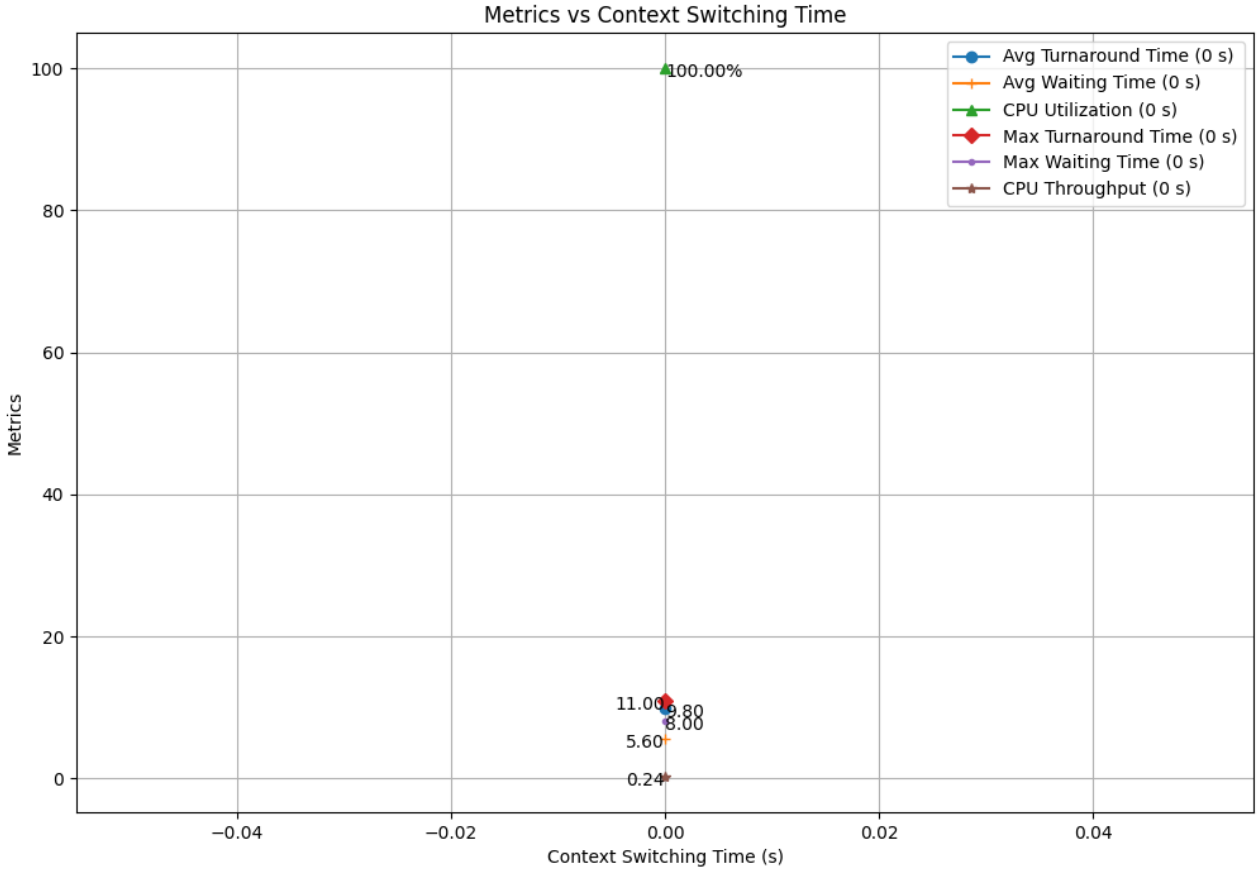
MLQ Output(FIFO + Priority based)

```
"D:\Program Files\Python310\python.exe" "E:\2.Online MS CS\2nd Year\repo\dev-cs\CPSC_503_OS\assig
Enter Context Switching Time(should be integer): 0
Enter Switch type (1 for Non Pre-emptive , 2 for Pre-emptive): 1
---------------------------------FIFO START HERE-----------------------------------------------
At time 0: -----------------starting JOB 1-----------------
Job status Running
At time 1: Running Job 1, 9 time units remaining.
At time 1: CPU available: False, Ready queue: []
At time 2: Running Job 1, 8 time units remaining.
At time 2: CPU available: False, Ready queue: []
At time 2: Job 2 arrived and added to ready queue.
Ready queue: [2]
At time 3: CPU available: False, Ready queue: [2]
At time 4: Job 1 exceeded aging threshold and transferred.
---------------------------------PRIORITY BASED START HERE-------------------------------------
At time 4: CPU available: True, Ready queue: []
At time 4: Job 1 arrived and added to ready queue.
Ready queue: [1]
At time 4: switching to Job 1
-----------------starting JOB 1-----------------
Job status Running
At time 4: Running Job 1, 7 time units remaining.
At time 5: CPU available: False, Ready queue: []
At time 5: Running Job 1, 6 time units remaining.
At time 6: CPU available: False, Ready queue: []
At time 6: Running Job 1, 5 time units remaining.
At time 7: CPU available: False, Ready queue: []
At time 7: Running Job 1, 4 time units remaining.
At time 8: CPU available: False, Ready queue: []
At time 8: Running Job 1, 3 time units remaining.
At time 9: CPU available: False, Ready queue: []
At time 9: Running Job 1, 2 time units remaining.
At time 10: CPU available: False, Ready queue: []
At time 10: Running Job 1, 1 time units remaining.
Job status exit
-----------------finishing JOB 1-----------------
---------------------------------PRIORITY BASED ENDS HERE---------------------------------------
At time 11: CPU available: True, Ready queue: [2]
At time 11: Job 3 arrived and added to ready queue.
Ready queue: [2, 3]
At time 11: switching to Job 2
-----------------starting JOB 2-----------------
Job status Running
At time 12: Running Job 2, 0 time units remaining.
Job status exit
-----------------finishing JOB 2-----------------
At time 12: CPU available: True, Ready queue: [3]
At time 12: switching to Job 3
-----------------starting JOB 3-----------------
Job status Running
At time 13: Running Job 3, 2.0 time units remaining.
At time 13: CPU available: False, Ready queue: []
At time 14: Running Job 3, 1.0 time units remaining.
At time 14: CPU available: False, Ready queue: []
Job status exit
-----------------finishing JOB 3-----------------
---------------------------------FIFO ENDS HERE-----------------------------------------------
Total time is: 15
```

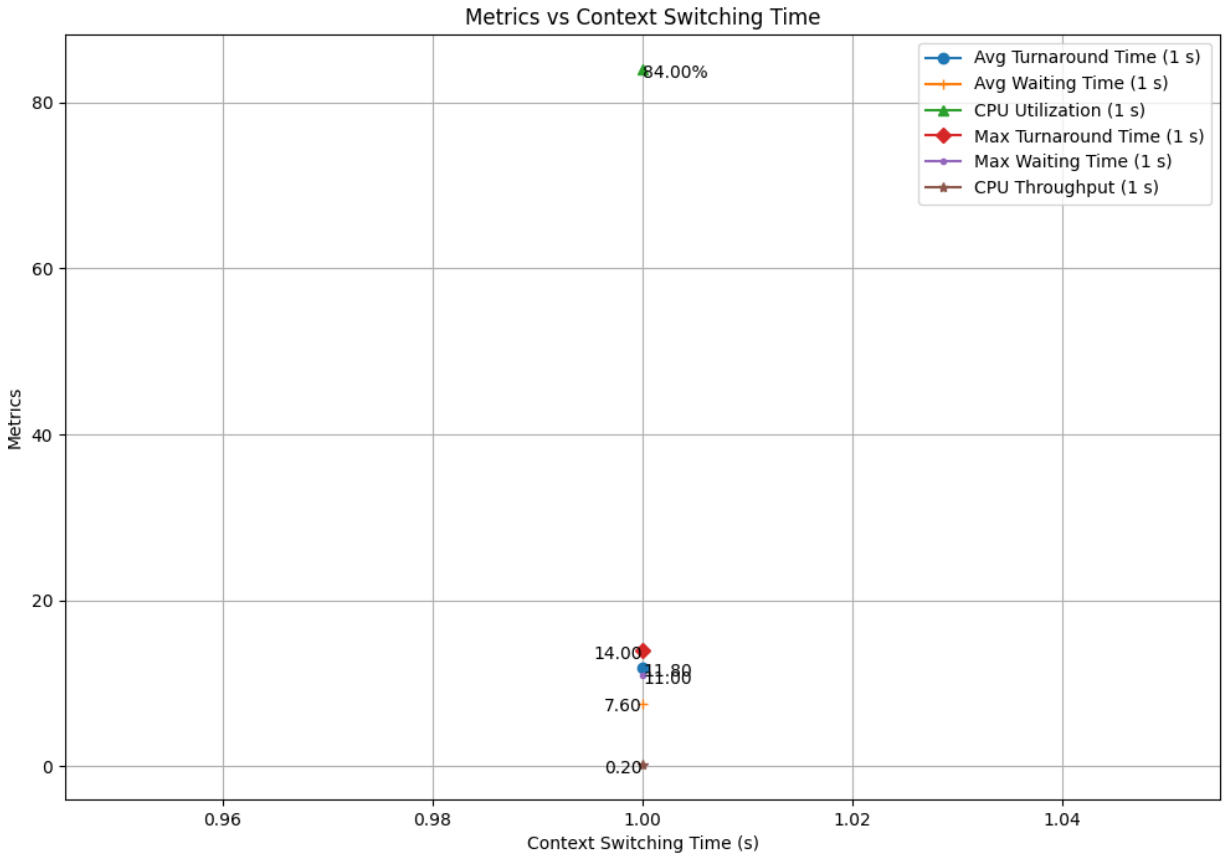
CPU Optimization

I investigated the effect of varying context switching time to see how it affects different performance measures the observed results are shown the graphs below

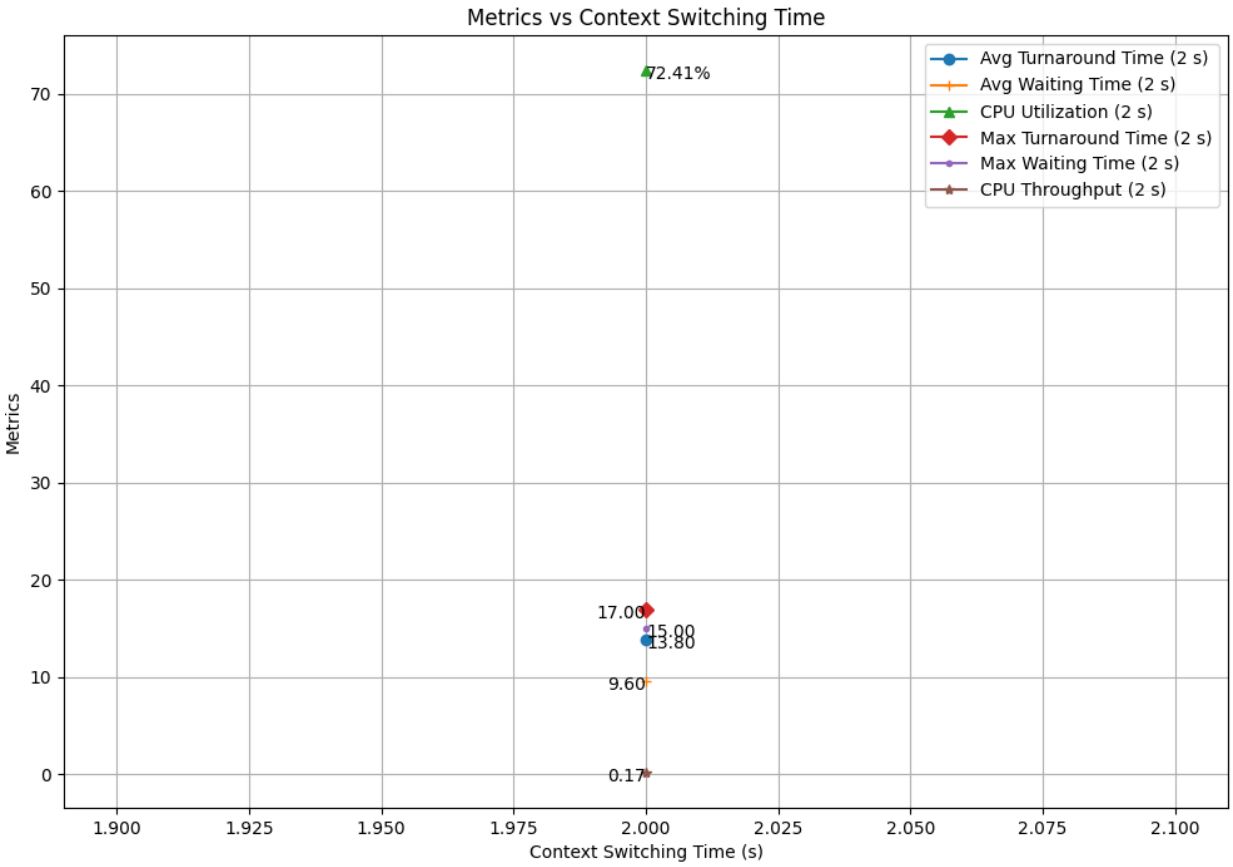
```
-------------------------------FIFO ENDS HERE-------------------------------------------
Total time is: 21
job is Job #1 - Arrival: 0.00, Execution Time: 10.00, Priority: 3, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 10 , Turn Around Time: 0
job is Job #2 - Arrival: 2.00, Execution Time: 1.00, Priority: 2, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 11 , Turn Around Time: 0
job is Job #3 - Arrival: 4.00, Execution Time: 3.00, Priority: 1, Queue: 1, Status: exit ,Remaining time: 0.0,Exit time: 14 , Turn Around Time: 0
job is Job #4 - Arrival: 8.00, Execution Time: 5.00, Priority: 5, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 19 , Turn Around Time: 0
job is Job #5 - Arrival: 12.00, Execution Time: 2.00, Priority: 4, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 21 , Turn Around Time: 0
```



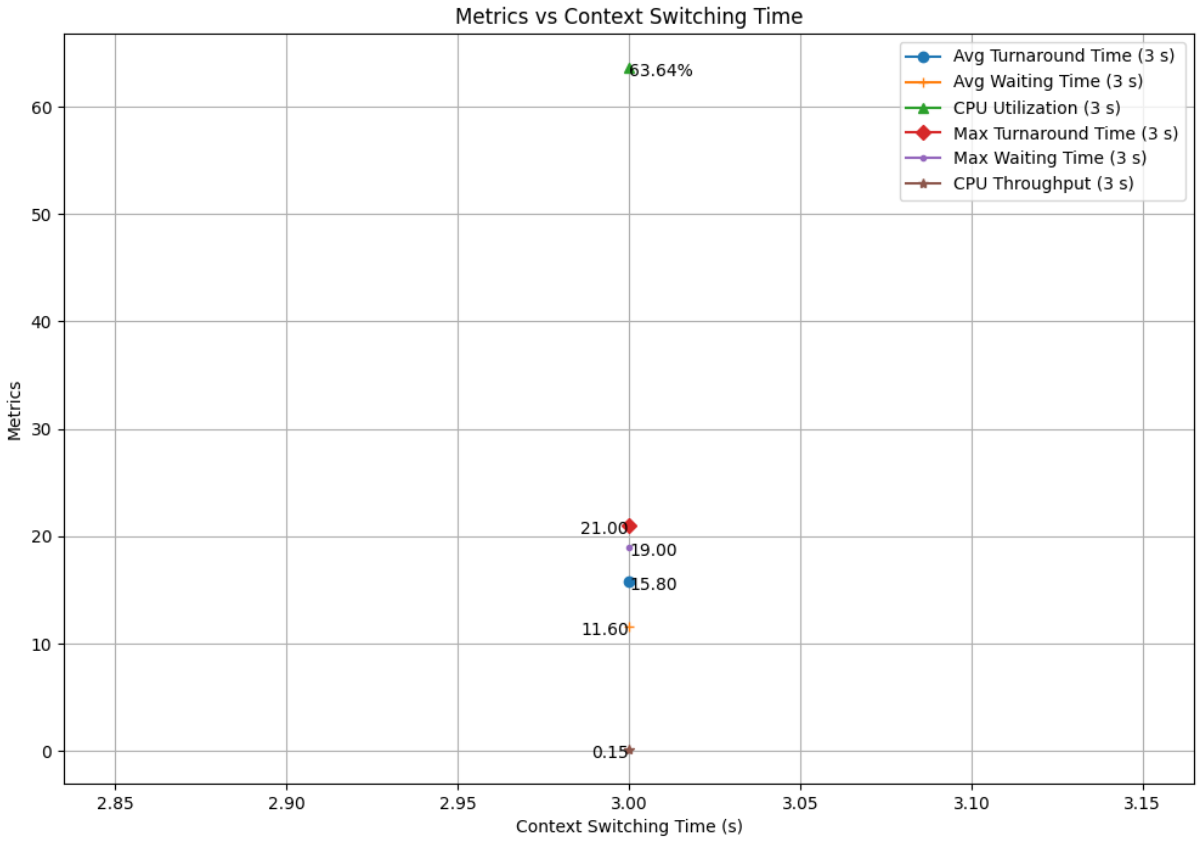
```
job is Job #1 - Arrival: 0.00, Execution Time: 10.00, Priority: 3, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 10
job is Job #2 - Arrival: 2.00, Execution Time: 1.00, Priority: 2, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 12
job is Job #3 - Arrival: 4.00, Execution Time: 3.00, Priority: 1, Queue: 1, Status: exit ,Remaining time: 0.0,Exit time: 16
job is Job #4 - Arrival: 8.00, Execution Time: 5.00, Priority: 5, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 22
job is Job #5 - Arrival: 12.00, Execution Time: 2.00, Priority: 4, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 25
```



```
-------------------------------FIFO ENDS HERE---------------------------------------------
Total time is: 29
job is Job #1 - Arrival: 0.00, Execution Time: 10.00, Priority: 3, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 10
job is Job #2 - Arrival: 2.00, Execution Time: 1.00, Priority: 2, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 13
job is Job #3 - Arrival: 4.00, Execution Time: 3.00, Priority: 1, Queue: 1, Status: exit ,Remaining time: 0.0,Exit time: 18
job is Job #4 - Arrival: 8.00, Execution Time: 5.00, Priority: 5, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 25
job is Job #5 - Arrival: 12.00, Execution Time: 2.00, Priority: 4, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 29
```



```
Total time is: 33
job is Job #1 - Arrival: 0.00, Execution Time: 10.00, Priority: 3, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 10
job is Job #2 - Arrival: 2.00, Execution Time: 1.00, Priority: 2, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 14
job is Job #3 - Arrival: 4.00, Execution Time: 3.00, Priority: 1, Queue: 1, Status: exit ,Remaining time: 0.0,Exit time: 20
job is Job #4 - Arrival: 8.00, Execution Time: 5.00, Priority: 5, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 28
job is Job #5 - Arrival: 12.00, Execution Time: 2.00, Priority: 4, Queue: 1, Status: exit ,Remaining time: 0,Exit time: 33
```



Conclusion

The influence of various parameters on the performance of scheduling algorithms is evident from the graphical analysis presented above. Notably, as the context switching time increased, CPU utilization demonstrated a decreasing trend from 100% (when context switching time was not factored into calculations) to 63.64% at a context switching time of 3 seconds. Conversely, the impact on waiting time and turnaround time was converse, with these metrics showing an upward trend as context switching time increased.

The decrease in CPU utilization with increasing context switching time can be attributed to the CPU idling during process transitions, resulting in reduced utilization rates. This

phenomenon highlights the critical role of context switching time in system performance, particularly in terms of resource utilization.

While FIFO and Priority-based scheduling exhibited satisfactory performance in managing processes, there is potential for enhancement by integrating additional algorithms such as Shortest Job First (SJF) and Round Robin. By incorporating these algorithms and enabling dynamic switching among them, overall scheduling efficiency can be further improved, leading to optimized system performance and resource utilization.

Overview

The implementation uses several classes to simulate a multilevel queue. The Job class represents jobs with attributes like job number, arrival time, execution time, priority, queue number, and status. The Scheduler class manages job execution based on priority, supporting both preemptive and non-preemptive modes. The PriorityBased class extends a linear queue structure for handling jobs based on their priority. The MultiLevelQueueScheduling class orchestrates the execution of jobs across multiple queues, implementing aging and context switching to manage job priorities effectively. The program processes jobs using various scheduling algorithms like FIFO and priority-based scheduling, calculating metrics such as average turnaround time, average waiting time, CPU utilization, maximum turnaround time, maximum waiting time, and CPU throughput to optimize performance