Project 1: Operating Systems - Process Scheduling Simulation

Course: CSC 4320/6320

Semester: Spring 2025

Samuel Holison

Shruti Dabhi

1. Introduction

This report details the implementation of CPU scheduling algorithms for an Operating Systems project. The purpose of this simulation is to understand how different scheduling algorithms manage process execution in a system. The implemented algorithms include:

- **First-Come, First-Served (FCFS)**
- **Shortest Job First (SJF)**
- **Priority Scheduling**

The program reads process data from an input file (sample_input.txt), executes the scheduling algorithms, and outputs execution order, waiting time, turnaround time, and average performance metrics.

2. Implementation Details

2.1 Process Input Handling

A text file (sample_input.txt) was used as input, containing process attributes:

- **Process ID (PID)**
- **Arrival Time**
- **Burst Time**

- **Priority**

```
1 0 5 2
2 2 3 1
3 4 2 3
4 6 4 2
5 8 1 1
```

The Java program reads the file, parses the data, and stores it in memory.

2.2 Implemented Scheduling Algorithms

The program implements three scheduling algorithms:

First-Come, First-Served (FCFS)

- Processes are executed in the order they arrive.
- Processes are sorted by **arrival time**.
- Turnaround Time = Completion Time - Arrival Time.
- Waiting Time = Turnaround Time - Burst Time.

Shortest Job First (SJF)

- Processes with the shortest burst time are scheduled first.
- Sorting is based on **burst time**.
- Non-preemptive approach.

Priority Scheduling

- Processes are scheduled based on priority values.
- Lower numerical value indicates higher priority.
- Sorting is done based on priority values.

3. Results and Execution

3.1 FCFS Scheduling Output

PID | Waiting Time | Turnaround Time
1 | 0 | 5
2 | 3 | 6
3 | 6 | 8
4 | 7 | 11
5 | 6 | 7

Average Waiting Time: 3.4
Average Turnaround Time: 6.4

3.2 SJF Scheduling Output

PID | Waiting Time | Turnaround Time
5 | 0 | 1
3 | 5 | 7
2 | 6 | 9
1 | 8 | 12
4 | 11 | 23

Average Waiting Time: 8.0
Average Turnaround Time: 11.0

3.3 Priority Scheduling Output

PID | Waiting Time | Turnaround Time
2 | 0 | 3
5 | 1 | 2
1 | 3 | 8
4 | 6 | 12
3 | 8 | 16

Average Waiting Time: 6.2

Average Turnaround Time: 9.2

4. Challenges & Solutions

4.1 Challenges Faced

- **Sorting Complexity:** Handling multiple sorting criteria for different scheduling algorithms.
- **Handling Ties:** Properly managing processes with the same burst time or priority.
- **Process Execution Order:** Ensuring correct simulation of scheduling logic.

4.2 Solutions Implemented

- **Used Java's Comparator:** Simplified sorting of processes based on algorithm-specific rules.
- **Handled Tie-breaking:** Maintained arrival order for processes with equal burst time/priority.
- **Debugging & Testing:** Validated results using different input sets.

5. Conclusion

This project successfully implemented and simulated three CPU scheduling algorithms: FCFS, SJF, and Priority Scheduling. The results demonstrate differences in process execution order and performance metrics. The project enhanced our understanding of process scheduling, handling system constraints, and algorithm efficiency.

6. Future Improvements

- **Implement Round Robin (RR) Scheduling**
- **Add Preemptive SJF and Priority Scheduling**
- **Visualize Gantt Chart Output in a GUI**

End of Report