Exploring CPU Scheduling Algorithms

Juan Gerardo Carvajal Corpus

October 29, 2024

1 Introduction

CPU scheduling is a critical process in operating systems, aimed at determining the order in which processes are executed on the processor. This report presents the implementation and evaluation of different CPU scheduling algorithms, including FCFS (First-Come, First-Served), SJF (Shortest Job First), and Round Robin. Their characteristics, advantages, and disadvantages will be analyzed, as well as their performance in terms of time metrics.

2 Description of Algorithms

2.1 FCFS (First-Come, First-Served)

The FCFS algorithm is the simplest of all. Processes are executed in the order they arrive. However, it can cause the problem of prolonged waiting, known as the *convoy effect*, where a long process can make all shorter processes arriving afterward wait.

2.2 SJF (Shortest Job First)

This algorithm selects the process with the shortest burst time. There are two variants: preemptive and non-preemptive. The preemptive version can interrupt a running process if a new process with a shorter burst time arrives. This can reduce waiting time, but it can also increase implementation complexity.

2.3 Round Robin

The Round Robin algorithm assigns a fixed time interval (quantum) to each process. If a process does not finish within its quantum, it is interrupted and placed at the end of the queue. This method is ideal for time-sharing systems and provides a balance between efficiency and quick response.

2.4 Priority Scheduling

This algorithm assigns priorities to processes and selects the highest priority one for execution. Like SJF, it can be preemptive or non-preemptive.

2.5 Multilevel Queue Scheduling

This approach combines multiple algorithms and uses several queues with different priorities. Each queue can have its own scheduling algorithm, allowing for more flexible process management.

3 Simulation Results

The results of the simulation of the implemented algorithms are presented below.

3.1 Performance Metrics

The following metrics have been measured for each algorithm:
- **Average Turnaround Time** - **Average Waiting Time** - **CPU Utilization** - **Throughput**

The obtained results are shown below:

Algorithm	Average Waiting Time	Average Turnaround Time
FCFS	8.6	12.8
SJF (Non-Preemptive)	4.0	8.2
Round Robin	12.6	16.8

Table 1: Performance Metrics of the Algorithms

3.2 Graphs

The following figure illustrates the differences in average waiting time and average turnaround time for each scheduling algorithm.

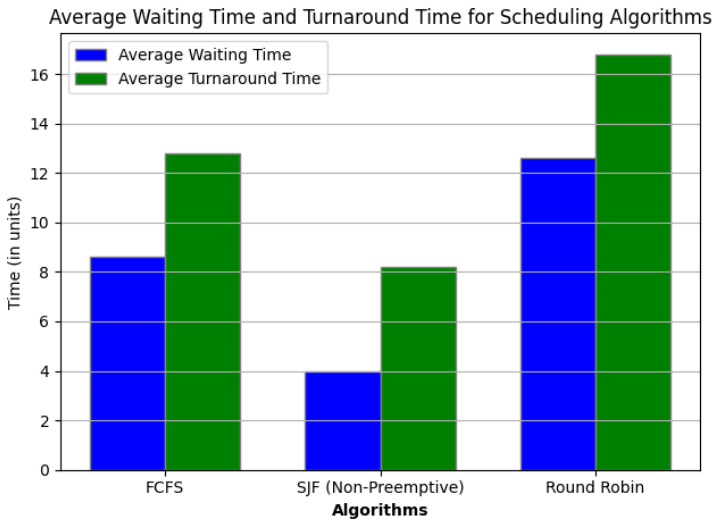

Figure 1: Comparison of Average Waiting Time and Turnaround Time

4 Comparative Analysis

Based on the obtained results, the SJF (non-preemptive) algorithm showed the best performance in terms of waiting time and turnaround time, indicating it is more efficient in situations where short processes are common. However, FCFS is easier to implement. Round Robin, while providing faster response times, may not be the most efficient in terms of average waiting time.

5 Optional Reflection

Considering the results, the non-preemptive SJF algorithm performed best in this simulation. However, in environments where arrival times are highly variable, an algorithm like Round Robin may be more appropriate.

6 Conclusions

CPU scheduling is fundamental to the performance of an operating system. Each algorithm has its advantages and disadvantages, and the choice of the right algorithm depends on the nature of the processes being managed.