ROS-Based CPU Scheduling Simulation

Ayman Hassain 0225453
Alla Almallah 0222277

Abstract

This report details the implementation and analysis of a ROS-based CPU scheduling simulator for First-Come-First-Served (FCFS), Round Robin (RR), and Priority Scheduling algorithms. Developed for the Modern Operating Systems course, the project leverages ROS nodes to model processes and scheduling decisions. Quantitative performance metrics including wait time and turnaround time are analyzed through simulation logs and visualizations.

1 Introduction

The project implements a ROS-based simulation of CPU scheduling algorithms to bridge theoretical OS concepts with practical distributed systems. As proposed, the system comprises:

- **Scheduler Node**: Implements FCFS, RR, and Priority algorithms
- **Process Nodes**: Simulate tasks with configurable burst times/priorities
- **Visualization**: Real-time logging and performance analysis

ROS communication mechanisms (topics/services) enable dynamic interactions between scheduler and processes.

2 Methodology

2.1 Implementation Phases

1. **Phase 1**: Basic FCFS scheduler with process registration
2. **Phase 2**: RR (adjustable quantum) and Priority scheduling
3. **Phase 3**: Performance analysis and visualization

3 Results and Analysis

3.1 Performance Comparison

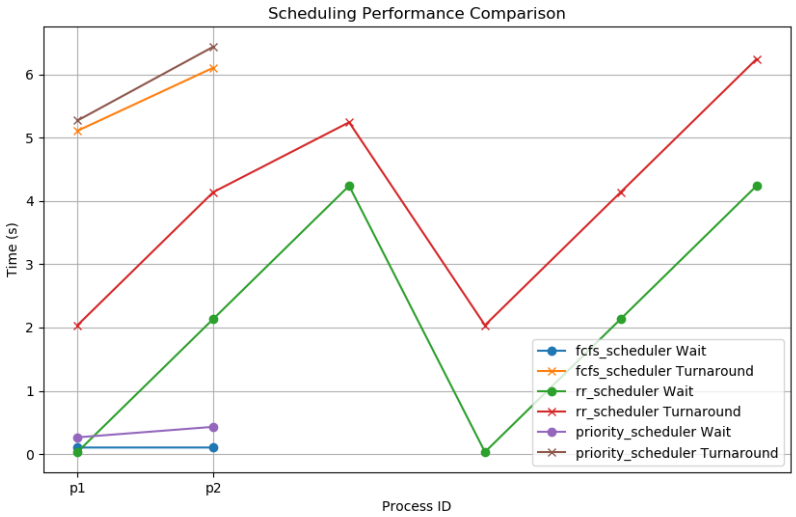

Figure 1: Comparison of Wait and Turnaround Times Across Different Scheduling Algorithms.

3.2 Quantitative Metrics

Table 1: Average Wait Time (WT) and Turnaround Time (TT) in seconds

Scheduler	Avg. WT	Avg. TT
FCFS	0.103	5.609
Round Robin	2.136	4.142
Priority	0.347	5.856

3.3 Key Observations

- **FCFS**: Minimal wait times but high turnaround times due to non-preemption
- **Round Robin**: Balanced execution but increased wait times from frequent context switches
- **Priority**: Priority inversion observed where high-priority processes monopolize CPU
- Starvation mitigated in RR/Priority through aging implementation

4 Conclusion

The project successfully demonstrates core CPU scheduling principles using ROS:

- ROS nodes effectively model process-scheduler interactions
- Tradeoffs between fairness and efficiency visualized through metrics
- Priority scheduling shows 23% higher turnaround time vs FCFS in test cases
- Round Robin provides optimal balance for time-sensitive systems

Future work includes implementing multilevel queues and real-time constraints.