011

Scheduling

Operating Systems

Lab011 Scheduling
(CPU Scheduling Algorithms)

Objective

Students will implement a simulation to compare four CPU scheduling algorithms—First-In-First-Out (FIFO), Round Robin (RR), Shortest Job First (SJF), and Shortest Remaining Time First (SRTF). The simulation will generate random CPU bursts, a random number of threads, and random arrival times, then calculate waiting times, turnaround times, and their averages for each algorithm, running all algorithms on the same dataset to enable direct comparison of performance metrics.

Scenario: Smart Parking Lot System

Imagine a single-core CPU in an operating system tasked with executing multiple processes (threads). Each process has a randomly determined CPU burst time (the amount of time it needs to run) and an arrival time (when it enters the ready queue). The OS must schedule these processes using different algorithms: FIFO (first-come, first-served), Round Robin (time-sliced), SJF (shortest burst first), and SRTF (preemptive shortest remaining time). This models real-world CPU scheduling in operating systems, where efficiency in managing process execution impacts system performance.

Assignment Tasks

1. **Simulate Process Threads:**
   o Generate a random number of threads (e.g., between 5 and 15) to represent processes.
   o Assign each thread a random CPU burst time (e.g., 1–10 seconds) and a random arrival time (e.g., 0–100 seconds).

2. **Implement Scheduling Algorithms:**
   o Simulate the following algorithms using threads:
     ▪ FIFO: Processes run in order of arrival, completing fully before the next starts.
     ▪ Round Robin: Processes run in order of arrival with a fixed time quantum (e.g., 2 seconds), cycling through the queue.
     ▪ SJF: Non-preemptive, selects the process with the shortest CPU burst from those that have arrived.

- SRTF: Preemptive, selects the process with the shortest remaining time, preempting if a shorter job arrives.

3. **Process Behavior:**
   - Each process thread must:
     - Arrive: Log its arrival with its assigned arrival time.
     - Start: Log when it begins execution.
     - Complete: Simulate CPU burst (e.g., via sleep) and log completion.

4. **Statistics Tracking:**
   - For each algorithm, calculate:
     - Waiting Time: Time from arrival to start of execution (or total time waiting in RR/SRTF).
     - Turnaround Time: Time from arrival to completion.
     - Averages: Average waiting time and average turnaround time across all threads.
   - Run all four algorithms on the same set of random bursts, thread counts, and arrival times for fair comparison.

5. **Deliverables:**
   - Source code files
   - Sample output showing process actions and statistics for each algorithm.

Dataset: 6 threads, Burst Times: [4, 2, 6, 3, 1, 5], Arrival Times: [0, 1, 2, 3, 4, 5]

--- FIFO Scheduling ---
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Arrived
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Started
[Fri Mar 21 15:00:04 2025] Process 0 (Burst 4): Completed
[Fri Mar 21 15:00:04 2025] Process 1 (Burst 2): Arrived at 1, Started (waited 3.00 seconds)
[Fri Mar 21 15:00:06 2025] Process 1 (Burst 2): Completed
[Fri Mar 21 15:00:06 2025] Process 2 (Burst 6): Arrived at 2, Started (waited 4.00 seconds)
...
Waiting Times: [0.00, 3.00, 4.00, 7.00, 9.00, 11.00]
Avg Waiting Time: 5.67 seconds
Turnaround Times: [4.00, 5.00, 10.00, 10.00, 10.00, 16.00]
Avg Turnaround Time: 9.17 seconds

--- Round Robin Scheduling (Quantum 2) ---
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Arrived
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Started
[Fri Mar 21 15:00:02 2025] Process 0 (Burst 2 remaining): Preempted
[Fri Mar 21 15:00:02 2025] Process 1 (Burst 2): Arrived at 1, Started (waited 1.00 seconds)
...

Avg Waiting Time: 4.33 seconds
Avg Turnaround Time: 7.83 seconds

--- SJF Scheduling ---
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Arrived
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Started
[Fri Mar 21 15:00:04 2025] Process 0 (Burst 4): Completed
[Fri Mar 21 15:00:04 2025] Process 4 (Burst 1): Arrived at 4, Started (waited 0.00 seconds)
...
Avg Waiting Time: 3.50 seconds
Avg Turnaround Time: 6.83 seconds

--- SRTF Scheduling ---
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Arrived
[Fri Mar 21 15:00:00 2025] Process 0 (Burst 4): Started
[Fri Mar 21 15:00:01 2025] Process 1 (Burst 2): Arrived at 1, Preempted 0 (remaining 3)
[Fri Mar 21 15:00:03 2025] Process 1 (Burst 2): Completed
...
Avg Waiting Time: 2.83 seconds
Avg Turnaround Time: 6.33 seconds

Extra Points

- Implement a graphical representation of the scheduling timeline (e.g., Gantt chart in ASCII or GUI).
- And from previous labs, this time you can add points by implementing Lab001 and Lab002 to run on BeagleBone (Yea is not about Scheduling, but we are preparing for the project)