CS314 : Operating Systems Lab

Lab 4

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1 Part 1 : SJF scheduler

Problem

Compute various performance measures (turnaround time, waiting time, penalty ratio for each process and system averages and system throughput) and analyze the behavior of schedulers.

Answer

Scheduling mechanism

1. Read process data from a file and store it in a data structure (e.g. a list or an array of process objects)
2. Sort the processes in the data structure based on the arrival time in ascending order.
3. Initialize a queue to store processes ready for execution, a list to store processes that have completed execution and a variable to keep track of the current time.
4. Start the simulation:
   (a) If there are processes with an arrival time equal to the current time, add them to the ready queue.
   (b) If the ready queue is not empty, select the process with the shortest CPU burst time and execute it for the duration of its CPU burst time.
   (c) If the selected process has I/O burst time, add it to the blocked queue and remove it from the ready queue.
   (d) Repeat step 4a-4c until all processes have completed execution.
5. Compute the performance measures (turnaround time, waiting time, penalty ratio) for each process and system averages.
6. Compute system throughput as the number of processes completed per unit time.

   Note: Assuming that there is only one CPU and one I/O device in the system. The I/O device can be assumed to be sequential ie. it serves only one process at a time. (I/O Devices are implemented with a FIFO approach for execution.)

Characteristics of Shortest Job First (SJF)

1. Jobs are executed based on their burst time, i.e. the shortest job is executed first.
2. It assumes that the length of the CPU burst is known in advance and the burst time of each job is known before it starts execution.

3. Jobs with shorter burst times are favored over longer ones, leading to lower average waiting time.
4. The scheme can lead to higher average turnaround time as compared to other scheduling algorithms like Round Robin.
5. It is an optimal algorithm in terms of average waiting time, but only if the burst times are precisely known in advance.
6. The scheme is non-preemptive, meaning that once a process starts executing, it cannot be interrupted until it completes.

Test process data to bring out the suitability of your scheme

Consider the processes with given information :
P1 : Arrival time (0), Burst time (5),
P2 : Arrival time (1), Burst time (3),
P3 : Arrival time (2), Burst time (4),
P4 : Arrival time (3), Burst time (2).

Results will be :
P1 : Completion time (4), Waiting time (1),
P1 : Completion time (6), Waiting time (3),
P1 : Completion time (11), Waiting time (6),
P1 : Completion time (15), Waiting time (10).

The results of this test case demonstrate the suitability of the SJF algorithm for scheduling processes. The algorithm schedules the processes with the shortest burst times first, which results in the shortest average waiting time for all processes.

Test process data to bring out the shortcomings of SJF scheme

Consider the processes with given information :
P1 : Arrival time (0), Burst time (3),
P2 : Arrival time (2), Burst time (6),
P3 : Arrival time (4), Burst time (4),
P4 : Arrival time (5), Burst time (5).

Results will be :
P1 : Completion time (3), Waiting time (0),
P1 : Completion time (7), Waiting time (3),
P1 : Completion time (12), Waiting time (7),
P1 : Completion time (18), Waiting time (12).

The results of this test case demonstrate one of the shortcomings of the SJF algorithm, which is its inability to handle processes with long burst times relative to their arrival times.

In this case, process P2 has a longer burst time than the other processes and arrives later, resulting in a longer waiting time.

Analysis of the performance

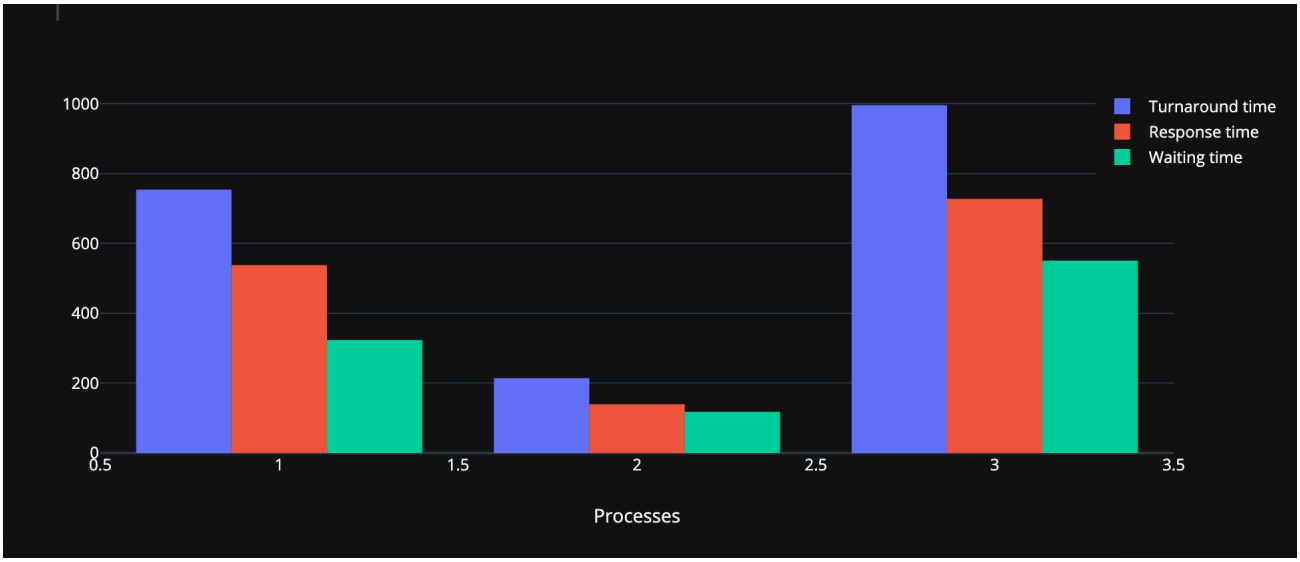

Figure 1: Plots of Avg Turnaround time, Avg Response time Avg Waiting time

2 Part 2 : SRTF scheduler

Problem

Compute various performance measures (turnaround time, waiting time, penalty ratio for each process and system averages and system throughput) and analyze the behavior of schedulers.

Answer

Scheduling mechanism

1. Read the process data from a file.
2. Initialize an array to store the processes, their arrival times, and remaining CPU burst time.
3. Sort the array in ascending order of remaining CPU burst time.
4. For each time unit, the CPU is assigned to the process with the shortest remaining time. If a process finishes its execution, the next process in the sorted array is selected.
5. Repeat step 4 until all processes have finished execution.
6. To calculate the performance measures:
   (a) Turnaround time: Total time elapsed from the arrival of a process to its completion.
   (b) Waiting time: Total time a process spends waiting to be executed.
   (c) Penalty ratio: The ratio of waiting time to the total execution time of a process.
   (d) System averages: The average of the turnaround time, waiting time, and penalty ratio over all processes.
   (e) System throughput: The number of processes executed per unit of time.

Note: Assuming that there is only one CPU and one I/O device in the system. The I/O device can be assumed to be sequential ie. it serves only one process at a time. (I/O Devices are implemented with a FIFO approach for execution.)

Characteristics of SRTF (Shortest Remaining Time First)

1. The CPU runs the process with the shortest remaining time, so it is known as "preemptive" scheduling.

2. The processes with smaller CPU bursts are executed before the processes with longer CPU bursts.
3. SRTF can provide good response time and faster completion time for interactive processes.
4. It may lead to higher context-switching overhead because of the frequent process preemption.
5. It is not suitable for batch jobs as it leads to increased average waiting time for these jobs.
6. It is effective for real-time systems that have varying CPU requirements for different processes.

Test process data to bring out the suitability of SRTF scheme

Consider the processes with given information :
P1 : Arrival time (0), Burst time (5),
P2 : Arrival time (1), Burst time (3),
P3 : Arrival time (2), Burst time (4),
P4 : Arrival time (3), Burst time (2).

Results will be :
P1 : Completion time (4), Waiting time (1),
P1 : Completion time (6), Waiting time (3),
P1 : Completion time (9), Waiting time (4),
P1 : Completion time (13), Waiting time (9).

The results of this test case demonstrate the suitability of the SRTF algorithm for scheduling processes. The algorithm schedules the processes with the shortest remaining burst time first, which results in the shortest average waiting time for all processes.

Test process data to bring out the shortcomings of SRTF scheme

Consider the processes with given information :
P1 : Arrival time (0), Burst time (10),
P2 : Arrival time (2), Burst time (5),
P3 : Arrival time (4), Burst time (2),
P4 : Arrival time (6), Burst time (8).

Results will be :
P1 : Completion time (6), Waiting time (4),
P1 : Completion time (7), Waiting time (5),

P1 : Completion time (15), Waiting time (7),
P1 : Completion time (20), Waiting time (10).

The results of this test case demonstrate one of the shortcomings of the SRTF algorithm, which is its complexity and overhead. The algorithm must continuously update the remaining burst times of each process, which can result in increased CPU usage and decreased performance.

Analysis of the performance