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CSE 4300 – Design Document

Objective

For this group project, we've decided to create a CPU scheduling simulator using C. The project incorporates 4 types of CPU scheduling methods on a single core processor, and calculates results for individual processes as well as averages, while each process has custom properties set by the user.

Design

Overall Design

The project is made into one file. Each scheduling simulation method runs as a function in the file. The processes are designed as a structured object called Process, with a lot of int variables that determine arrival time, burst, remaining time, waiting and turnaround time, and completion time stamps. It also has Boolean variables that determine if the process is in queue for Round Robin, or if the whole process has been completed.

Interface

On execution, the user should submit an argument to select what type of scheduling method they would like to simulate. The user can select *s* for SJF simulation, *f* for SRTF simulation, *r* for round robin simulation, or *p* for priority queue simulation. Once a selection is made, the user is then prompted to select how many processes they would like to create. Certain selections (such as Round Robin) may have a maximum number of processes they can handle, and the software will notify the user of that. Just after the user makes a selection of how many processes they would like to run, they are then prompted to enter arrival and burst times for each process. If the user selects priority, they are also prompted to pick the process's priority level on a scale of 1 to 5, with 1 being the highest priority.

Shortest Job First (SJF)

The SJF function incorporates two counters, one for the time period and the other for completed jobs. The primary function of SJF is to find and complete the shortest available job first. If a large job comes in before a small job and the CPU begins to work on the small job, it will continue on the large job until it is completed; however, if two of them arrive at the same time, one large and one small, the CPU will pick the smaller one to complete. It

sorts jobs in the shortest burst time first, and arrival time second. Upon completion of all jobs, the function will display results for each process, as well as average turnaround and wait times.

Shortest Remaining Time to Finish (SRTF)

Similar to SJF, SRTF incorporates a preemptive approach to its scheduling procedure. It does this by running at concrete time intervals and constantly checking if another job with a shorter remaining finish time has arrived. If a large job is in process and a smaller one arrives, the CPU will process the shorter job before returning to the larger one. Upon completion, each process will display its individual results and the function will produce its average figures.

Round Robin

The Round Robin approach incorporates a running queue of waiting jobs. At the start, a user inputs a time interval setting for the simulation, and it breaks CPU time into time blocks of that interval. If a job is completed in the middle of its assigned CPU time, it moves to the next in the queue and the process gets removed. The queue also handles arrivals and puts them into the queue as they come in. Upon completion of all processes, it will display results and average figures for turnaround and wait times.

Priority Queue

For the Priority Queue, it runs similar to the SJF scheduler in the sense that it is non-preemptive. Upon creating processes, the simulator also asks for priority assignments for each one, ranging from 1 – 5 where 1 is the highest priority. The scheduler will then perform jobs based on arrival of the jobs and the priority. If two jobs come in simultaneously, the one with the highest priority will be processed first. And just like the rest of the schedule simulations, it will display results and average figures.

Results

Test Case – 4 Processes

Process 1: Arrival: 0, Burst: 2 (Priority case: 4)

Process 2: Arrival: 2, Burst: 3 (Priority case: 3)

Process 3: Arrival: 4, Burst: 2 (Priority case: 2)

Process 4: Arrival: 1, Burst: 5 (Priority case: 1)

SJF

```
eli@Elis-MacBook-Air EPMJCSE4300-1 % ./cpusim s
Enter the number of processes: 4

Enter process details (Arrival and Burst Times (and )):
Process 1
Arrival Time: 0

Burst Time: 2
Process 2
Arrival Time: 2

Burst Time: 3
Process 3
Arrival Time: 4

Burst Time: 2
Process 4
Arrival Time: 1

Burst Time: 5

--- SJF Results ---
==================================
Process ID: 1
Arrival Time: 0 Burst Time: 2
Completion Time: 2     Turnaround Time: 2     Wait Time: 0
==================================
Process ID: 2
Arrival Time: 2 Burst Time: 3
Completion Time: 5     Turnaround Time: 3     Wait Time: 0
==================================
Process ID: 3
Arrival Time: 4 Burst Time: 2
Completion Time: 7     Turnaround Time: 3     Wait Time: 1
==================================
Process ID: 4
Arrival Time: 1 Burst Time: 5
Completion Time: 12     Turnaround Time: 11     Wait Time: 6
==================================
Average Turnaround Time: 4.75
Average Wait Time: 1.75
```

SRTF

```
eli@Elis-MacBook-Air EPMJCSE4300-1 % ./cpusim f
 CPU Process Scheduler Simulator
You have selected: Shortest Remaining Time to Finish (SRTF)
Enter the number of processes: 4

Enter process details (Arrival and Burst Times (and )):
Process 1
Arrival Time: 0

Burst Time: 2
Process 2
Arrival Time: 2

Burst Time: 3
Process 3
Arrival Time: 4

Burst Time: 2
Process 4
Arrival Time: 1

Burst Time: 5

--- SRTF Results ---
===================================
Process ID: 1
Arrival Time: 0 Burst Time: 2
Completion Time: 2      Turnaround Time: 2      Wait Time: 0
===================================
Process ID: 2
Arrival Time: 2 Burst Time: 3
Completion Time: 5      Turnaround Time: 3      Wait Time: 0
===================================
Process ID: 3
Arrival Time: 4 Burst Time: 2
Completion Time: 7      Turnaround Time: 3      Wait Time: 1
===================================
Process ID: 4
Arrival Time: 1 Burst Time: 5
Completion Time: 12     Turnaround Time: 11     Wait Time: 6
===================================
Average Turnaround Time: 4.75
Average Wait Time: 1.75
```

Round Robin – 2 time units

```
● eli@Elis-MacBook-Air EPMJCSE4300-1 % ./cpusim r
  CPU Process Scheduler Simulator
 You have selected: Round Robin
 (Note: You can only have a maximum of 100 processes to simulate
 Enter the number of processes: 4

 Enter process details (Arrival and Burst Times (and )):
 Process 1
 Arrival Time: 0

 Burst Time: 2
 Process 2
 Arrival Time: 2

 Burst Time: 3
 Process 3
 Arrival Time: 4

 Burst Time: 2
 Process 4
 Arrival Time: 1

 Burst Time: 5
 Please enter desired time interval: 2

 --- Round Robin Results ---
 =================================
 Process ID: 1
 Arrival Time: 0 Burst Time: 2
 Completion Time: 2      Turnaround Time: 2      Wait Time: 0
 =================================
 Process ID: 2
 Arrival Time: 2 Burst Time: 3
 Completion Time: 9      Turnaround Time: 7      Wait Time: 4
 =================================
 Process ID: 3
 Arrival Time: 4 Burst Time: 2
 Completion Time: 8      Turnaround Time: 4      Wait Time: 2
 =================================
 Process ID: 4
 Arrival Time: 1 Burst Time: 5
 Completion Time: 12     Turnaround Time: 11     Wait Time: 6
 =================================
 Average Turnaround Time: 6.00
 Average Wait Time: 3.00
```

Priority

```
eli@Elis-MacBook-Air EPMJCSE4300-1 % ./cpusim p
 CPU Process Scheduler Simulator
You have selected: Priority
Enter the number of processes: 4

Enter process details (Arrival and Burst Times (and )):
Process 1
Arrival Time: 0

Burst Time: 2

 Select priority 1-5 with 1 being highest: 4
Process 2
Arrival Time: 2

Burst Time: 3

 Select priority 1-5 with 1 being highest: 3
Process 3
Arrival Time: 4

Burst Time: 2

 Select priority 1-5 with 1 being highest: 2
Process 4
Arrival Time: 1

Burst Time: 5

 Select priority 1-5 with 1 being highest: 1

--- Priority Scheduling Results ---
================================
Process ID: 1
Arrival Time: 0 Burst Time: 2
Completion Time: 2      Turnaround Time: 2      Wait Time: 0
================================
Process ID: 2
Arrival Time: 2 Burst Time: 3
Completion Time: 12     Turnaround Time: 10     Wait Time: 7
================================
Process ID: 3
Arrival Time: 4 Burst Time: 2
Completion Time: 9      Turnaround Time: 5      Wait Time: 3
================================
Process ID: 4
Arrival Time: 1 Burst Time: 5
Completion Time: 7      Turnaround Time: 6      Wait Time: 1
================================
Average Turnaround Time: 5.75
Average Wait Time: 2.75
```