Program 3 {modified January 30th} 40 Points

Due: February 6, 2008 at 11:59 p.m.

Event-Driven Simulation of a Processor Scheduling Queue in C

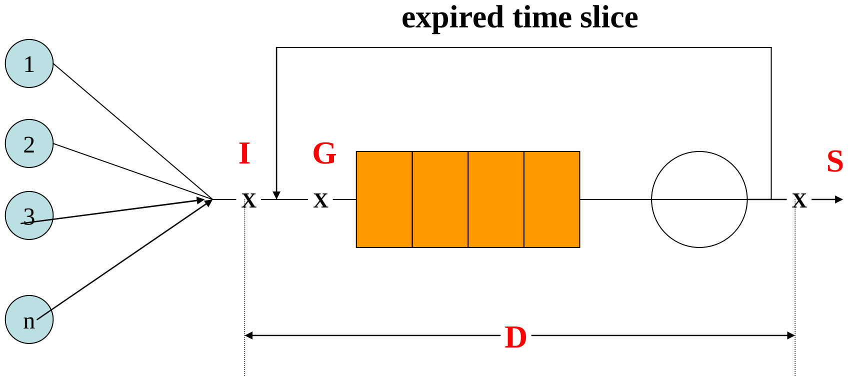
This assignment focuses on the use of data structures built in C with ***structures.*** One specific goal of this assignment is to give the students practice with C pointers.

Additionally, completing this assignment will require understanding the basics of event-driven simulation which is used prominently in the performance analysis of computer systems and computer networks. The primary objective of this assignment is to use event-driven simulation to compare the performance of a FCFS (First Come First Served) scheduler against a **RR (Round Robin) scheduler. The preemptive RR scheduler is now only for 6 extra credits!** The simulation topology consists of n processes arriving at the CPU scheduler for service (e.g. see the RR scheduler figure below). Assume queue sizes are unbounded in this program.

An FCFS scheduler serves customers in the order of their arrival to the scheduler queue. Each process runs on the CPU within interruption.

Developed for multiprogrammed, time-sharing operating systems, a RR scheduler allocates up to a time slice (e.g., 100 milliseconds) of CPU service for a time slice to the process at the front of the scheduler queue. In simple RR, arriving customers are enqueued at the back of the scheduler queue. If the process does not finish within a time slice, as indicated in the figure, the process returns to the back of the scheduler queue to await its turn for another time slice.

Round Robin Queue



Preemptive RR is a small variant of RR designed to give priority to very short jobs. Upon the arrival of a new process at the scheduler queue, the currently running process is preempted in mid time slice. The newly arriving process then receives one initial time slice before being enqueued at the back of the scheduler queue. Once the preempting process completes, the preempted process is resumed to receive the remainder of its preempted time slice of service.

Assignment Inputs

Your program begins by reading in two command line arguments source and time-slice to indicate respectively, the number of source processes to simulate and the time slice to be used in the preemptive RR simulation.

For this simulator all time will be represented in 100 milliseconds units. Thus, a command line time-slice of 2 indicates a 200 millisecond time slice. Moreover 100 milliseconds is the smallest granularity of the simulator.

The program reads source lines of input from a script file (in ASCII) where each line of input contains:

```
process-id  arrival_time  cpu_time
```

where arrival_time and cpu_time are in simulation units (i.e. 100 milliseconds)

For example, the input line:

```
2166 30 205
```

indicates that process **2166** arrives at the scheduler at simulated time **3** seconds needing **20.5** seconds of CPU service.

Since the input script will drive both the simulation of FCFS and preemptive RR, your program should first store all the input script in memory.

Main Assignment

The assignment is to use an event list mechanism to simulate the performance of the customer script for both FCFS and **RR processor** scheduling. Your final output consists of two files annotating the simulation of both queuing mechanism. Namely, output to a file a time log that shows the simulated arrival time and completion time of all processes in simulated chronological order. The end of each file should also record the mean and variance of customer response time for that queuing mechanism.

The Event List

Event-driven simulation is controlled by a linked list known as the event list. Future events are inserted into the event list in chronological order with the next event in simulated time at the front of the list. In this assignment, the event list will hold two event types, process arrivals and the completion time of the process currently running on the CPU. The simulation runs in a continuous loop processing the next event at the front of the event list until the event list is empty. Processing an arrival event involves taking the entry off the event list and sending the process to the scheduler queue. Processing a CPU completion event involves first determining whether the process still requires more CPU time at the end of the time slice. If the process has completed, process statistics are calculated and recorded before the process is terminated. If the process still needs more CPU time the process is enqueued at the back of the scheduler queue. In either case, taking the completion event off the event list triggers a call to the processor scheduler. If there is a process at the front of the scheduler, it is taken off the front of the scheduler queue and a new event with the appropriate completion time is inserted into the event list.

The FCFS Scheduler

The FCFS scheduler is implemented as a queue data structure with arriving processes enqueued at the back of the queue.

The Preemptive RR Scheduler

The preemptive RR scheduler is also implemented as a queue. When a new process is sent to the RR queue, a check needs to be made to determine if another process is running. An indication of a currently running process implies taking its completion event off the event list and putting the interrupted process back at the front of the scheduler queue. In either case, a new completion event is added to the event list for the newly arriving process with the appropriate completion time.

What to turn in for Program 3

An official test file will be made available a few days before the due date. Turn in your assignment using the ***turnin*** program on the CCC machines. You should turn in a tarred file that includes your source code, a make file and a README file. The README file should provide any information to help the TA or SA test your program for grading purpose.