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159.201 Algorithms & Data Structures
S1 2015

Assignment 3

Consider a router with N ports. There are 4 important sources of delays, ***transmission, nodal processing, propagation and queueing***. The first 3 forms of delay depend on the hardware and low-level protocols. However, the ***queueing delay*** only depends on the *traffic pattern*, i.e., on how busy the network is and what type of traffic is involved. We are going to model our router as per Fig. 1. Every packet has a specific port to go out (e.g., blue for port 1, orange for port 2 etc).

Note that there are *input queues* and *output queues*, and that the bottleneck is defined by the transmission and propagation delays of the links of the router. Transmission, propagation and nodal processing are fixed for the router. The throughput of each link is 1Gbit/sec, and the nodal processing is so small that it can be disregarded (in reality it is going to take the time to read the destination of the packet). Note also that the router has a shared bus between the input and output ports. This means that only one packet at a time can leave the input queue and be copied to the appropriate output queue.

The simulation works by moving packets from input queues (start with 1, then 2 … N, then go back to 1) to output queues at every clock cycle. You need to use `Join()`, `Leave()` and `Front()` in the appropriate queues. After moving a packet, a global array variable CongestionSize[N] should keep the state of all output ports. These values should be updated only when the sum of all packets is larger than the current sum of all elements of CongestionSize[N]. At the end of the simulation, when all input ports are empty, CongestionSize[N] will contain the information to be printed.

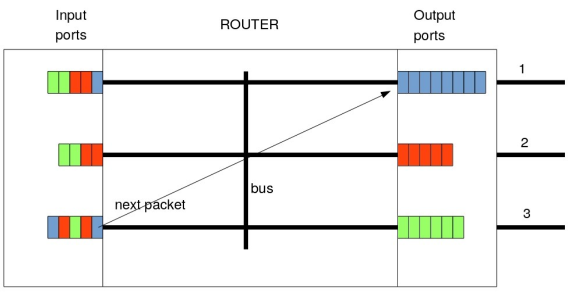

Figure 1: Status of the router when the router is at its maximum congestion.

Your task is to complete the simulation code, creating the appropriate queues and calculating what was the maximum congestion (in number of packets) in all queues at some point in the simulation. Your program should print N lines with the ***state of each output queue*** when the congestion was at its peak. For example, suppose that you have a router with N=3. After running the simulation, the output should like this (suppose that the drawing above represents the maximum congestion):

```
output port 1: 3 packets
output port 2: 6 packets
output port 3: 5 packets
```

The input queues are filled at the start of the simulation, reading the various inputs from a text file at once. The format of the file contains information about how many packets, packet sizes etc. Please, use the start-up code given on Stream and stick to the input format given in the examples, as well as the output format given above. The maximum number of ports used in the simulation will be **N=128**, therefore you can use a static CongestionSize[N] array. However, queues should only be created when needed. Due to the size of the queues, you must use queues implemented with ***linked-lists*** (please, do ***not*** use STL in this assignment).

Use our virtual machine to test your submissions (host name **vm000296**). The input/output requirements are essential, please follow them carefully to avoid losing marks. Spaces matter and text is case sensitive.

After you are satisfied with the performance of your code as tested in the virtual machine, submit a **one source file** code on Stream by **Friday 20th of March 2015.** Your **name** and **ID number** must appear **on top of the file as comments.** If you are working in a group, then ***all*** names and IDs must appear on top of the file as comments, but you still need to **submit individually** in both the virtual machine and Stream.