Traffic Shaper

Computer Science Society
Programming Contest
Fall 2007

In this problem, we simulate sending outgoing payloads of bytes through a network with a given rate capacity. Each outgoing payload is part of a network service identified by a destination port number. In order to reserve capacity for specific network services and leave remaining capacity for all other services, we allow outgoing rate reservations based on a payload's destination port number. For each rate-reserved service, there is a separate first-in first-out queue of outgoing payloads, from which bytes can be dequeued and sent at a reserved rate. For all other services, there is one first-in first-out queue of outgoing payloads, from which bytes are dequeued and sent at the remaining rate capacity.

Input Format

The first line of input contains a positive number R, which is the total rate in bytes/second at which outgoing payload bytes can be sent. Subsequent lines of input contain two positive numbers—a destination port number p and its corresponding rate reservation r—indicating that outgoing payload bytes destined for port p can be sent at a rate of r bytes/second. An input line containing the string `"---"` follows the rate reservation input lines. The remaining lines of input each contain three positive numbers—t, p and b—describing an outgoing payload enqueued for outgoing delivery at time t (seconds after simulation startup), destined for port p, consisting of b bytes. The outgoing payloads are implicitly numbered $1, 2, 3, \ldots$ and are given in the order they are enqueued for outgoing delivery.

Output Format

Simulate sending the outgoing payloads described in the input, subject to the rate reservations given in the input. A payload won't start being sent before the time it's enqueued for outgoing delivery, and may start being sent later if there are payloads in the same queue ahead of it. The number of seconds it takes for a payload to be completely sent is its size in bytes divided by the rate limit that applies to its queue. The simulation should monitor the state of the outgoing payload queues every second after startup. Whenever the simulation sees that a payload is completely sent, report the payload number, the destination port and the time (in whole seconds after simulation startup).

Input Sample

```
10000
22 100
21 500
80 3000
---
3 22 200
5 21 8200
10 21 1800
10 443 10000
```

Output Sample

```
payload 1 port 22 done at 5
payload 4 port 443 done at 12
payload 2 port 21 done at 22
payload 3 port 21 done at 25
```