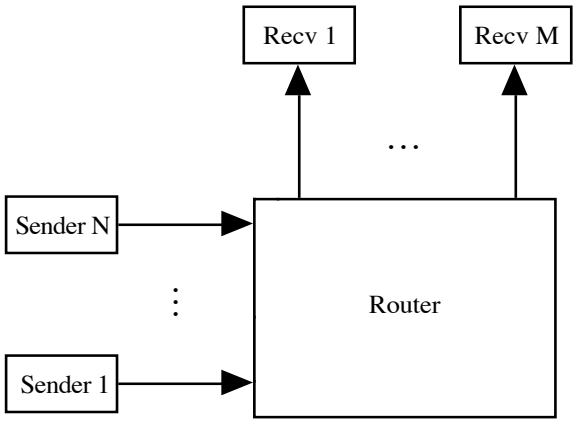
CS 580 Specification of Software Systems

Homework 09: Router specification.

A router is a complex device that relies on a combination of custom hardware and software to accomplish a relatively simple task, robust transmission of messages from senders to receivers. Much of the complexity and costs are associated with the need to achieve high degrees of reliability and throughput. A correct and precise specification of the router is an important first step towards its proper design.

Consider a router that connects N senders with M receivers.



Messages arrive on the input lines and are passed on the output lines based on their stated destination. Each message is divided into a finite set of fixed-size packets and consists of a header packet that specifies the intended destination, one or more body packets, and a tail packet.

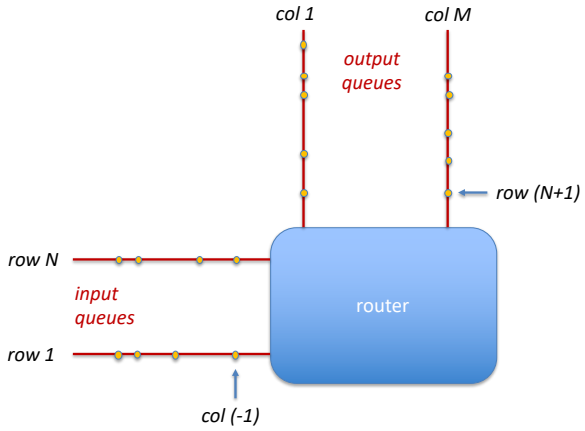
Informally, the requirements for message processing by the router can be stated as follows:

R1	Packets in transit cannot be modified in any way.
R2	Packet ordering within a message must be preserved.
R3	Messages from the same source going to the same destination must not be reordered (at the receiver).
R4	Messages from different sources going to the same destination must not be interleaved (at the receiver).
R5	Each message that is sent must eventually be delivered to the intended receiver.

Your assignment is to generate a formal specification for the router.

Hints:

- Abstract the senders and the receivers as infinite input and output queues represented as arrays.
- Let the input queues contain all the packets that must be sent while the output queues and the router are empty.
- Each packet in the input and output environments resides at some distinct location (row, column).



- Each packet consists of a tag (h, b, t —header, body, and tail) and a value; the value of the header consists of three fields, unique message identifier, source, and destination; the value in the tail is simply empty. Functions can be defined to access the fields of some packet α:
  - $\alpha.\tau$ returns the packet type, i.e., tag
  - $\alpha.v$ (the actual contents of the packet aside from the tag)
  - $\alpha.src$ source in the header packet, undefined otherwise
  - $\alpha.dest$ destination in the header packet, undefined otherwise
- Augment each packet with extra fields (like auxiliary variables) that cannot be used by the router, but can simplify the specification. For instance, each augmented packet can have a source and destination associated with it.
- Finally, you may want to make each packet unique for ease of reference.