EXERCISE 1: The IP protocol running on an Internet Host receives as input (from the subnetwork on top of which the IP protocol operates) packets with a Poissonian rate λ. Packets are then reassembled into datagrams, which are forwarded to the TCP at an exponential rate μ. Each datagram is made up of a random number of packets n {0,1,2,…}. Assume that the reassembling process can be modeled by means of the discrete state, continuous time Markov chain reported in Figure 1.1.

1. Give an interpretation of the transitions {n=1,2,3,….} -> {R}.
2. Write down the global balance equations for states {n=0,1,2,3,….} and express, p_R and p_n (n>=1) as a function of p_0.
3. Using the equations derived in point 2, determine the stability region of the system and calculate, in that region, the steady state probabilities.
4. Calculate the probability mass function of the number of packets in the system observed by the *arriving tagged packet* and by the *random observer*.
5. Calculate the probability P_L that an arriving packet will be discarded and the rate $\lambda_{acc}^{(packet)}$at which packets are accepted in the system. Express $\lambda_{acc}^{(packet)}$ as a function of λ and P_L.
6. Calculate the average number $E[N]$ of packets in the system.

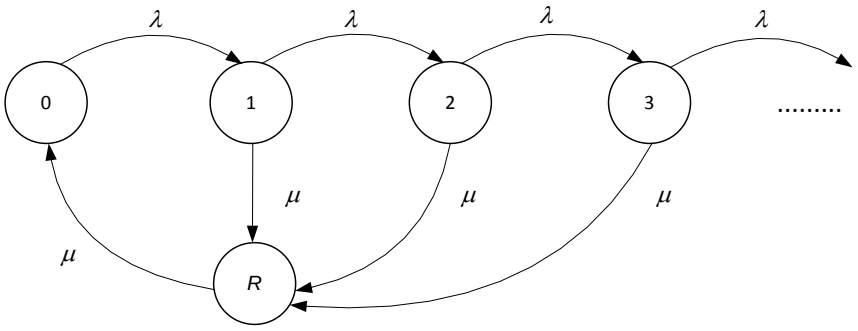

Figure 1.1: State-transition-rate diagram