

## Network traffic

Traffic of requests to a web server can be categorized in three different level: **HIGH, MEDIUM, and LOW**. Transitions from one level to another occurs according to exponential distributions, characterized by the following rates:

- LOW to MEDIUM  $\rightarrow \lambda = 0.33 \text{ h}^{-1}$
- MEDIUM to LOW  $\rightarrow \lambda = 0.6 \text{ h}^{-1}$
- MEDIUM to HIGH  $\rightarrow \lambda = 0.4 \text{ h}^{-1}$
- HIGH to MEDIUM  $\rightarrow \lambda = 1 \text{ h}^{-1}$

Moreover, in each traffic state, the network might go to a **DOWN** state, according to an exponential distribution of rate  $\lambda = 0.05 \text{ h}^{-1}$ . The network remains in the DOWN state for an exponentially distributed amount of time, with rate  $\lambda = 6 \text{ h}^{-1}$ , then returns to a traffic state, with the following probabilities:

- DOWN to LOW  $\rightarrow p = 0.6$
- DOWN to MEDIUM  $\rightarrow p = 0.3$
- DOWN to HIGH  $\rightarrow p = 0.1$

Analyze the considered network using a CTMC:

1. Draw the corresponding Markov Chain.
2. Compute the infinitesimal generator.
3. Show on a plot, the evolution of the states of the system starting from the MEDIUM traffic state, in time interval  $T = [0, 8]$ .
4. Show on a plot, the evolution of the states of the system starting from the DOWN state, in time interval  $T = [0, 8]$ .