

# MPRI - Course 2-8: verification of real-time systems

## TD1 - hybrid modeling

### 1 Genetic network

We consider expression of two genes A and B, i.e. production of two proteins P and Q

- The proteins are degraded with rate  $k$  (the proportion  $k$  of each protein disappears in a unit of time).
- The protein P catalyses the expression of the gene B: the production of the protein Q is proportional to the concentration of P with a coefficient  $a$ . As soon as the concentration of P crosses a threshold  $s$ , the production of Q becomes constant equal to  $as$
- The protein Q inhibits the expression of the gene A: the production of the protein P equals  $d - b \cdot (\text{concentration de Q})$ . As soon as the concentration of Q crosses a threshold  $r$ , the production of P blocks.

Modelize this system by a hybrid automaton.

### 2 Scheduling

We want to schedule two jobs with a total execution time up to 16 minutes.

- Job 1 : Compute (10 min); Print (5 min)
- Job 2 : Download (3 min); Compute (1 min); Print (2 min)

There is only one printer and one computing board.

Represent the problem as reachability for a timed or hybrid automaton:

1. without preemption;
2. with preemptible computing.