Cyber-physical systems and their verification(2.8.2)
TD nº 1 : Modeling

Exercice 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·(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.

Exercice 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.

Exercice 3 – *Bus stop verification*

System : A bus passes every 7 to 9 minutes. A taxi passes every 6 to 8 minutes. At noon a bus and a taxi passed. **Property :** Between 12 :05 and 12 :30, within 5 minutes after every bus, a taxi passes.

1. Represent by a timed automaton all possible behaviors of the system.

2. Represent by a timed automaton all behaviors violating the property.

3. Think how to verify whether the property always holds