A formal approach to modelize biological regulatory networks

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Abstract. Compution Tree Logic (CTL) [1] is a formal language which can express properties of a biological regulatory networks. The multi-valuated regulatory networks of René Thomas [3] which allow to study this kind of systems, constitute the semantic of our formal approach. With this semantic, CTL formula expressing a biological phenomenon can be written. Then, we check if the suggested modelisation satisfies the formula by model checking. Moreover, we can proposed scenarii to confront the models to experimentation. The biological system chosen to illustrate this formal approach is the mucus production of *Pseudomonas aeruginosa*, a bacteria which secretes mucus in lung affected by cystic fibrosis. The mucus production increases the respiratory deficiency of the patients. But in a healthy lung, there is no mucus production. Moreover, if one isolates a population of cells from a sick lung and if one puts it in a healthy environment, the mucus production can persist or resume progressively its non-mucoid phenotype after numerous generations. Biologists have shown that when the production persists, mucoid strain is generated by mutation. But, this model does not explain why it may happen that the mucus production stops. Biologists of Rouen [2] made the hypothesis that the mucus production is an epigenetic phenomenon. We have found 14 models which satisfy the emitted hypothesis written in CTL. Moreover to validate or invalidate them, we have proposed a plan of experiments which mimes the CTL formula.

References

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