1 Exercise Tutorial

Consider the following description of a gene regulatory network:

- $X_1$ activates $X_2$ synthesis at low concentrations and it represses its own synthesis at high concentrations.
- $X_2$ represses the synthesis of $X_1$.

Build and analyse a discrete model using the following the steps:

1. Draw the corresponding interaction graph $\mathcal{I}$.
2. Give a differential equation model of $\mathcal{I}$ using Hill functions.
3. Give the logical equations for the corresponding discrete model.
4. What are the possible values of the discrete variables?
5. What are the logical parameters of the discrete model and what is their range?
6. Give the state table of the discrete model in terms of the logical parameters.
7. Assume that all logical parameters take their maximum value and draw the corresponding asynchronous state transition graph $\mathcal{T}$.
8. Find all stable states and cycles in $\mathcal{T}$. 
2 Exercise Homework

Consider the following gene interaction network $\mathcal{I}$:

$X_1 \xrightarrow{-} X_2 \xrightarrow{-} X_1 \xrightarrow{+} X_2$

Assume that upon activation, $X_1$ first acts on $X_2$, and then on itself, i.e. $\theta_{21} < \theta_{11}$. Build and analyse a discrete model using the following the steps:

1. Give a differential equation model of $\mathcal{I}$ using Hill functions.
2. Give the logical equations for the corresponding discrete model.
3. What are the possible values of the discrete variables?
4. What are the logical parameters of the discrete model and what is their range?
5. Give the state table of the discrete model in terms of the logical parameters.
6. Assume that all logical parameters take their maximum value and draw the corresponding asynchronous state transition graph $\mathcal{T}$.
7. Find all stable states and cycles in $\mathcal{T}$.

Send the solution for exercise 2 until Wednesday 24. May, 08:00 am to Annika.Roehl@fu-berlin.de