Institut für Informatik
Praktische Informatik und Bioinformatik
Prof. Dr. Ralf Zimmer
Dr. Evi Berchtold, Markus Joppich, Felix Offensperger, Jewgenija Zhdanovich

Corona/Online Winter Term 2020/21
Computational Systems Biology

Assignments 2020-1 (b)
Concepts of Systems Biology

Working period: One week (10.11.-17.11.2020)
Hand-in anytime or in any exercise class
Please hand-in only reproducible results, answers, figures, tables, simulations, ...

In this class we checkout the programming environment we setup for Task/Report 1 and experiment with a number of introduced systems biology regulation concepts.

Task 1 (The two-component system)

Study the two-component system mentioned in the lecture (see slide 26).

(a) Implement the system such that you can simulate its behaviour over time. Of course you need initial values and parameters for the strength of the indicated regulatory interactions. You also have to decide how to implement the joint regulation (which function) of A by both A and B.

(b) plot the behaviour of the system via showing the abundances of A and B over time.

(c) Explore the parameter space by trying out some interesting combinations of the parameter values.

(d) Experiment with different functions for the combination of A and B regulating A.

(e) Experiment with different classes of (also non-linear), "activation functions" for the activation and inhibition.

Task 2 (Branched pathways)

Study an indirect regulation via competition for resources in branched pathways (see slide 27).

(a) Implement a branched pathways a a user-definable partitioning of A into B and C.

(b) plot the dependancy of the behaviour on the partitioning constant.

(c) How does the behaviour depend of the feedback regulation of E1 by B

(d) Experiment with different classes of (also non-linear), "activation functions" for the regulation of E1.

Task 3 (Time delays)

Study the regulation pattern indicated by different time delayed pathways (see slide 29).

(a) Implement the system and experiment with various time delays on the two paths.

(b) What about more than two paths with more individual time delays. Will that increase the regulatory options of the system?

Task 4 (Glycolysis: alternative models and hypotheses)

Experiment with the hypothetical variants of the "glycolysis' pathways.

(a) Implement various options and test (plot, visualize) whether the variant is compatible with the observed data (glucose can run out and be used up later on).

(b) compute the time until half of the glucose after the restart has been used up in the various models.

(c) the behaviour of the gylcolysis depends in any variant on the respective time delays and speeds of the reactions.