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 (c)
Concepts of Systems Biology

Working period: One week (17.11.-24.11.2020)
Hand-in anytime or in any exercise class
Please hand-in only reproducible results, answers, figures, tables, simulations, ...
Due May 24, 2020

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

Task 1 (The Island Biography model)

Study the island model described in the lecture.

(a) Implement the system such that you can simulate its behaviour over time.

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

(c) How could you generate some "training data", i.e. for benchmarking your model?

(d) Use the training data to derive likely parameters via regression.

(e) Choose some parameter combination, stochastically run the system several times and aplly (d). Could you recover the parameters used. What is the observed error?

(f) Does the error improve when using more training data (more stochastic runs)? How?

Task 2 (Model Classification)

(a) Classify the island model according to as many criteria as possible. Justify your classifications!

(b) Think of any other model you encountered at university. Do (a) for it!

Task 3 (Malthus- and Verhulst-Models)

(a) Implement both models and plot the results (dependent on r)

(b) Determine the time t, for which the two models deviate by 10%, 50%, or 100% (i.e. $E(t) = 2 * L(t)$).

(c) Plot the times t for which $E(t) = 2 * L(t)$ as a function of r.

Task 4 (Behaviour of models)

(a) Implement the simple three-dimensional example system described on slide VL5-51.

(b) Approximate the solution by discretizing the System via small discrete time intervalls Δt.

(c) Compare the results for various Δt and with (a).

(d) Are there initial values for which the system is well-behaved?