Freie Universität Berlin
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8. Assignment
Complex Systems for Bioinformaticians
SS 2025

Deadline: June 17, 12:00 (**before** the lecture)

The homework should be worked out individually, or in groups of 2 students. Pen & paper exercises should be handed at the designated deadline. Each solution sheet must contain the names and 'Matrikulationnummer' of all group members and the name of the group. The name of the group must include the last names of the group members, in alphabetic order, e.g. "AlbertRamakrishnanRastapopoulos", for group members Mandy Albert, Mike Ramakrishnan, and Marcus Rastapopoulos. Please staple all sheets.
Programming exercises must be submitted via Whiteboard.

Homework 1 (Programming –fishy, 10points)
Consider the swarming model from Couzin et al. (`https://doi.org/10.1006/yjtbi.3065`; the paper can be found under resources) with $N = 30$ individuals and explore the parameter region where swarming around a 'Torus' occurs. Let your program run such that you can observe interesting dynamics, but do not let it run for too long (i.e. such that the movie it generates remains of reasonable size).
(**to be uploaded via Whiteboard**) Write a program implementing this model, visualize the swarming behaviour and let your program generate an mp4 movie that it writes into the file FishSwarm.mp4. Name your code 'Ex1.py' and upload via whiteboard.

Homework 2 (Programming, 5 bonus points)
Implement a diffusion process on a discrete 100×100 2D plane. Use a diffusion constant $D = 1$ and finite differencing with time step $\tau = 1$ to simulate the diffusion process.
(**to be uploaded via Whiteboard**) Write a program implementing this model and initialize $u(t0, z0) = 1$ at a single point $z0$ of your plane (the other locations are 0; $u(t0, \hat{z}) = 0$), where $\hat{z}$ excludes $z0$). Generate a 'contour' or 'surface' of your variable $u(t, z)$ over time and let your program make an mp4 movie of it that it writes into the file 'Diffusion.mp4'. Name your code 'Ex2.py' and upload via whiteboard.

Good luck!