Theoretical Biophysics
A Computational Approach
Concepts, Models, Methods and Algorithms

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Introduction

Introduction I

As always, some assumptions need to be made. Here it is assumed that there is

- a basic knowledge of statistical physics
- and some programming experience to understand the methods and algorithms.

Problem Sets

- The four-weekly problem sets (3 sets in total) allow students to get a first-hand experience in applying the ideas introduced during lectures.
- Each assignment will consist of a set of exercises.
- Each problem set will involve purely analytical calculations to understand a particular model and one requiring a numerical approach.

Collaboration on the sets is encouraged and groups of up to three people can hand in their solutions.

Grading

- The course grade will be determined by an oral exam.
- Prerequisite to the exam is to have solved 50% of the analytical problems as well as handed in one of the numerical problems.

Reading Materials

The lectures do not lean heavily on a specific textbook. Resources from the literature will be introduced as needed in the downloadable material.

Learning Outcomes

- Have an understanding of the basic mathematical concepts that describe the probabilities of biophysical observables.
- Ability to apply numerical methods to complex biophysical problems.
- Construct, solve (either analytically or numerically), and interpret the results of a stochastic, dynamical models.
- Understand the role entropy in the functioning of biological systems.

Planned Schedule

Week 1
- General Introduction
- Methods
  - Molecular Dynamics

Week 2
- Methods (cont'd)
  - Monte Carlo Methods

Week 3
- Diffusion
- Transport

Week 4
- Reaction-Diffusion
- Cellular Automata

Week 5
- Phase Transitions
- (public holiday)

Week 6
- Phase Transitions (cont'd)
- Growth Models

Week 7
- Growth Models (cont'd)
- Recap

Week 8
- Pattern and Structure Formation

Introduction VII

	■ (public holiday)
Week 9	■ Pattern and Structure Formation (cont'd)
Week 10	■ Static Networks
	■ Temporal Networks
Week 11	■ RNA, Proteins and DNA
Week 12	■ Membranes
Week 13	■ Learning
Week 14	■ Learning (cont'd)