Mini-Course: *Modelling Micro-Evolution*

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28, 29 and 30 May from 9:15–11:00
Lecture Theatre B, NBI.*

Micro-evolution describes the evolution of a population of gene sequences which undergo selection, amplification, mutation and sexual recombination, as well as other possible evolution operators. Although originally motivated by biology it has also taken on an extra significance as a description of *Directed Molecular Evolution* and *Genetic Algorithms*. In the former evolution in a test tube is used to develop new drugs and enzymes while in the latter an evolutionary strategy is used to evolve good solutions to hard problems. This course introduces the applications of micro-evolution and develops a theory for describing micro-evolution based on statistical physics.

Lectures

- **Tuesday 28 May.** Applications of Micro-Evolution
  - **Directed Molecular Evolution.** Some micro-biology, DNA, RNA and proteins, overview of the techniques used in directed molecular evolution.
  - **Genetic Algorithms.** Optimization problems, NP-completeness, hill-climbing techniques, simulated annealing, description of GAs, selection, mutation and crossover.
  - **Problems of Biology.** Fitness landscapes, neutral selection, locally distributed populations, co-evolution, why is there sex?, why is there diploidy?, multiplicative fitness landscapes, Muller's ratchet, evolution in noisy environments.
- **Wednesday 29 May.** Micro-Evolution as a Statistical Mechanics Problem.
  - **The Statistical Mechanics Formalism.** Phase space, microscopic variables, order-parameters, cumulants, correlations.
  - **Selection.** Calculating selection, roulette wheel selection, deterministic/Baker selection, scaling selection, tournament selection, ranking selection, truncation selection, Boltzmann selection, optimization, noise in selection.
- **Thursday 30 May.** The Genetic Operators.
  - **Mutation.** Calculating mutation, maximum entropy techniques.
  - **Crossover/Sexual Recombination.** Uniform Crossover, single-point crossover, interface energy, mixing, the shuffling problem.
  - **The Benefits of Sexual Recombination.** Trap functions, stochastic hill-climbing, basin with a barrier.

*For questions or further information contact `adam@nordita.dk`.
*See also `http://www.nordita.dk:80/~adam/evol-course`