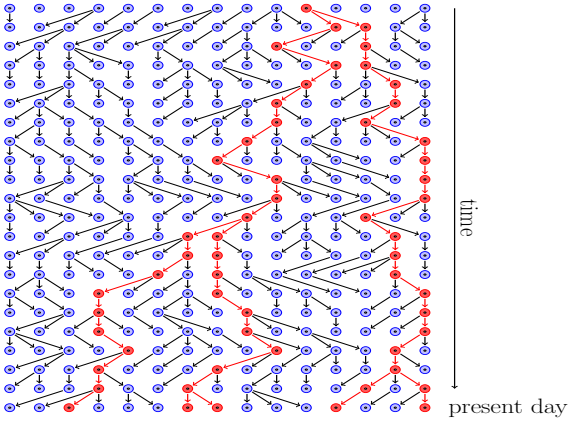
Stochastic population models[1]

Dozent/in: Prof. Dr. Matthias Birkner

Termine[2]**: Thu, Fri 12-14**

There is a lot of variability – both genetic and phenotypic – in real populations. Stochastic models can help to understand this and to quantify underlying evolutionary mechanisms like selection, mutation, genetic drift, recombination or spatial structure. They also form the basis for inference of biological mechanisms and their parameters based on observed genetic variability in sampled individuals. A central thread of the course will be the interplay between the forwards in time dynamics of the population and the backwards in time view on the genealogy of samples.

Some exemplary (technical[3], but see notes) keywords: Wright-Fisher model and diffusion, coalescents, Ewens' sampling formula, ancestral selection and recombination graphs, branching processes, stepping stone model, interacting particle systems



Schematic representation of a randomly reproducing population
and a present-day sample together with its genealogy (in red)

Literature:

R. Durrett, *Probability Models for DNA Sequence Evolution*, Springer (2008).
W. Ewens, *Mathematical population genetics*, Springer (2004).
J. Wakeley, *Coalescent Theory: An Introduction*, Roberts & Company (2008).
M. Birkner, *Stochastische Modelle der Populationsbiologie*, Vorlesungsskript, JGU Mainz (2016) `https://www.staff.uni-mainz.de/birkner/SMPB1516/smpb1516.pdf`
S. Ethier, T. Kurtz, *Markov processes: characterization and convergence*, Wiley (1996).

Notes 1. The language can to some extent be negotiated at the beginning. A mixture of German and English is also an option.
2. Brown bag: Given the times, it is perfectly fine to bring a (small) lunch to lectures.
3. The principal ideas and phenomena can be understood and appreciated using notions from "Grundlagen der Stochastik". Advanced tools, e.g. diffusion processes or stochastic differential equations, may feature occasionally but will be motivated and illustrated by discrete approximations (and this course is of course also an invitation to learn about such objects). From the introduction of W. Feller's famous book on probability: "The traveler often has the choice between climbing a peak or using a cable car."
4. M.Ed. students (with our without biology as a second subject) are very welcome.