Computational Information Theory and Inference
Carlo Albert

Basic Principles

- Bayesian Statistics: prior, likelihood, posterior.
- The Monte Carlo Paradigm: noise vs. bias.
- Basic building blocks of samplers: transformations, weighting (importance sampling), acceptance/rejection.

Exploring a high-dimensional potential

- The Metropolis algorithm (Markov Chain Monte Carlo)
- Gibbs sampling: local interactions.
- Adaptive (non-Markov) algorithms
- Ensemble methods

Hamiltonian Dynamics: Beyond random search.

- Hamiltonian Monte Carlo (HMC)
- HMC for stochastic differential equations: path-integrals and separation of time.

Thermodynamics: Entropy and learning.

- Approximate Bayesian Computation (ABC)
- Simulated Annealing ABC: learning with minimal entropy production [Albert et al. 2014].
- Summary Statistics: Machine Learning of thermodynamic state variables.

Statistical Mechanics: Interacting particle systems as inference tool.

- Field-theoretic description: Doi-Peliti formalism.
- Inference: particle filters and path-integral methods.