LSB: Local Self-Balancing MCMC in Discrete Spaces

Emanuele Sansone

**Problem**

- Sampling in high dimensions: $p_X(x) = \frac{p_X(x)}{Z}$
- MCMC: $T(x'|x) = A(x', x)Q(x'|x)$
- Locally Balanced Proposal [1]:
  \[ Q(x'|x) = \frac{g((x'|x))/g(x)}{Z(x)} \]

**Question:** How to adapt the proposal to target to improve sampling efficiency?

**Solution**

**Parametrizations**

- Linear (LSB 1):
  \[ g(t) = tg(1/t) \]
  \[ g_\theta(t) = \sum_{i=1}^{\theta} g_i(t) = \frac{1}{2} I(\theta) \sum_{i=1}^{\theta} g_i(t) \]

- Nonlinear (LSB 2):
  \[ g_\theta(t) = \min \left\{ \ell_\theta(t), t \frac{1}{t} \right\} \]

**Objective**

\[ I_\theta = KL(p_X(x)T(x'|x)||p_X(x)p_X(x')) \]

Any non-negative real function $\ell_\theta(t)$

**Learning procedure**

Use historical samples to estimate the objective and update theta at each sampling iteration (during burn-in phase)

**Experiments**

- 2D Ising
- Bayesian Networks

**References**


Contact: emanuele.sansone@kuleuven.be