CS281: Advanced ML **November 6, 2017**

Lecture 16: Loopy BP, Gibbs Sampling, and VI with Gradients

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1 Loopy BP

The history of Loopy-BP begain in 1988 with Judea Pearl who tried to analyze the behavior of the BP algorithm (which gives exact marginal inference on tree) on graphs that are not trees, like the Ising model. Remember the message passing algorithms is

$$m_{s\to t}(x_t) = \sum_{x_s} \psi(x_s)\psi(x_s, x_t) \prod_{u\in \text{NBR}(s)-t} m_{u\to s}(x_s)$$
$$bel_s(x_s) \propto \psi(x_s) \prod_{t\in \text{NBR}(s)} m_{t\to s}(x_s)$$

Note that this algorithm doesn't require an ordering on the nodes, so it can naturally extend to cyclic graphs. A decade after Pearl raised the question of the BP algorithm on general graphs papers from