When is Loopy BP Effective?

Graphs with Long Cycles *(Gallager 1963; Richardson & Urbanke 2001)*

- Turbo codes & low density parity check (LDPC) codes
- For long block lengths, graph becomes *locally tree-like*, and BP accurate with high probability

Graphs with Weak Potentials *(Tatikonda & Jordan 2002; Heskes 2004; Ihler et. al. 2005; Mooij & Kappen 2005)*

- If potentials are sufficiently weak, BP has a *unique fixed point*
- Analyzing compatibility strength in context of graph structure can sometimes guarantee message passing *convergence*

Graphs with Attractive Potentials?

- Existing theory does not explain empirical effectiveness
- We will show that the Bethe approximation *lower bounds* the true partition function for a family of attractive models