

ED-BP: Belief Propagation via Edge Deletion

UCLA Automated Reasoning Group

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Glen

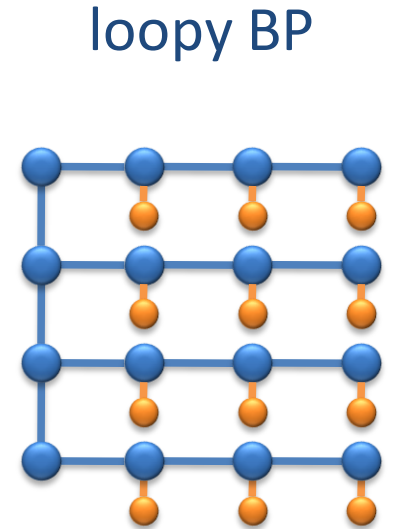
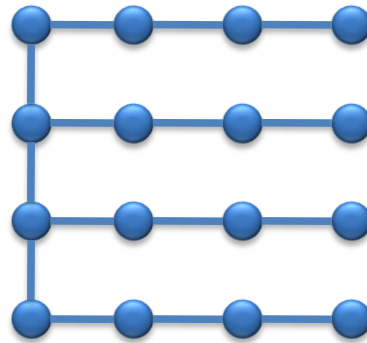
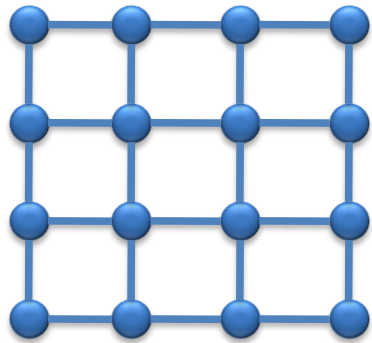
Adnan

Knot

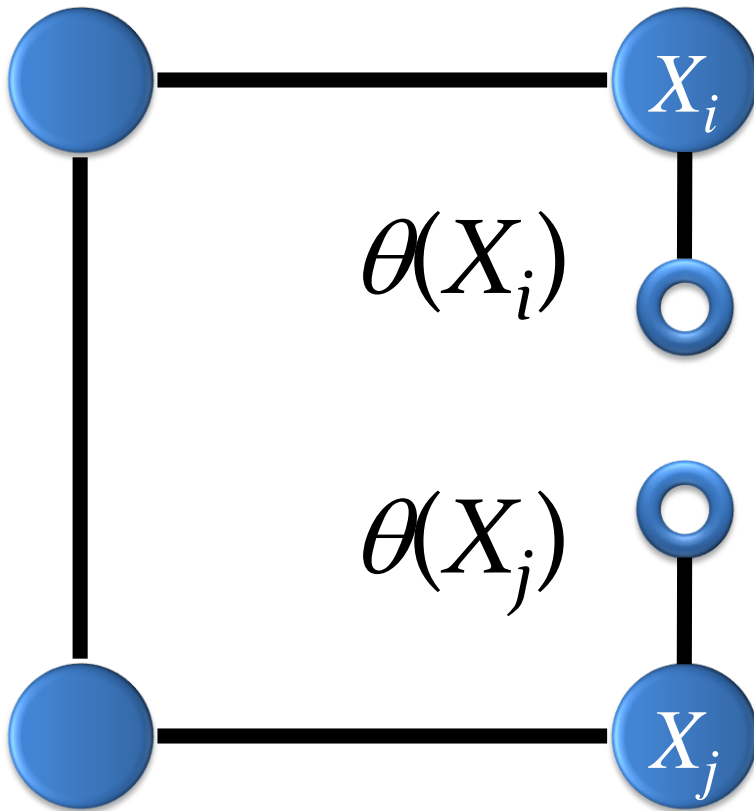
Arthur



ED-BP: Idea



Characterizing Belief Propagation



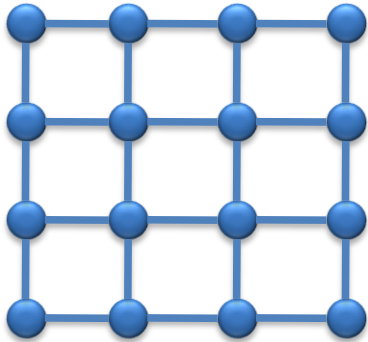
- ED-BP characterization:

$$\begin{aligned}\Pr(X_i = \mathbf{x}) &= \Pr(X_j = \mathbf{x}) \\ &= \theta(X_i = \mathbf{x}) \theta(X_j = \mathbf{x}) / z_{ij}\end{aligned}$$

- in a tree:
 - MAR: BP marginals
 - PR: Bethe
 - MPE: BP max-marginals

Edge Deletion

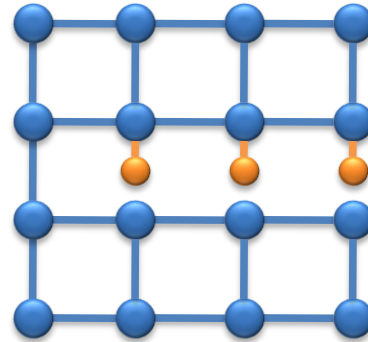
exact



delete
edges

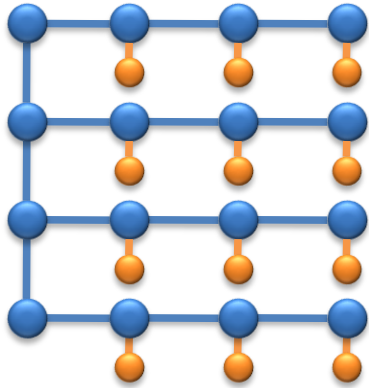


?

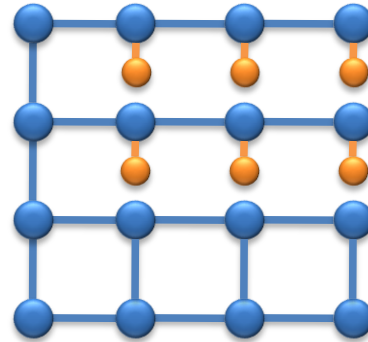


Edge Recovery

loopy BP



recover edges



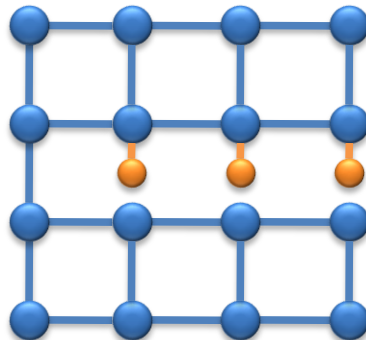
recover edges



...

...

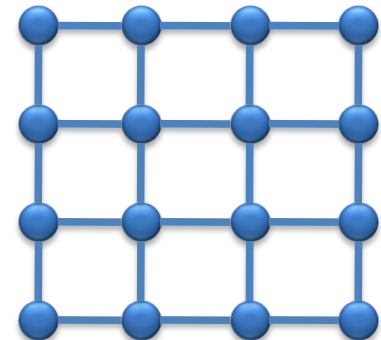
recover edges



recover edges

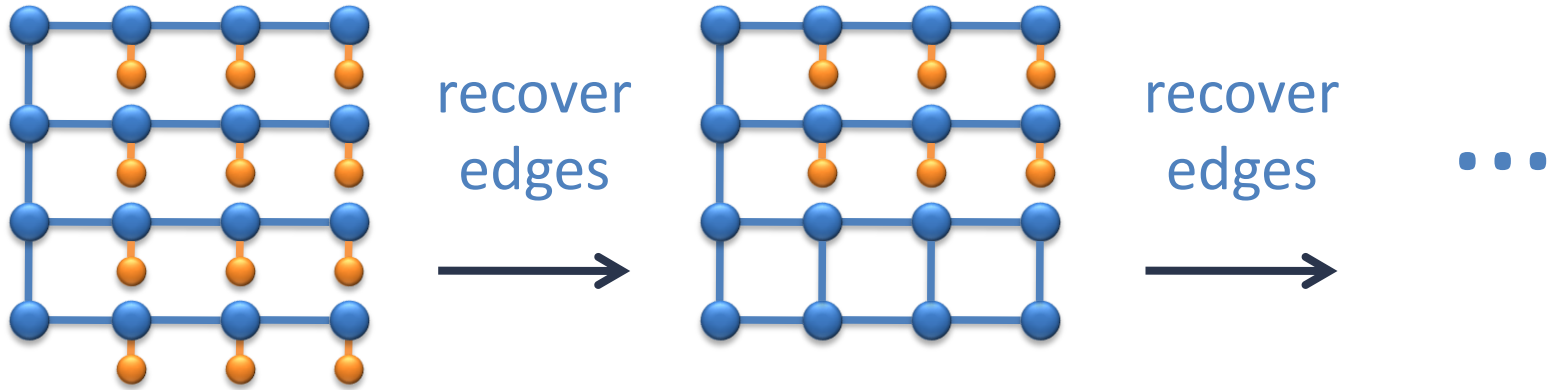


exact

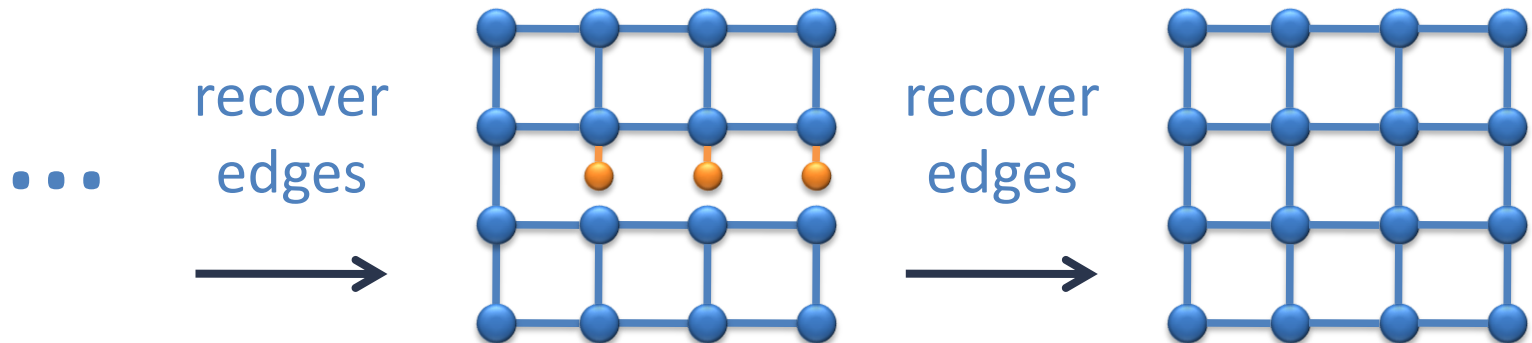


Edge Recovery: Old Idea

loopy BP

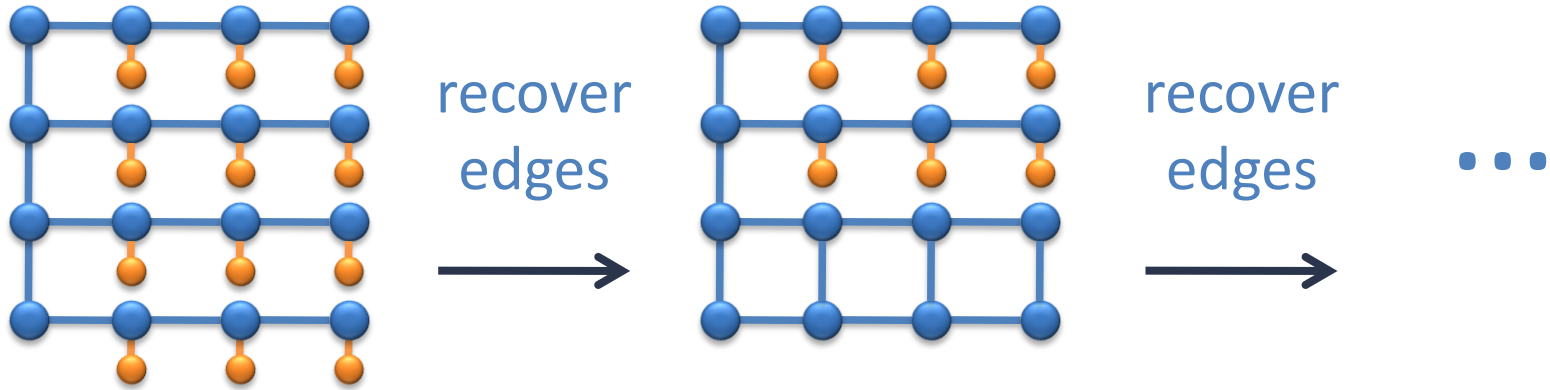


[CD06]: target quality: use mutual information

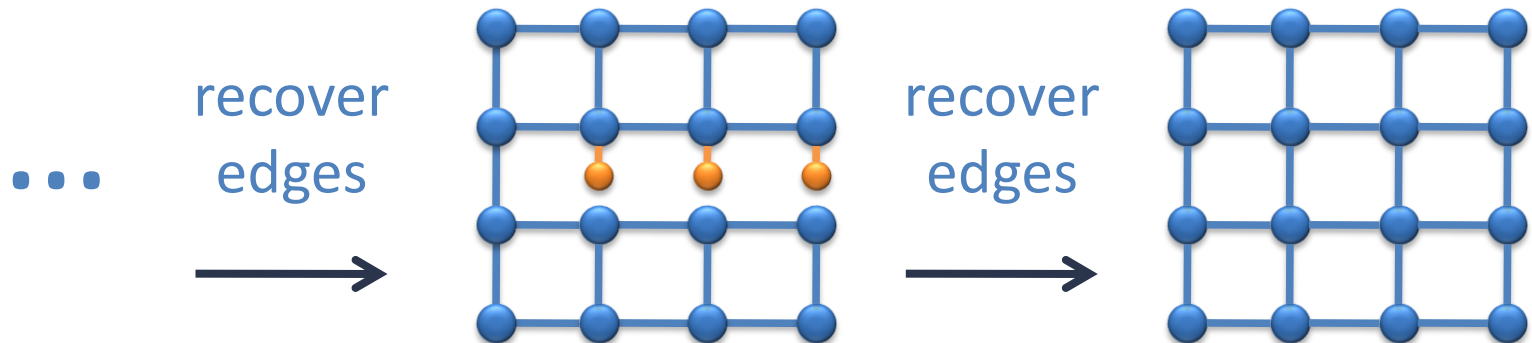


Edge Recovery: New Idea

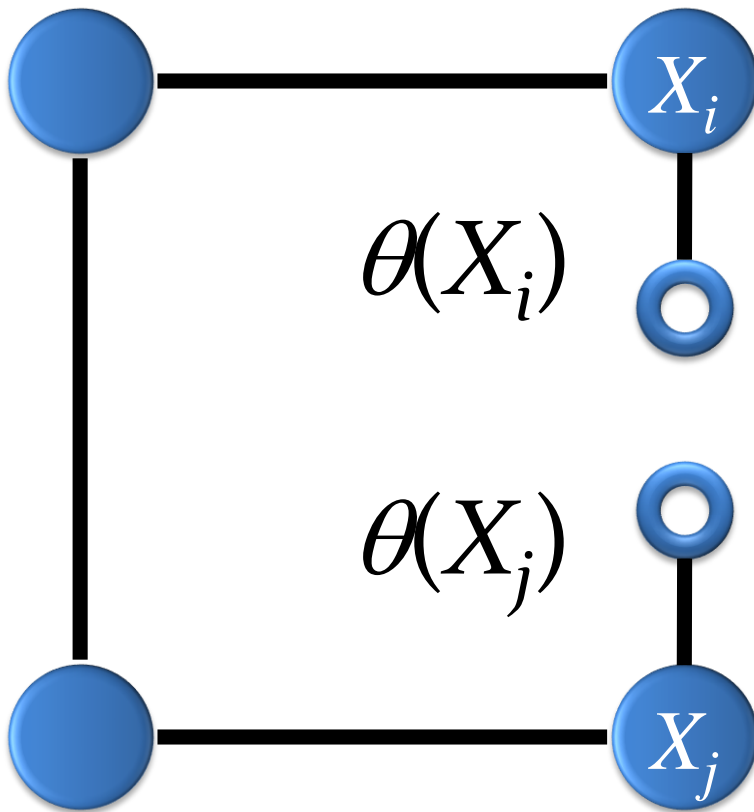
loopy BP



Challenge UAI-10: encourage convergence, *residual recovery*



ED-BP: Residual Recovery



- Recover edges based on how close they are to convergence
- ED-BP characterization:

$$\begin{aligned}\Pr(X_i = \mathbf{x}) &= \Pr(X_j = \mathbf{x}) \\ &= \theta(X_i) \theta(X_j) / z_{ij}\end{aligned}$$

- Ongoing: try residuals as in residual BP

Exact Solvers

- Exact inference in a simplified network: ED-BP can use any black box inference engine
 - currently using vanilla Hugin and Shenoy-Shafer jointree algorithms
 - not currently using Ace, or other advanced inference engines ...

Overall Results

PR Task: 20 Seconds

Solver	Score
edbr	1.7146
vgogate	2.1620
libDai	2.2775

MAR Task: 20 Seconds

Solver	Score
edbq	0.2390
libDai2	0.3064
vgogate	0.4409

Overall Results

PR Task: 20 Minutes

Solver	Score
vgogate	1.2610
edbp	1.3063
libDai	2.0707

MAR Task: 20 Minutes

Solver	Score
ijgp	0.1722
edbq	0.1742
libDai3	0.2810

Overall Results

PR Task: 1 Hour

Solver	Score
vgogate	1.2609
edbr	1.2699
libDai	2.0707

MAR Task: 1 Hour

Solver	Score
ijgp	0.1703
edbr	0.1753
libDai3	0.2639

Overall Results

PR Task: 1 Hour

Solver	Score
vgogate	1.2609
edbr	1.2699
libDai	2.0707

MAR Task: 1 Hour

Solver	Score
ijgp	0.1703
edbr	0.1753
libDai3	0.2639

Congratulations Vibhav

Extra Slides

ED-BP: The Solver

- Based on UAI'08 solver, new MPE version
- Numerous improvements
 - pre-processing
 - initial spanning tree
 - internal inference engine for *exact* reasoning
 - *edge recovery*
 - led to biggest impact in performance

ED-BP: The Solver

- Pre-processing
 - lightweight
 - RSat: infer fixed values from network zero's
- Initial spanning tree
 - random spanning tree
 - max spanning tree (mutual information)
- Black box engine for exact inference
 - jointree algorithms: shenoy-shafer versus hugin
 - in the future: compilation to ACs (Ace)

ED-BP: Last Day of Challenge

MAR Task: 20 Minutes

Solver	Score
edbr	0.1841
viper2	0.1763

ED-BP: Last Day of Challenge

MAR Task: 20 Minutes

Solver	Score
edbr	0.1841
viper2	0.1763
edbp	0.1762

ED-BP: Last Day of Challenge

MAR Task: 20 Minutes

Solver	Score
edbr	0.1841
viper2	0.1763
edbp	0.1762
vgogate	0.1761

ED-BP: Last Day of Challenge

MAR Task: 20 Minutes

Solver	Score
edbr	0.1841
viper2	0.1763
edbp	0.1762
vgogate	0.1761
edbq	0.1742

ED-BP: Last Day of Challenge

MAR Task: 20 Minutes

Solver	Score
edbr	0.1841
viper2	0.1763
edbp	0.1762
vgogate	0.1761
edbq	0.1742
ijgp	0.1722

ED-BP: Last Day of Challenge

MAR Task: 20 Minutes

Solver	Score
edbr	0.1841
viper2	0.1763
edbp	0.1762
vgogate	0.1761
edbq	0.1742
ijgp	0.1722

Congratulations Vibhav