Belief Updating in Bayesian Networks
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Part 3:
Loopy belief propagation
Loopy belief propagation

- Popular method for approximating probability distributions without sampling
- Similar to junction tree algorithm
  - Uses the original network instead of junction tree
  - Uses message passing between neighboring nodes
- Approximates
  - Identical to junction tree in simple cases
  - Convergence to correct probabilities not guaranteed
Graph for message passing

- Original Network →
  - Directions removed
  - Separators added (parent nodes)
Message passing

- „Marching regime“
  - At each node pass messages to all of its separators
    - Multiply node's potential with potentials from all other separators
    - Project the result to the separator
    - Pass the message to separator
  - Do so for each node in sequence
  - Repeat until sufficient convergence is achieved

- Probability distribution of a variable
  - Multiply node's potential with separator's and marginalize
Message passing

- $\lambda$ – message from child to parent (likelihood)
- $\pi$ – message from parent to child (probability distribution)
Usability

• If network is singly connected
  • Two passes produce exact same result junction tree
  • So not of much use

• More complex networks
  • Usable in case when cliques are very large
  • Gives often good results

• Enables calculation of a graph containing cycles (not technically a Bayesian network)