

Message Passing: Belief Update

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Topics

1. Overview
2. Variable Elimination and Clique Trees
3. Message Passing: Sum-Product
 - VE in a Clique Tree
 - Clique-Tree Calibration
 - Sum-product Belief Propagation Algorithm
4. Message Passing: Belief Update
5. Constructing a Clique Tree

Message Passing: Belief Update

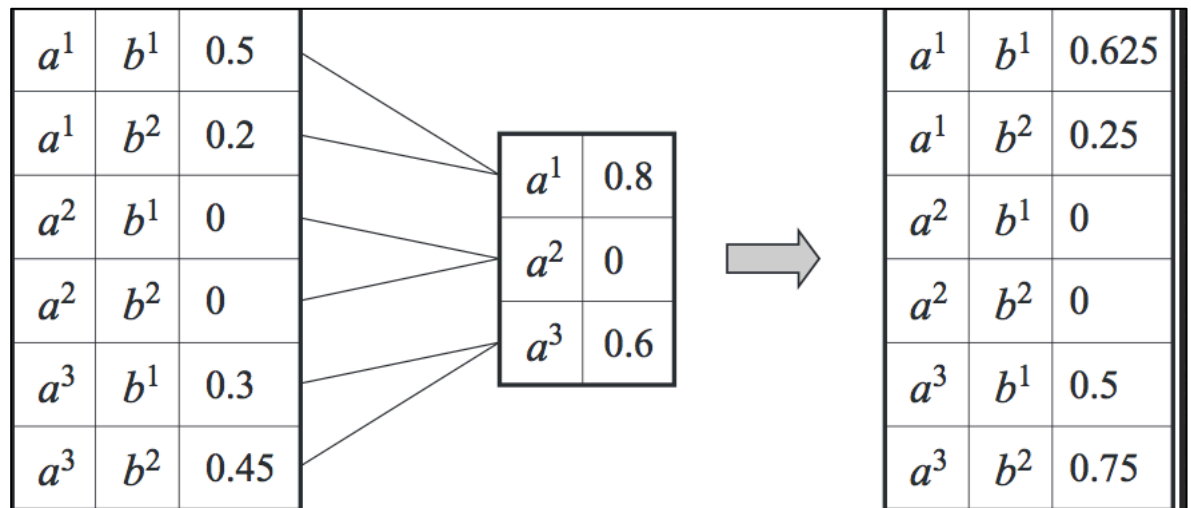
- Alternative Message Passing Scheme
- Involves operations on reparameterized distribution in terms of
 - cliques $\{\beta_i(C_i)\}$, $i \in V_T$ and
 - sepset beliefs $\{\mu_{i,j}(S_{i,j})\}$, $(i-j) \in V_T$

Message Passing with Division

- Multiply all the messages and then divide the resulting factor by $\delta_{j \rightarrow i}$

Factor Division

- Message Passing with Division
- An example of factor division



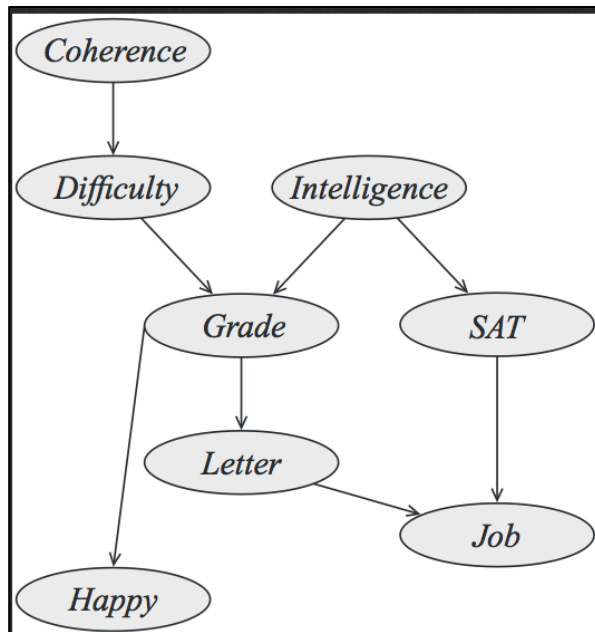
Constructing a Clique Tree

- Two approaches to construct a clique tree from a graph
 - From Variable Elimination
 - From Chordal Graphs

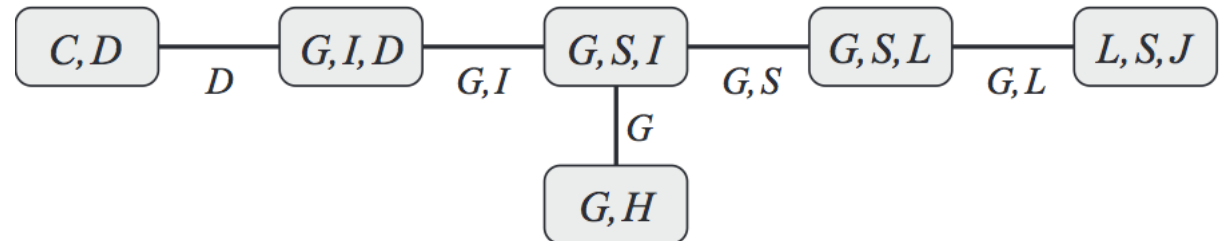
Clique Tree from VE

- Execution of Variable Elimination can be associated with a cluster graph
 - Satisfies running intersection property and is hence a clique tree

Unambitious Student



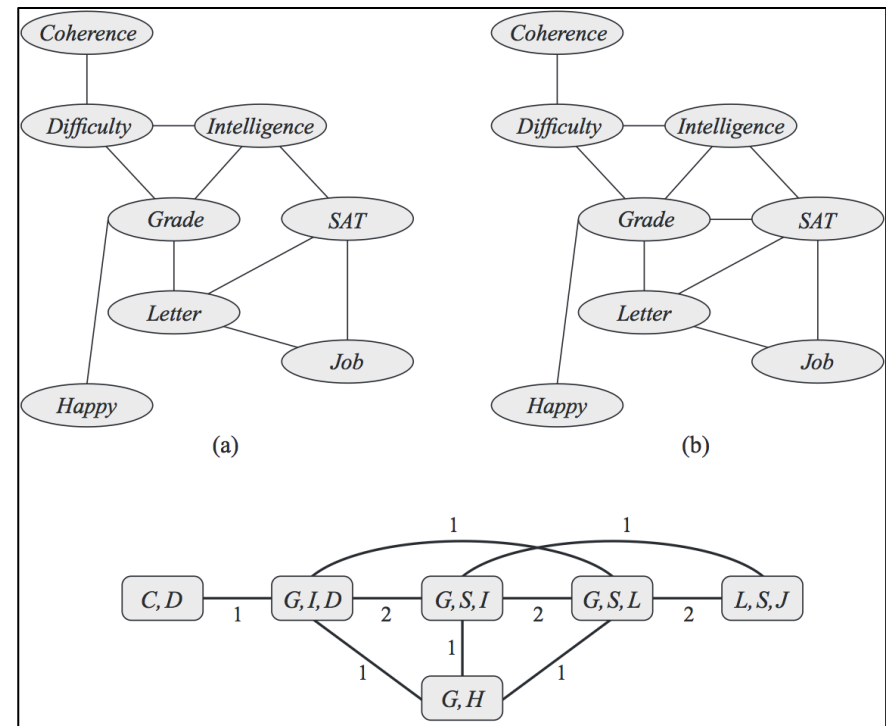
Variable Elimination with ordering J, L, S, H, C, D, I, G results in clique tree:



Clique Tree from Chordal Graphs

- There exists a clique tree for Φ whose cliques are precisely the maximal cliques in $I_{\Phi, <}$
 - Triangulation: construct chordal graph subsuming existing graph

1. Undirected factor graph
2. A triangulation
3. Cluster graph
 - With edge weights



Algorithm: Clique Tree from Chordal Graph

- Given a set of factors, construct the undirected graph H_Φ
- Triangulate H_Φ to construct Chordal Graph H^*
- Find cliques in H^* , and make each one a node in a cluster graph
- Run the maximal spanning tree algorithm on the cluster graph to construct a tree