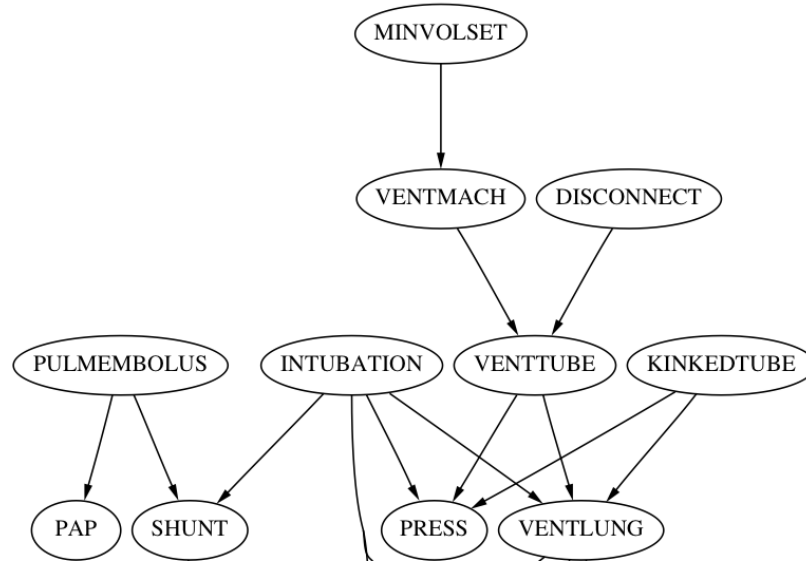


## Homework 2

### Probabilistic and Bayesian Machine Learning

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#### 1. [40 points] Junction Tree Algorithm.



The model is part of a larger model called ALARM. Ignore the vertical line leading nowhere in the bottom middle of figure.

Go through each step of the algorithm to construct a junction tree from the directed graphical model above. Draw out the result after each step below.

- Convert to factor graph.
- Convert to undirected graph.
- Triangulate the undirected graph.
- Identify the cliques and for each pair of cliques the separator separating them.
- Identify the maximum weight spanning tree from the graph of cliques and separators.
- Draw out the final junction tree.

#### 2. [60 points] Variational Bayes.

Derive the variational Bayesian EM learning algorithm for the mixture of multivariate Bernoullis in the previous homework.

- What is the conjugate prior for the parameters?
- Write down and simplify the formula for the VB free energy. The formula should be one that you could implement in a program.
- Derive the VB E and M steps from the VB free energy. You can drop constant terms in your derivation to keep the formulas shorter.