Bayesian Networks I
Advanced Artificial Intelligence: Workshop

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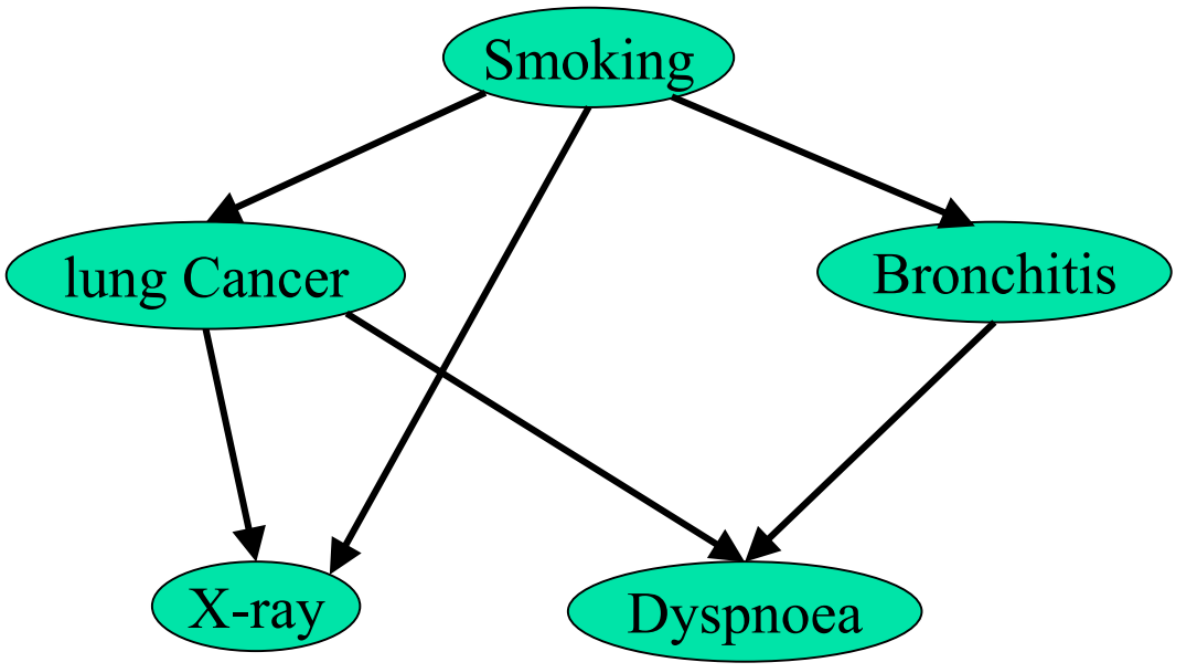
9 October 2019

Overview

- Joint and Conditional Probability Distributions
- Number of Parameters in Bayesian Networks
- Exact Probabilistic Inference
- Maximum Likelihood Estimation

Bayesian Network: Structure and Parameters

Given the following Bayesian Network with binary variables,



- Complete the following equation: $\mathbf{P}(S, C, B, X, D)=$
- What is the number of parameters (i.e. probabilities)?

Parameter Learning

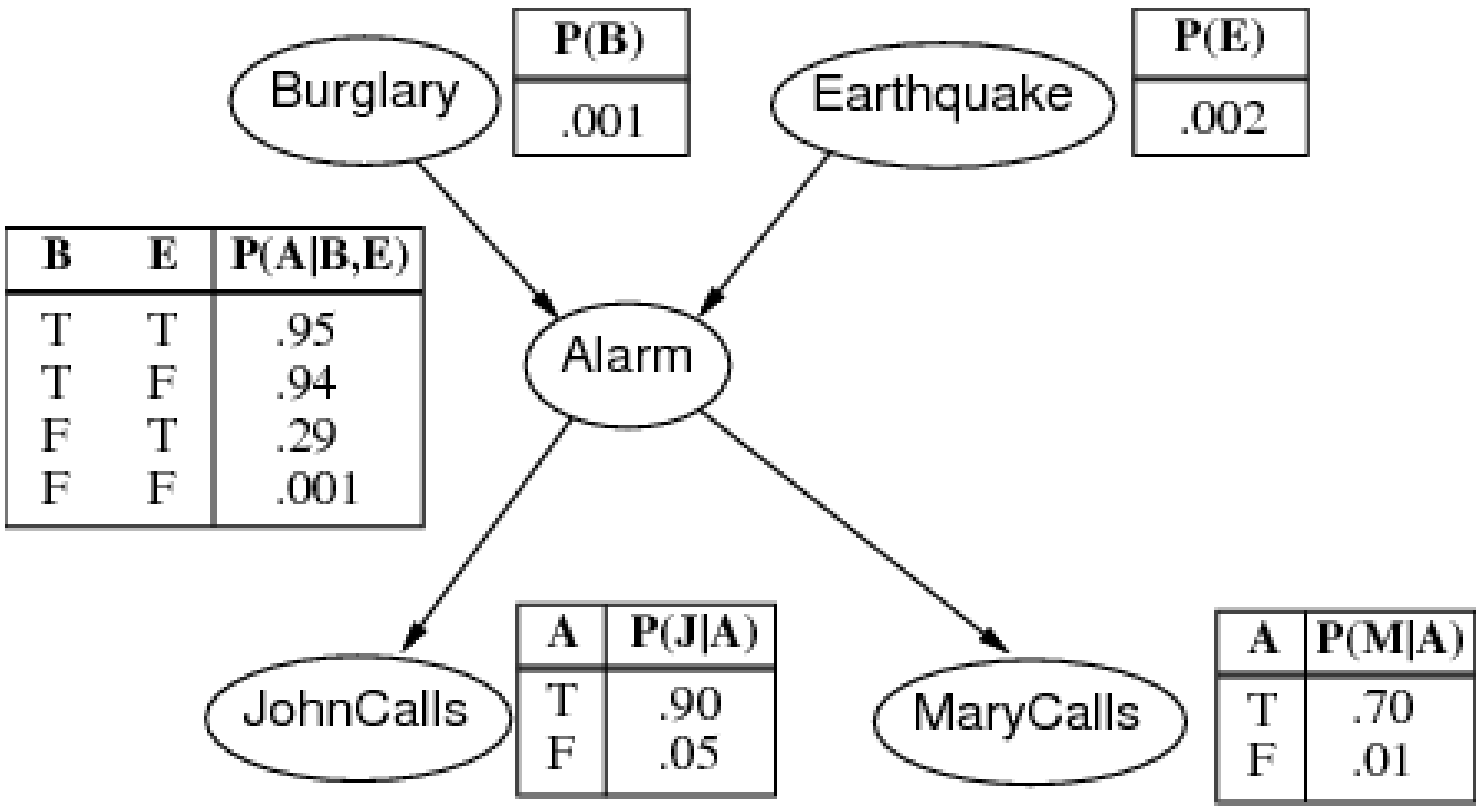
Calculate the Conditional Probability Tables (CPTs) of the Burglary network using the following data

Alarm	Mary	John	Burglary	Earthquake
T	T	T	T	F
F	F	F	F	F
T	T	F	F	T
F	F	T	F	F
F	F	F	F	F
F	F	F	F	F
T	T	T	T	F
T	T	T	T	F
F	F	F	F	T
T	T	T	F	T

and Maximum Likelihood Estimation, where $|X|$ refers to domain size:

- For CPTs with 1 variable: $P(X = x) = \frac{count(x)+1}{count(X)+|X|}$
- For CPTs with 2 variables: $P(x|y) = \frac{count(x \wedge y)+1}{count(y)+|X|}$
- For CPTs with 3 variables: $P(x|y,z) = \frac{count(x \wedge y \wedge z)+1}{count(y \wedge z)+|X|}$

Probabilistic Inference



Given your newly calculated probabilities (not the same as the above), calculate $\mathbf{P}(B|j,m)$ using inference by enumeration and inference by variable elimination. Did you get the same results with both methods?