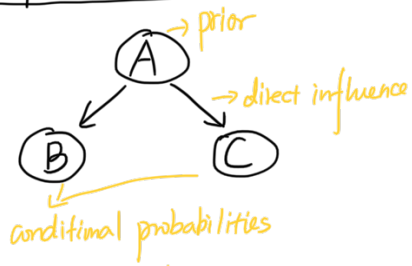
15 Bayesian Networks

A data structure:

represent (in)dependencies among random variables

used to compute full joint distribution

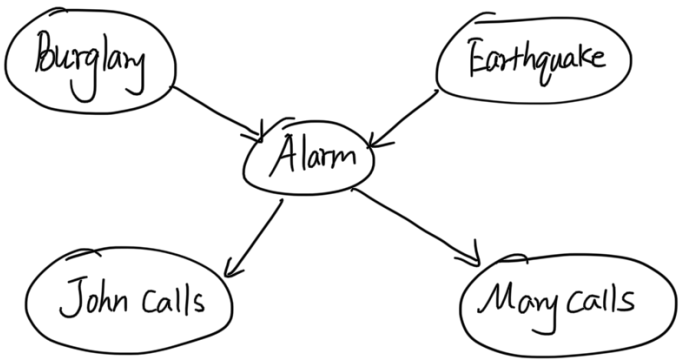
A, B, C: random variables



full joint distri: $P(x_1, \dots x_n) = \prod_{i=1}^{n} P(x_i \mid Parents(x_i))$

$$Pr(Query \mid Evidence) = \frac{Pr(Query \wedge Evidence)}{Pr(Evidence)}$$

example:



$$P(B \mid J = True, Mary = True) = \frac{P(B, J, M)}{P(J, M)} \quad \begin{matrix} -① \\ -② \end{matrix} \quad (条件概率定义)$$

① $P(B, J, M) = \sum_{A,E} P(J \mid A) P(A \mid B, E) P(B) P(E) P(M \mid A)$

(要知道J, 先得知道A; 要知道A, 先得知道B, E ...)

② $P(J, M) = \sum_{A,B,E} P(J \mid A) P(A \mid B, E) P(B) P(E) P(M \mid A)$

Complexity: Time: $O(2^n)$ Space: $O(n)$

Notes:

BN encodes conditional independence assumptions and store conditional probs

Exact-inference with BN:

NP-hard

解決方案 { dynamic programming
appximate inferen