Stochastic Simulation in BNs (§4.8 [J07])

\[ P(E = y) \approx \frac{\text{number of cases for which } E = y}{\text{total number of cases}} = \frac{N(E = y)}{N} \]

Example (p. 146)

Diagram of BN with nodes A, B, C, D, and E.
4.8.1 Probabilistic Logic Sampling

1. Let \( <x_1, \ldots, x_n> \) be a topological ordering of the variables (e.g., \( <A, B, C, D, E> \))
2. For $j = 1$ to $N$ 

\[ N \text{ is the number of samples.} \]

a) For $i = 1$ to $n$ 

\[ n \text{ is the number of variables in this BN} \]

sample a state $X_i$ of $X_i$ using $P(X_i | \text{pa}(X_i) = \pi_j)$, 

where $\pi_j$ is the configuration already computed for $\text{pa}(X_i)$.

b) If $X = \langle X_1, \ldots, X_n \rangle$ is consistent with the evidence, then

\[ N(X_i = x_i) := N(X_i = x_i) + 1 \]

where $x_i$ is the state that was sampled for $X_i$.

[else, discard $X$ if it is inconsistent with the evidence]
3. Return
\[ P(X_{k} = x_{k} | \xi) = \frac{N(X_{k} = x_{k})}{\sum_{x \in X_{k}} N(X_{k} = x)} \]

Problem: if the evidence is a rare case \((P(\xi))\) is small, then many samples are thrown away.