Approximate Inference in Bayesian Networks

Section 14.5

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What is approximate inference?

- A method of estimating probabilities in Bayesian networks
- Also called ‘Monte Carlo’ algorithms
- We will discuss two types of algorithms: direct sampling and Markov chain sampling
Why use approximate inference?

- Exact inference becomes intractable for large multiply-connected networks
- Variable elimination can have exponential time and space complexity
- Exact inference is strictly HARDER than NP-complete problems (#P-hard)

Direct Sampling

- Take samples of events
- We expect the frequency of the samples to converge on the probability of the event
**Direct Sampling**

*Rejection Sampling*

- Used to compute conditional probabilities $P(X|e)$
- Generate samples as before
- Reject samples that do not match evidence
- Estimate by counting how often event $X$ is in the resulting samples

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**Direct Sampling**

*Likelihood Weighting*

- Avoid inefficiency of rejection sampling
- Fix values for evidence variables and only sample the remaining variables
- Weight samples with regard to how likely they are
Markov Chain Sampling

- Generate events by making a random change to the preceding event
- This change is made using the *Markov Blanket* of the variable to be changed
- Markov Blanket = parents, children, children’s parents
- Tally and normalize results
- See book for explanation of why this works

Why do we care?

- Bayesian algorithms have many applications
- Ever get “spam” email?
- Troubleshooting/diagnostics
- Many other problems
Any questions?