Constructing Bayesian Networks

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Lecture 11

Based on work by K. Leyton-Brown, K. Larson, and P. van Beek

Outline

Learning Goals

By the end of the lecture, you should be able to

- Determine if a Bayesian network is a correct representation of a domain based on its conditional independence assumptions.
- Determine whether a Bayesian network is a good representation of a domain based on the number of probabilities required to define the Bayesian network.
- Construct a correct Bayesian network representation for a given domain.

Constructing Bayes Nets

Two questions to consider

- ▶ Given a Bayesian network, is it a correct and good representation of the domain?
- ▶ How do we construct a Bayesian network that is a correct and good representation of the domain?

Correct and Good Bayes Networks

A Bayes network is a correct representation of the domain iff

- it makes the correct independence assumptions.

Among all the correct Bayes network representations,
a Bayes network is a good representation of the domain iff

- the number of required probabilities is relatively small, and
- the probabilities required are natural to specify.

Constructing a Correct Bayesian Network

1. Determine the set of variables that are required to model the domain.
2. Order the variables, $\{X_1, ..., X_n\}$.
3. For $i = 1$ to n, do the following
   3.1 Choose a minimum set of parents from $X_1, ..., X_{i-1}$ such that $P(X_i|Parents(X_i)) = P(X_i|X_{i-1}, \ldots, X_1)$ is satisfied.
   3.2 Create a link from each parent of X_i to X_i.
   3.3 Write down the conditional probability table $P(X_i|Parents(X_i))$.

Example: Construct a Bayes Net

Construct a correct Bayesian network using the following ordering. (Let's drop Radio.)
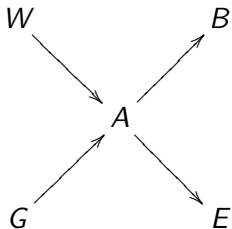
$$B, E, A, W, G$$

Example: Construct a Bayes Net

Construct a correct Bayesian network using the following ordering. (Let's drop Radio.)

$$W, G, A, B, E$$

CQ Is this Bayes Net correct?

CQ: Consider the node ordering: W, G, A, B, E. Is the following Bayesian network a correct representation of the domain?

Hint: In our domain, Watson and Gibbon are not independent of each other. What about in this network?

(A) Yes

(B) No

(C) I don't know.

Exercise: Construct a Bayes Net

Construct a correct Bayesian network using the following ordering.

$$W, G, E, B, A$$

Revisiting the Learning Goals

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