HW5: Bayesian Networks & Independence

CS6300: Artificial Intelligence, Spring 2018 **Jake Pitkin**
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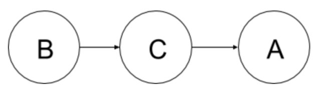
1 Independences from Probability Tables

A	**B**	**C**	p
T	T	T	1/16
T	T	F	1/3
T	F	T	1/32
T	F	F	1/12
F	T	T	3/16
F	T	F	1/6
F	F	T	3/32
F	F	F	1/24

Table 1: $P(A, B, C)$

I considered a few factorizations and found one that satisfied the above table.



This factorizes the joint probability $P(A, B, C)$ as a product of the conditional probabilities $P(B)$, $P(C|B)$, and $P(A|C)$.

B	p
T	3/4
F	1/4

Table 2: $P(B)$

C	**B**	p
T	T	1/3
T	F	1/2
F	T	2/3
F	F	1/2

Table 3: $P(C|B)$

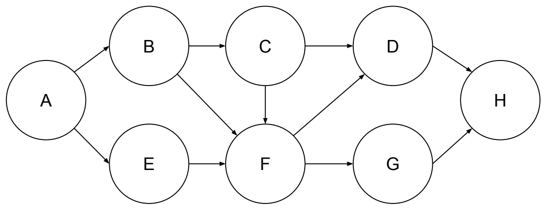
A	**C**	p
T	T	1/4
T	F	2/3
F	T	3/4
F	F	1/3

Table 4: $P(A|C)$

With 10 total entries, this is the smallest you can get the conditional probability tables (keeping the graph connected). These were derived by marginalizing out variables from $P(A, B, C)$ and using the product rule for dependent variables.

2 Independence in Graphical Models

Consider the graphical model shown below:



Please answer the following conditional independence questions from this model:

1. $A \perp H$
2. $A \perp H|C$
3. $A \perp H|C, F$
4. $E \perp B|A$
5. $E \perp B|C, F$
6. $E \perp B|A, C, F$

3 Inference by Enumeration and Variable Elimination

Consider the graphical model for the alarm network. Using inference by enumeration, compute the following probabilities (show your work!!!):

1. $p(b, \neg e | a, j, m)$
2. $p(b|a)$
3. $p(b|e, a)$ (how does this compare to the previous one?)
4. $p(a|j, \neg m)$

Now, repeat items (2) and (4) using variable elimination. When you have to choose a variable to eliminate, choose alphabetically.