COMP3270 Chapter 6 Teacher Notes

Slide 16:

Assuming the domains are all binary 2^27.

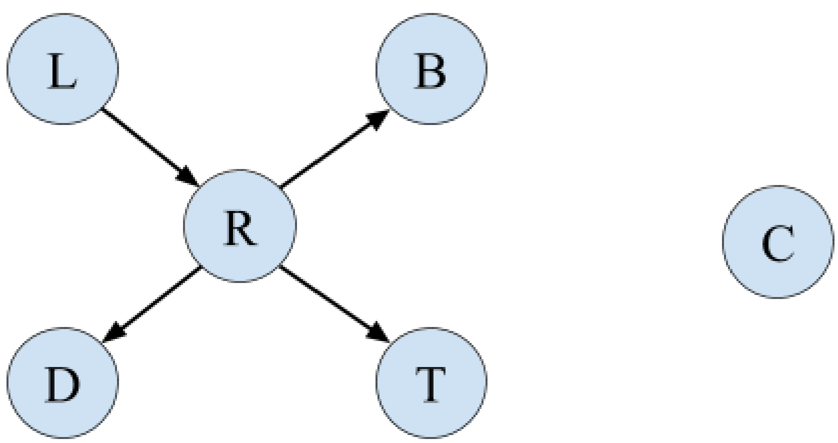
Slide 17:

The 'Car won't start' variable because it has the most arcs coming in, i.e., the most parents.

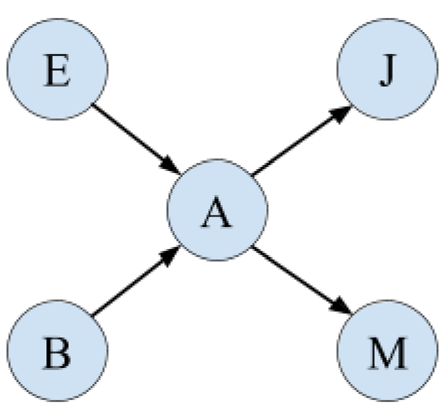
Slide 20:

With model 1 you are unable to reason about one variable given the other because they are modeled as being independent. Model 2 is a better choice because the two variables are related.

Slide 21:



Slide 22:



Slide 25:

P(+cavity) P(+catch | +cavity) P(-toothache | +cavity)

Slide 27:

0.5 * 0.5 * 0.5 * 0.5

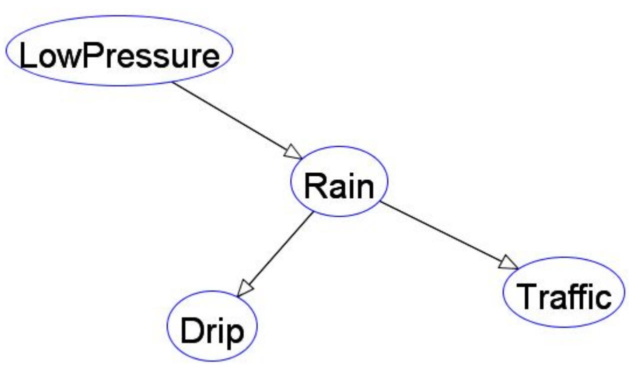
Slide 28:

P(+r) * P(-t | +r) = ¼ * ¼

Slide 33:

2^5 * 30 = 960
vs
2^30 = 1 billion

Slide 34:



Probability Table for LowPressure

	P(LowPressure=T)	P(LowPressure=F)
Prior Probability	0.1	0.9

Probability Table for Rain

LowPressure	P(Rain=T)	P(Rain=F)
T	0.9	0.1
F	0.1	0.9

Probability Table for Drip

Rain	P(Drip=T)	P(Drip=F)
T	0.9	0.1
F	1.0E-4	0.9999

Probability Table for Traffic

Rain	P(Traffic=T)	P(Traffic=F)
T	0.9	0.1
F	0.3	0.7

Now we have a Bayes net. What can we do with it?

We can ask: What is the probability that there is traffic: (Click on Query, then traffic)
Answer should be 40%

Let's add an observation of drop. What is the probability that there is traffic given that my roof is dripping? Answer Should be 90%

Let's now observe rain. Answer should be 90%, slightly higher.

If we now also now its low pressure, the traffic will stay the same because they are independent given the Rain observation.

Slide 42:

a) $Z \perp X \mid Y$, $W \perp X, Y \mid Z$

b) $X \perp W \mid Y$

Proof:
We need to proof this $P(w \mid x, y) =? P(w \mid y)$

$P(w \mid x, y) = P(x, y, w) / P(x,y) = \text{sum\_z } P(x)P(y|x)P(z|y)P(w|z) / P(x)P(y \mid x) =$
$= \text{sum\_z } P(z|y)P(w|z) = \text{sum\_z } P(z|y)P(w|y,z) = \text{sum\_z } P(z,w \mid y) = P(w \mid y)$

Slide 43:

You can never exclude independence. Independence is always possible. You can always find a CPT to make all variables independent, i.e., no variables depend on their parents

Slide 50:

Note that this is the assumption we make when we build up our Bayes net. For every variable X_i that we introduce, we assume:

$X_i \perp \{X_1 \dots X_{i-1}\} - \text{parents}(X_i) \mid \text{parents}(X_i)$

With the following ordering X, Y, Z this becomes.

$Y \perp X$ | (parents (Y) = empty set) = $Y \perp X$

Are X and Y independent given Z?
No: seeing traffic puts the rain and the ballgame in competition
Example: Say you know there is traffic. You know that Rain could cause traffic or the Ballgame. Say that now someone tells you that there is Rain. This will change your probability of weather or not there is a ballgame.

Slide 53:

Reachability almost works:

Say we want to find out if two variables are independent given another variable.
We look at the path. Shade observations. Example: Is L independent of B given R: $L \perp B \mid R$

It doesn't work because the common effect case is different compared to the other two cases.

Slide 69:

1: No
2: Yes
3: Yes
4: No
5: Yes
6: No
7: Yes
8: No
9: Yes
10: No
11: No
12: Yes
13: No
14: Yes
15: Yes
16: Yes
17: No

Slide 77:

1) $\{ X \perp Z \mid Y \}$
2) $\{ X \perp Z \mid Y \}$
3) $\{X \perp Z\}$
4) $\{\}$

4) Does not make any assumptions.
1) and 2) make the same assumptions. Any distribution modeled by 1) can also be modeled by 2)