131 Morgan Rockett

1)

a) $P(X|Y) < P(X)$

False, if $Y=0$ and doesnt occur then this would not hold true

b) $P(Z|X,Y) = P(Z|X)P(Z|Y)$

$\to \frac{P(X,Y,Z)}{P(X,Y)} = \frac{P(X)P(Y|X)P(Z|Y)}{P(Y|X)P(X)} = P(Z|Y)$
$= P(Z|X)$

$\to \frac{P(X,Z,Y)}{P(Y,X)} = P(Z|X) \quad P(Z|Y)$

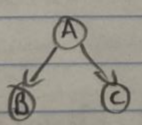
No, we cant assume for any Z

c) Depending on how it is constructed, this can be true.

3 binary nodes

$2^3 - 1 = 7$

Full JPT



$5 < 7$

A	B	C	
1	2	2	$\Sigma = 5$

No need to store T, F values for node w/ no parents in Bayes network.

2)

a) RSum $P=0.04$ 8th -3 runs

$P=0.5$ D +1, B +1 -1 runs

	H	¬H
D	0.2	0.8
B	0.1	0.9

D B	Prob HR both
TT	$0.2*0.1 = 0.02$
TF	$0.2*0.9$
FT	$0.8*0.1$
FF	$0.8*0.9$

$\left.\right\}$ 0.98

$P(D \cap B)$

$P(\text{both HR}) = 0.02$

b) $(D \cap B \mid \neg W)$

No double HR's

$P(W) = 0.04$

$P(\neg W) = 0.96$

double HR's

$P(W) = 0.50$

$P(\neg W) = 0.50$

Let X = double HRs

$X = 0.02$

$$P(X \mid \neg W) = \frac{P(\neg W \mid X)\,P(X)}{P(\neg W)} = \frac{(\quad)(0.02)}{0.50}$$

$\underline{0.98}$

$$\frac{0.02 * 0.50}{0.98 * 0.96 + 0.02 * 0.50}$$

$0.50 * \sum \left(\frac{0.02}{0.98}\right) = 0.50$

$$\frac{0.01}{0.9508} = 0.011$$

	DHR	¬DHR
W	0.5	0.04
¬W	0.5	0.96

could enum along D, B but DHR can replace

$$\frac{0.5}{0.5+0.96}$$

$0.5+0.5+0.5+0.96-0.5$

2)

$P(w \mid \neg X)$ $\neg X = 0.98$

$\overline{}$

0.98

doesnt happen, then still 0.04 odds of winning

$\frac{0.04}{0.98}$

3)

a) 2 2 1 1 1 1

1 4 8 2 2 2

1 2 3 with 7 params

b) 1) we see type 2 out d A $\rightarrow$ B, D

C Cant influence D beyond A, since blocking

True

2) A blocks D due to type 3 d separation

True

3) No, could be dependent

No d separation

C - A - D

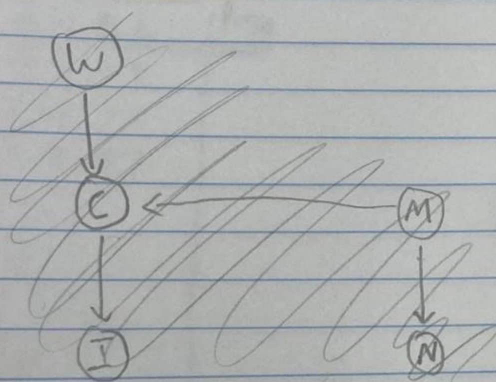
c) $P(D|C) = \frac{P(C|D)\,P(D)}{P(C)} = P(C|D)\,P(D)\,P(D|B)$

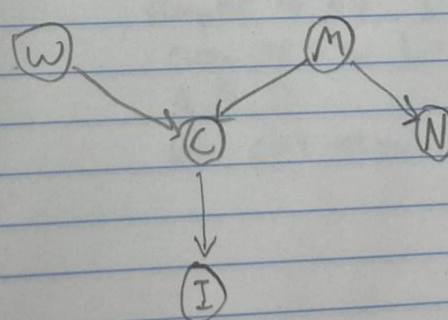
$P(C) \rightarrow P(C|A)\,P(C)$

4)

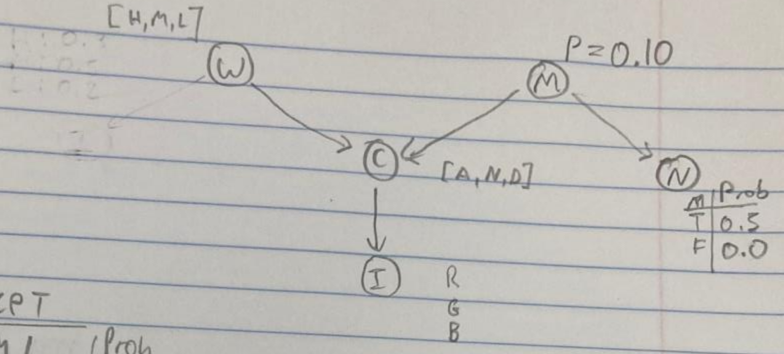
Power plant

C =	Core	A, N, D
W =	a) power	H, M, L
M =	b) meltdown	T, F
I =	Dial	R, G, B
N	Donut	T, F





4)



16-row CPT

core CPT

M	H	M	L	Prob
T	T	T	T	
T	T	T	F	
T	T	F	T	
⋮				
F	F	F	T	
F	F	F	F	

Col 1 Meltdown
Col 2 Power High
Col 3 Power Med
Col 4 Power Low

Distribution of C

{ A:
N:
D: }

tempted to do 2^7 rows bc of sprinkler example - to hold dist of core A, N, D
but CPT should just be parents

c) The dial is conditionally independent due to type 1 blocking by C on the path I → C → M

d) Yes, the third type of d blocking occurs at C in between M → C → W (conditionally independent)