

$$\prod_{X_i} P(X_i | pa(X_i))$$

$$P(M, R_a, O, w, R_u) = P(M) P(R_a) P(O) P(w | R_a, O) P(R_u | M, w)$$

M	R	O	w	R <sub>u</sub>	P
T	T	T	T	T	.9 .7 .2 .9 .8 = .0216
T	T	T	T	F	
⋮					

$$\sum_x \sum_y \sum_z \sum_u \sum_v A(xyz) B(yu) D(zuv) \underbrace{\sum_w C(zw)}_{E(z)}$$

$$\overbrace{E(z)}^{T|z} \sum_x \sum_y \sum_z \sum_u A(xyz) B(yu) E(z) \underbrace{\sum_v D(zuv)}_{F(zu)}$$

$$\overbrace{F(zu)}^{T|z} \sum_x \sum_y \sum_z A(xyz) E(z) \underbrace{\sum_u B(yu) F(zu)}_{G(yz)}$$

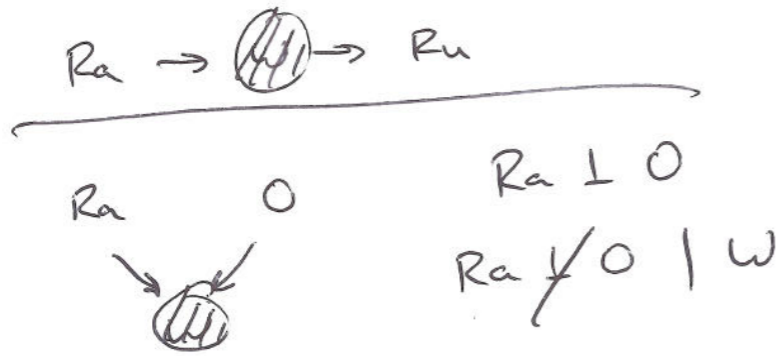
$B \cdot F(yzu)$   
 $3-1=2$  treewidth

	B	F	BF
TTT	0	2	0
TTF	1	2	2
TFT	0	2	0
TF	1	1	1
FTT	1	2	2
FTF	1	2	2
FFT	1	2	2
FFF	1	1	1

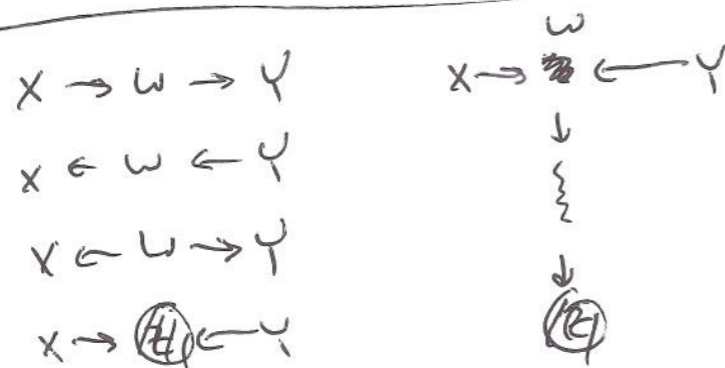
$$\overbrace{G(yz)}^{T|z}$$

TT	2
TF	1
FT	4
FF	3

$$\begin{aligned}
 & R_a \rightarrow W \rightarrow R_u \rightarrow \text{dep} \\
 & \frac{P(R_a) P(W|R_a) P(R_u|W)}{P(R_a) P(W=F|R_a) P(R_u|W=F)} \\
 & \text{Ra only} \qquad \text{Ru only}
 \end{aligned}$$



$$P(R_a) P(O) P(W=F | R_a, O)$$



$$\begin{aligned}
 & \sum_{R_a} \sum_W \sum_{R_u} P(M) P(R_a) P(O) P(W|R_a, O) P(R_u | M, W) \\
 & = \sum_{R_a} \sum_W P(M) P(R_a) P(O) P(W|R_a, O) \sum_{R_u} P(R_u | M, W) \\
 & = \sum_{R_a} P(M) P(R_a) P(O) \sum_W P(W|R_a, O)
 \end{aligned}$$

$$\begin{aligned}
 & = P(M) P(O) \\
 & \quad \uparrow \quad \quad \uparrow \\
 & \quad .9 \quad \quad .7
 \end{aligned}$$

- M ⊥ O
- Ra ⊥ O
- M ⊥ R
- M ⊥ W

	T	O	F
M=T	.43	.27	
M=F	.07	.03	

O ⊥ Ru

$$\begin{aligned}
 P(O, R_u | W=F) &= P(O | W=F) P(R_u | W=F) \\
 & \quad O \perp R_u | W
 \end{aligned}$$

X active : unstacked  $\rightarrow X \rightarrow$

$\leftarrow X \leftarrow$

$\leftarrow X \rightarrow$

stacked

~~$\leftarrow X \leftarrow$~~   
 $\rightarrow \textcircled{X} \leftarrow$

$\rightarrow \textcircled{X} \leftarrow$   
↓  
 $\textcircled{X}$