$P(W \mid winter)$ $\quad Q = W$, $E = \{winter\}$, $H = \{T\}$

evidence, hidden, query

S	T	W	
w	h	s	0.10
w	h	r	0.05
w	c	s	0.15
w	c	r	0.20

S	W		normalize	
w	s	0.25	→	0.5
w	r	0.25	→	0.5

$P(W, T, winter)$ $\quad P(W, winter)$ $\quad P(W \mid winter)$

Join

$\sum_T$ (sum out hidden variable)

$P(W \mid winter) \propto_W P(W, winter)$

$Z, X_1, \cdots, X_{n-1}$

$P(Z)\, P(X_1 \mid Z)\, P(X_2 \mid Z) \cdots P(X_n \mid Z)$ $\quad n+1$ variables.

① $\sum_Z$

size of the factor $= 2^n$ (after summing out Z)

② $\sum_{X_1}$ $f_1(X_1, \cdots, X_{n-1})\, P(y_1 \mid X_1) \xrightarrow{\text{sum out } X_1} f_2(y_1, X_2, \cdots, X_{n-1})$

$X_1, X_2, \cdots, X_{n-1}, Z$

① $\sum_{X_1}$ $P(X_1 \mid Z)\, P(y_1 \mid X_1)$ $\quad 2$ variables

size of the factor $= 2$

② $\sum_{X_2}$ $f_1'(y_1, Z)\, P(X_2 \mid Z)\, P(y_2 \mid X_2) \xrightarrow{\text{sum out } X_2} f_2'(y_1, y_2, Z)$