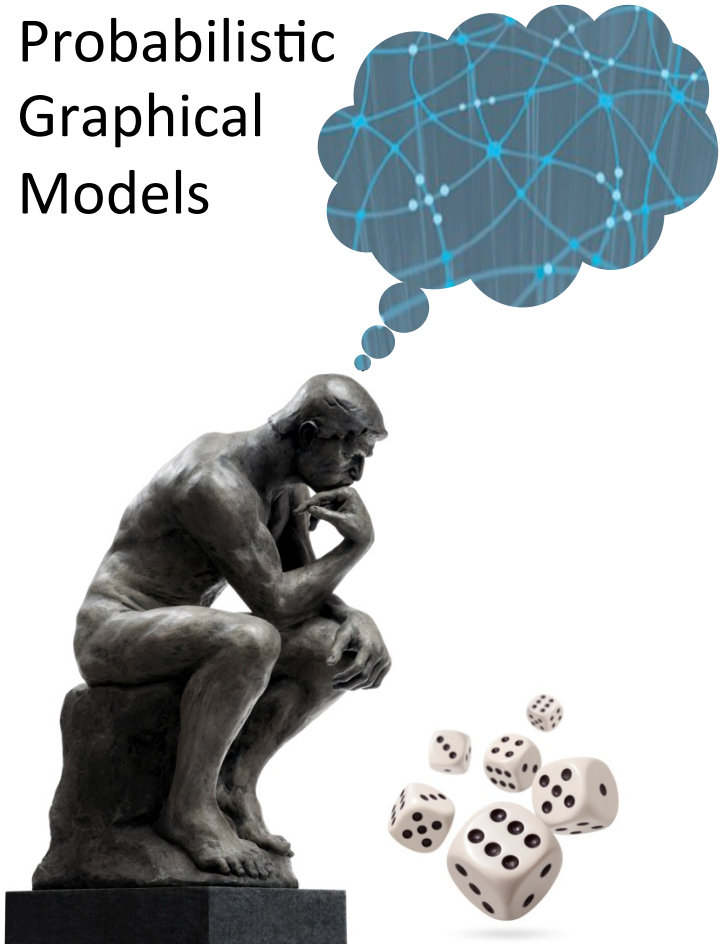
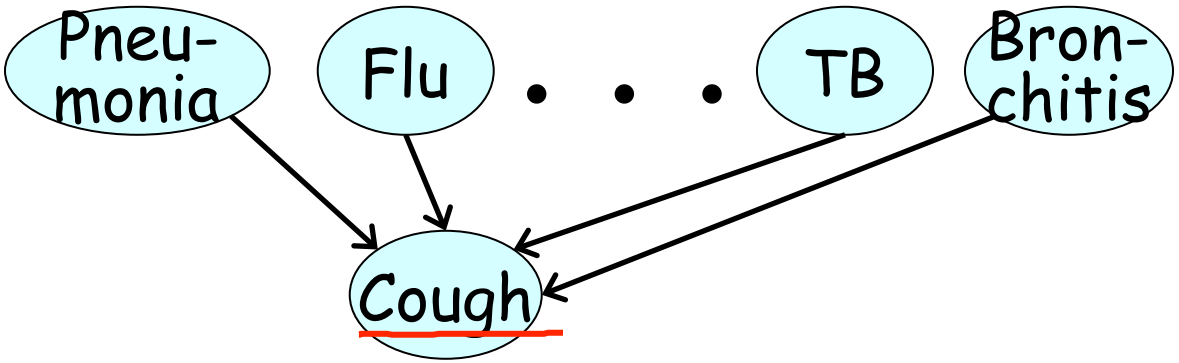
Probabilistic Graphical Models



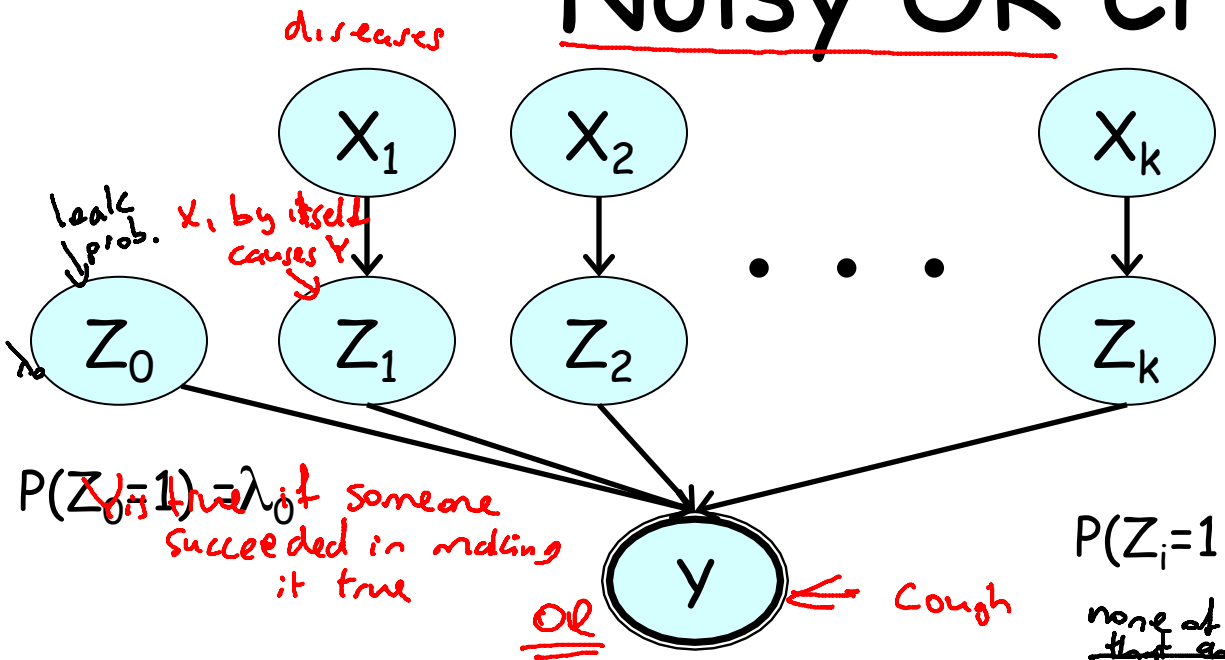
Representation

Local Structure

Independence of Causal Influence


Pneu-
monia
Flu
TB
Bron-
chitis
Cough

Noisy OR CPD



$$P(Z_i=1 \mid X_i) = \begin{cases} 0 & X_i=0 \\ \lambda_i & X_i=1 \end{cases} \quad \lambda_i \in [0,1]$$

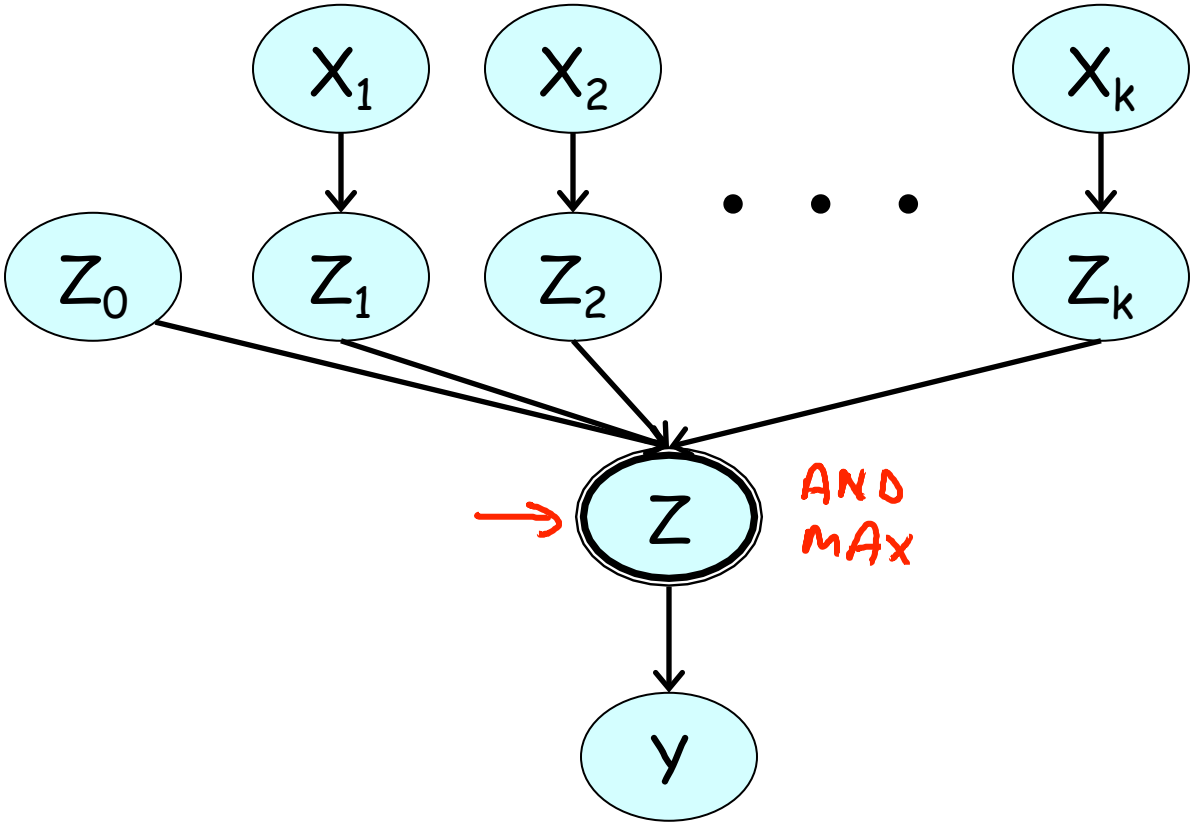
none of causes that are on succeeded

$$P(Y=0 \mid X_1,\ldots,X_k) = (1-\lambda_0) \prod_{i:X_i=1} (1-\lambda_i)$$

$$P(Y=1 \mid X_1,\ldots,X_k) = 1 - P(Y=0 \mid X_1,\ldots,X_k)$$

Daphne Koller

Independence of Causal Influence



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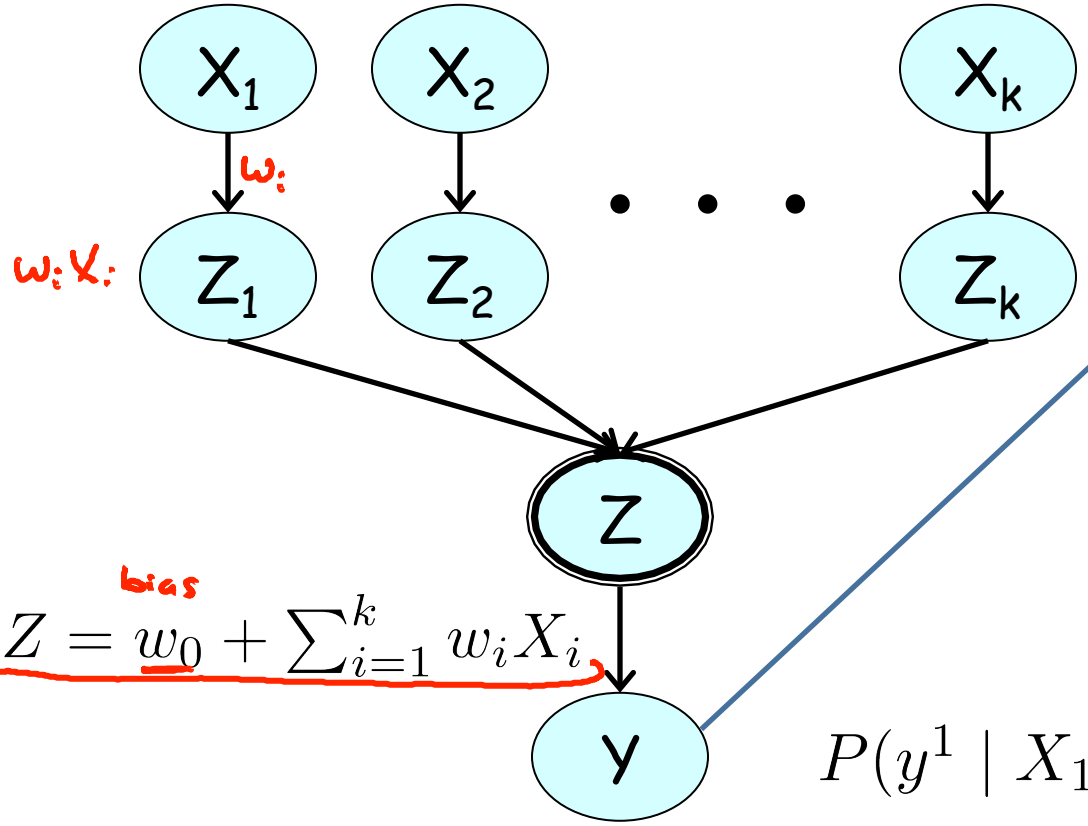
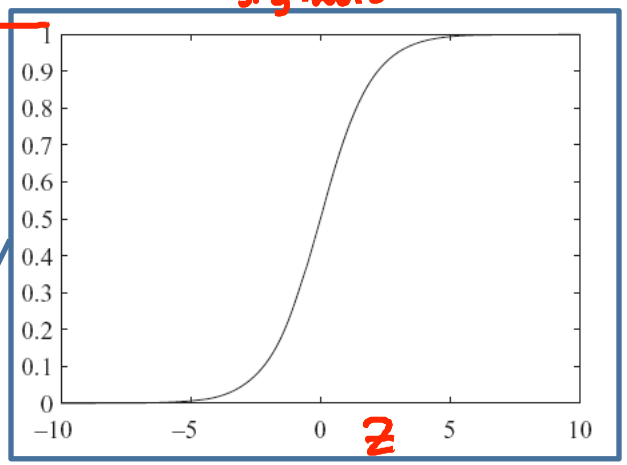
Sigmoid CPD

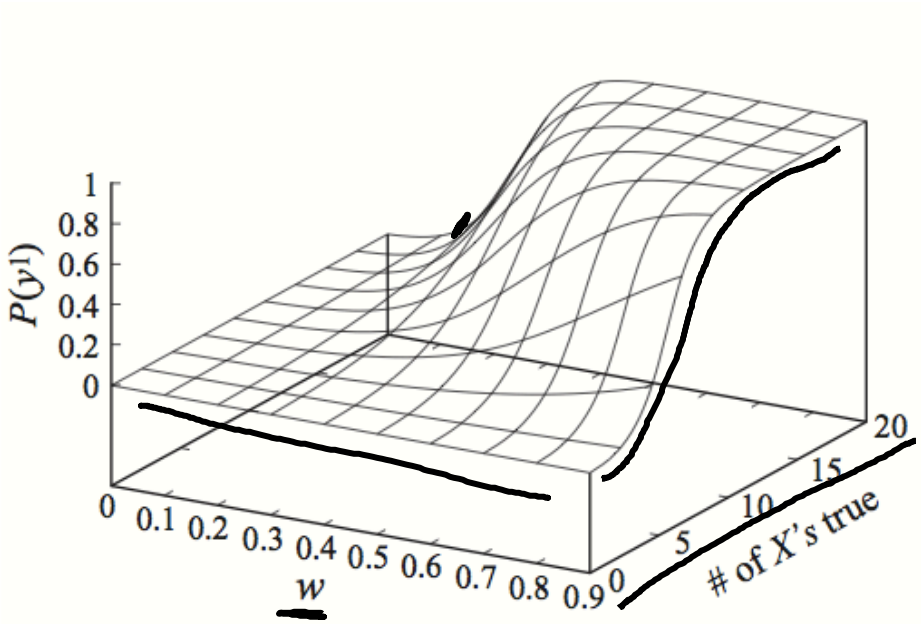




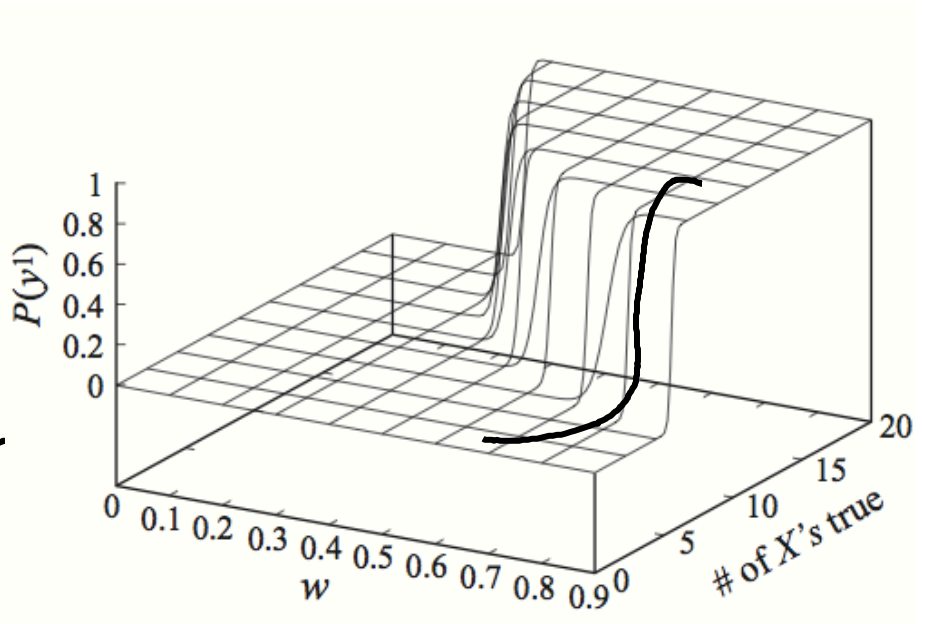
$$\text{sigmoid}(z) = \frac{e^z}{1 + e^z}$$

$$P(y^1 \mid X_1, \ldots, X_k) = \text{sigmoid}(Z)$$

Behavior of Sigmoid CPD



$w_0 = -5$



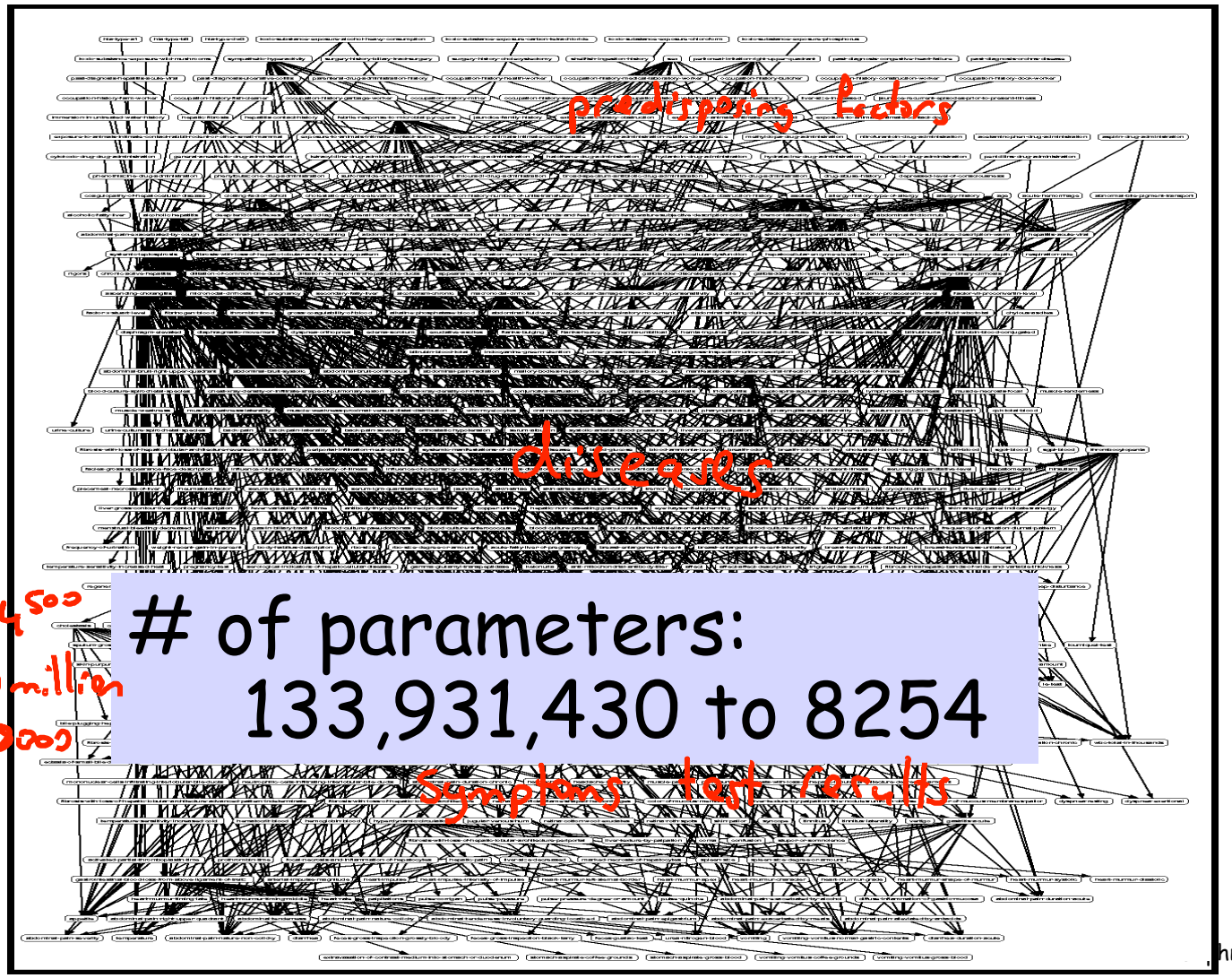
multiply w and w_0 by 10

Daphne Koller

CPCS

M. Pradhan
G. Provan
B. Middleton
M. Henrion
UAI 1994

joint dist ≈ 4^{500}
factorized ≈ 134 million
noisy max CPD ≈ 1000



# of parameters:
133,931,430 to 8254