

# Bayes Nets

Friday, October 21, 2016 8:59 AM

Product Rule:  $P(a, b) = \underline{P(a|b)} P(b) = \underline{P(b|a)} P(a)$

Bayes Rule:  $P(a|b) = \alpha P(b|a) P(a)$

$$P(a|b, c) = \alpha P(c|a, b) \underline{P(a, b)} \leftarrow \text{Bayes}$$

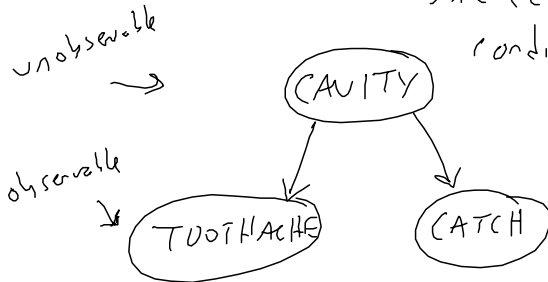
$$= \alpha P(c|a, b) P(b|a) P(a)$$

Bayesian Net: Visualization of relations btwn variables

Node: Random Variable

Arc (directed): indicate causal influence

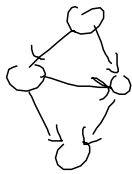
conditional probability tables: for each arc



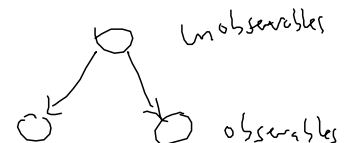
CAVITY	$P(\text{tooth}   \text{CAVITY})$	$P(\neg \text{tooth}   \text{CAVITY})$
T	0.6	0.4
F	0.1	0.9

\* Modeling a problem  
No cycles!

if we were  
doing logic  $P \rightarrow \neg Q$



Naive Bayes Assumption: if you have cause  $\rightarrow$  effects  
effects are independent



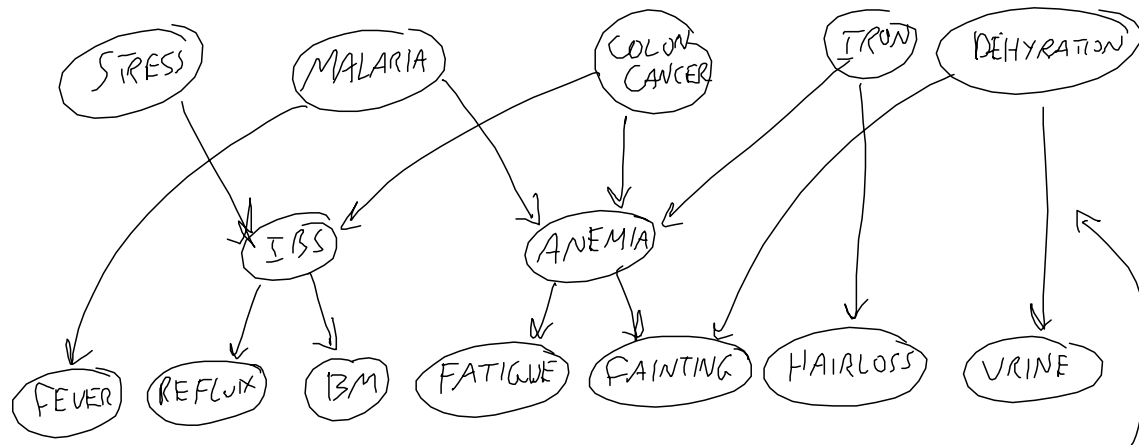
(CAUSE)



$$P(\text{CAUSE} | \text{EFFECT}_1 \dots \text{EFFECT}_N) = P(\text{CAUSE}) \prod_{i=1}^N P(\text{EFFECT}_i | \text{CAUSE})$$

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D	$P(\text{URINE}=Y D)$	$P(U=M D)$	$P(U=C D)$
High			
Med			
Low			

$$P(X_1, X_2, X_3, \dots, X_n) = \prod_{i=1}^n P(X_i | \text{PARENTS}(X_i))$$

Almost never have a full joint distribution, but conditional prob. tables are easy to get  
 Translate Full Joint Distributions to conditional probability tables

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