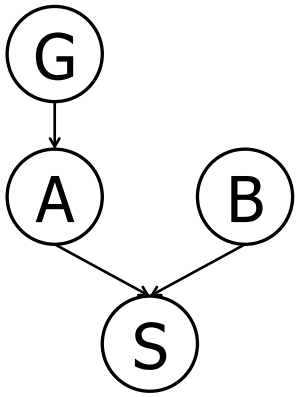
CS 188
Fall 2022

Regular Discussion 6

1 Bayes' Nets Representation and Probability

Suppose that a patient can have a symptom (S) that can be caused by two different diseases (A and B). It is known that the variation of gene G plays a big role in the manifestation of disease A. The Bayes' Net and corresponding conditional probability tables for this situation are shown below. For each part, you may leave your answer as an arithmetic expression.



$P(G)$	
$+g$	0.1
$-g$	0.9

$P(A\|G)$		
$+g$	$+a$	1.0
$+g$	$-a$	0.0
$-g$	$+a$	0.1
$-g$	$-a$	0.9

$P(B)$	
$+b$	0.4
$-b$	0.6

$P(S\|A,B)$			
$+a$	$+b$	$+s$	1.0
$+a$	$+b$	$-s$	0.0
$+a$	$-b$	$+s$	0.9
$+a$	$-b$	$-s$	0.1
$-a$	$+b$	$+s$	0.8
$-a$	$+b$	$-s$	0.2
$-a$	$-b$	$+s$	0.1
$-a$	$-b$	$-s$	0.9

(a) Compute the following entry from the joint distribution:

$P(+g, +a, +b, +s) =$

(b) What is the probability that a patient has disease A?

$P(+a) =$

(c) What is the probability that a patient has disease A given that they have disease B?

$P(+a|+b) =$

(d) What is the probability that a patient has disease A given that they have symptom S and disease B?

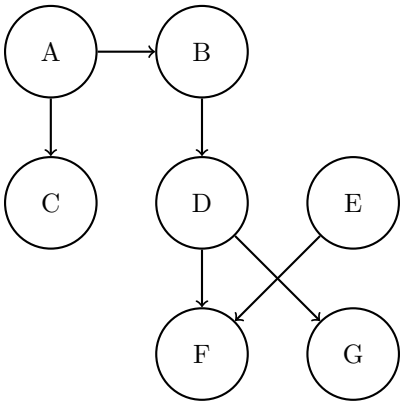
$P(+a|+s,+b) =$

(e) What is the probability that a patient has the disease carrying gene variation G given that they have disease A?

$P(+g|+a) =$

2 Bayes Nets: Representation

Parts (a), (b), and (c) pertain to the following Bayes' Net.



(a) Express the joint probability distribution as a product of terms from the Bayes Nets CPTs.

(b) Assume each node can take on 4 values. How many entries do the factors at A, D, and F have?

A: _____ D: _____ F: _____

(c) Mark all that are guaranteed to be true:

- ☐ $B \perp\!\!\!\perp C$
- ☐ $A \perp\!\!\!\perp F$
- ☐ $D \perp\!\!\!\perp E|F$
- ☐ $E \perp\!\!\!\perp A|D$
- ☐ $F \perp\!\!\!\perp G|D$
- ☐ $B \perp\!\!\!\perp F|D$
- ☐ $C \perp\!\!\!\perp G$
- ☐ $D \perp\!\!\!\perp E$

Parts (d) and (e) pertain to the following CPTs.

A	$P(A)$
+a	0.8
−a	0.2

A	B	$P(B\|A)$
+a	+b	0.9
+a	−b	0.1
−a	+b	0.6
−a	−b	0.4

B	C	$P(C\|B)$
+b	+c	0.8
+b	−c	0.2
−b	+c	0.8
−b	−c	0.2

C	D	$P(D\|C)$
+c	+d	0.25
+c	−d	0.75
−c	+d	0.5
−c	−d	0.5

(d) State all non-conditional independence assumptions that are implied by the probability distribution tables.

(e) Circle all the Bayes net(s) that can represent a distribution that is consistent with the tables given.