Homework 3

Instructions

Points: Please see the points for each problem.
Submission: Submit completed homework as a PDF file. Handwritten work or photos of handwritten work must be neat and legible.

Points Summary

Question Number	Points Possible	Points Earned
1	1	_____
2	1	_____
3	1	_____
4	1	_____
5	1	_____
6	1	_____
7	1	_____
8	1	_____
9	3	_____
10	3	_____
11	3	_____
12	3	_____
Total	**20**	_____

1 Bayes' Nets Representation

Graph Structure: Conditional Independence

Consider the Bayes' net given below.

Recall:

- $X \perp\!\!\!\perp Y$ reads as "X is independent of Y".
- $X \perp\!\!\!\perp Y \mid \{Z, W\}$ reads as "X is independent of Y given Z and W".

For each statement below, indicate whether it is True or False. (1 point each)

1. **True** **False**
   It is guaranteed that $A \perp\!\!\!\perp B$.
2. **True** **False**
   It is guaranteed that $A \perp\!\!\!\perp C$.

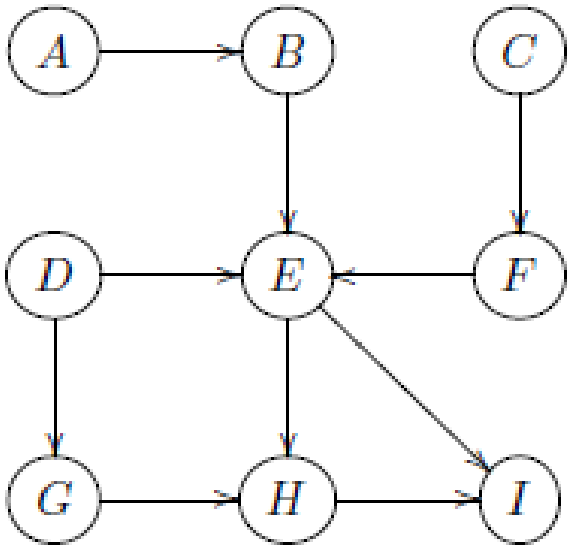


Figure 1: Bayes' net graph structure showing nodes A through I and their directed dependencies

3. **True** **False**
   It is guaranteed that $A \perp\!\!\!\perp D \mid E$.

4. **True** **False**
   It is guaranteed that $A \perp\!\!\!\perp I \mid E$.

5. **True** **False**
   It is guaranteed that $B \perp\!\!\!\perp C \mid I$.

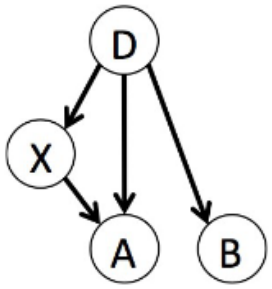
6. **True** **False**
   It is guaranteed that $F \perp\!\!\!\perp A \mid H$.

7. **True** **False**
   It is guaranteed that $D \perp\!\!\!\perp I \mid \{E, G\}$.

5. **True** **False**
   It is guaranteed that $C \perp\!\!\!\perp H \mid G$.

2 Bayes' Net Reasoning

$P(A\|D,X)$			
$+d$	$+x$	$+a$	0.9
$+d$	$+x$	$-a$	0.1
$+d$	$-x$	$+a$	0.8
$+d$	$-x$	$-a$	0.2
$-d$	$+x$	$+a$	0.6
$-d$	$+x$	$-a$	0.4
$-d$	$-x$	$+a$	0.1
$-d$	$-x$	$-a$	0.9



$P(D)$	
$+d$	0.1
$-d$	0.9

$P(X\|D)$		
$+d$	$+x$	0.7
$+d$	$-x$	0.3
$-d$	$+x$	0.8
$-d$	$-x$	0.2

$P(B\|D)$		
$+d$	$+b$	0.7
$+d$	$-b$	0.3
$-d$	$+b$	0.5
$-d$	$-b$	0.5

Figure 2: Bayes' net for disease testing with disease D and tests A and B, showing conditional probability tables

1. What is the probability of having disease D and getting a positive result on test A? $P(+d, +a) =$
3. What is the probability of not having disease D and getting a positive result on test A? $P(-d, +a) =$
3. What is the probability of having disease D given a positive result on test A? $P(+d|+a) =$
4. What is the probability of having disease D given a positive result on test B? $P(+d|+b) =$