0/11 Questions Answered

HW 5 (Electronic Component)

STUDENT NAME

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Q1 Combining Factors

12 Points

A, B, C, D are random variables. A's domain is $\{a_1, a_2\}$, B's domain is $\{b_1, b_2, b_3\}$, C's domain is $\{c_1, c_2, c_3, c_4, c_5\}$, D's domain is $\{d_1, d_2, d_3, d_4, d_5, d_6, d_7\}$.

Q1.1

3 Points

Given the factors $P(A \mid C)$ and $P(B \mid A, C)$, what is the size of the resulting factor after doing the pointwise product?

Enter your answer here

Save Answer

Q1.2

3 Points

Given the factors $P(A|B)$ and $P(B|C)$ and $P(C)$, what is the size of the new factor created if we sum out C from the pointwise product of the relevant factors?

Enter your answer here

Save Answer

Q1.3
3 Points

Given the factors $P(A|C)$ and $P(B|A,C)$, what is the size of the new factor created if we sum out A from the pointwise product of the relevant factors??

Enter your answer here

Save Answer

Q1.4
3 Points

Given the factors $P(C|A)$, $P(D|A,B,C)$, $P(B|A,C)$, what is the size of the new factor created if we sum out C from the pointwise product of the relevant factors??

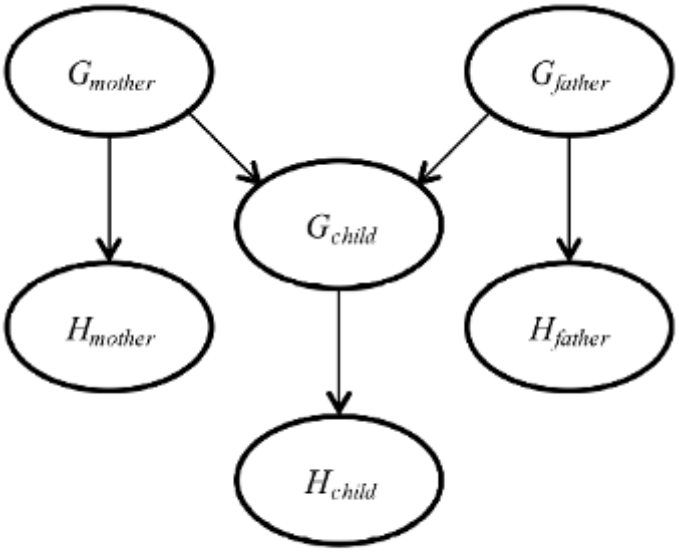
Enter your answer here

Save Answer

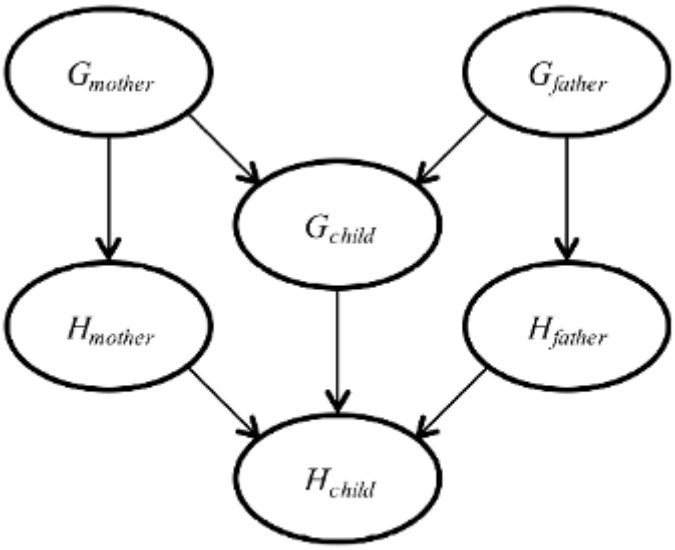
Q2 Bayes' Nets Independence
12 Points

Let H_x be a random variable denoting the handedness of an individual x, with possible values l or r. A common hypothesis is that left- or right-handedness is inherited by a simple mechanism; that is, perhaps there is a gene G_x, also with values l or r, and perhaps actual handedness turns out mostly the same (with some probability s) as the gene an individual possesses. Furthermore, perhaps the gene itself is equally likely to be inherited from either of an individual's parents, with a small nonzero probability m of a random mutation flipping the handedness.

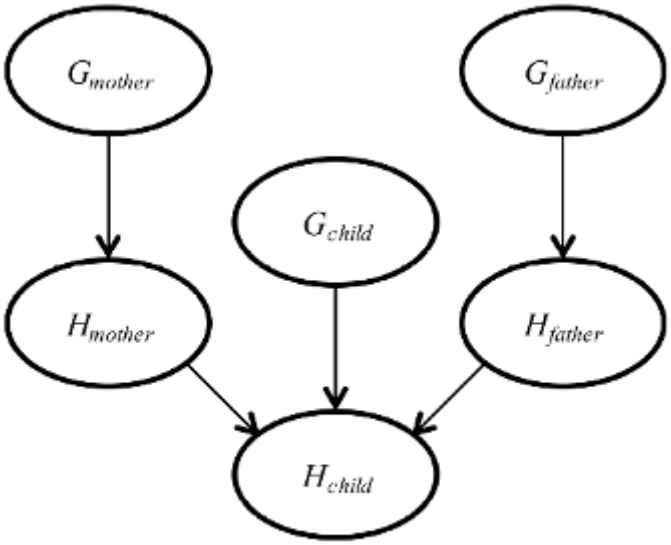
The following three images are possible models involving the genes G and handednesses H.



(a)



(b)



(c)

Q2.1

4 Points

Which of the three networks above claim that $P(G_{father}, G_{mother}, G_{child}) = P(G_{father})P(G_{mother})P(G_{child})$?

- [ ] (a)
- [ ] (b)
- [ ] (c)

Save Answer

Q2.2

4 Points

Which of the three networks make independence claims that are consistent with the hypothesis about the inheritance of handedness?

- [ ] (a)
- [ ] (b)
- [ ] (c)

Save Answer

Q2.3
4 Points

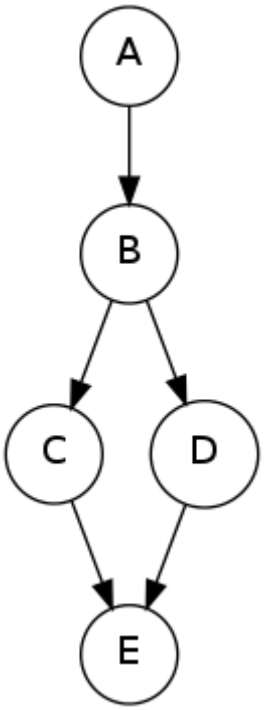
Which of the three networks is the best description of the hypothesis?

- ○ (a)
- ○ (b)
- ○ (c)

Save Answer

Q3 Variable Elimination Tables
21 Points

Assume the following Bayes Net and corresponding CPTs. In this exercise, we are given the query $P(C \mid e = 1)$, and we will complete the tables for each factor generated during the elimination process.



After introducing evidence, we have the following probability tables.

A	$P(A)$
0	0.100
1	0.900

B	A	$P(B\|A)$
0	0	0.500
1	0	0.500
0	1	0.400
1	1	0.600

C	B	$P(C\|B)$
0	0	0.400
1	0	0.600
0	1	0.300
1	1	0.700

D	B	$P(D\|B)$
0	0	0.600
1	0	0.400
0	1	0.900
1	1	0.100

C	D	$P(e=1\|C,D)$
0	0	0.600
1	0	0.200
0	1	0.600
1	1	0.200

Q3.1

15 Points

Three steps are required for elimination, with the resulting factors listed below:

Step 1: eliminate A. We get the factor $f_1(B) = \sum_a P(a)P(B|a)$

Step 2: eliminate B. We get the factor $f_2(C, D) = \sum_b P(C|b)P(D|b)f_1(b)$

Step 3: eliminate D. We get the factor $f_3(C, e = 1) = \sum_d P(e = 1|C, d)f_2(C, d)$.

Fill in the missing quantities. (some of the quantities are computed for you)

$f_1(B=0) =$

Enter your answer here

$f_1(B=1) =$

Enter your answer here

$f_2(C=0, D=0) =$

Enter your answer here

$f_2(C=1, D=0) =$

Enter your answer here

$f_2(C=0, D=1) = 0.083$

$f_2(C=1, D=1) = 0.14$

$f_3(C=0, e=1) =$

Enter your answer here

$f_3(C=1, e=1) = 0.132$

Save Answer

Q3.2

6 Points

After getting the final factor $f_3(C, e=1)$, a final renormalization step needs to be carried out to obtain the conditional probability $P(C|e=1)$. Fill in the final conditional probabilities below.

$P(C=0 \mid e=1) =$

Enter your answer here

$P(C = 1 \mid e = 1) =$

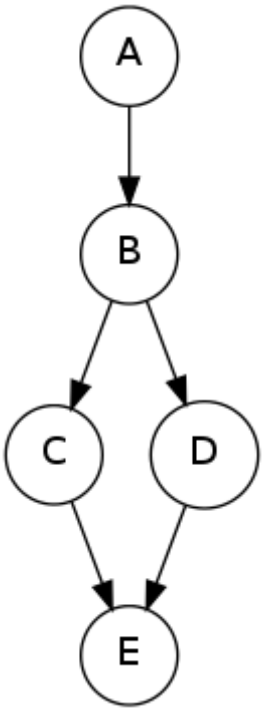
Enter your answer here

Save Answer

Q4 Rejection Sampling

12 Points

We will work with a Bayes' net of the following structure.



In this question, we will perform rejection sampling to estimate $P(C = 1 \mid B = 1, E = 1)$. Perform one round of rejection sampling, using the random samples given in the table below. Variables are sampled in the order A, B, C, D, E. In the boxes below, choose the value (0 or 1) that each variable gets assigned to. **Note that the sampling attempt should stop as soon as you discover that the sample will be rejected. In that case mark the assignment of that variable and write `none` for the rest of the variables.**

When generating random samples, use as many values as needed from the table below, which we generated independently and uniformly at random from $[0, 1)$. Use numbers from left to right. To sample a binary variable W with probability $P(W = 0) = p$ and $P(W = 1) = 1 - p$ using a value a from the table, choose $W = 0$ if $a < p$ and $W = 1$ if $a \geq p$.

0.320	0.037	0.303	0.318	0.032	0.969	0.018	0.058	0.908	0.249

A	$P(A)$
0	0.200
1	0.800

B	A	$P(B\|A)$
0	0	0.800
1	0	0.200
0	1	0.400
1	1	0.600

C	B	$P(C\|B)$
0	0	0.600
1	0	0.400
0	1	0.400
1	1	0.600

D	B	$P(D\|B)$
0	0	0.800
1	0	0.200
0	1	0.600
1	1	0.400

E	C	D	$P(E\|C, D)$
0	0	0	0.800
1	0	0	0.200
0	1	0	0.600
1	1	0	0.400
0	0	1	0.400
1	0	1	0.600
0	1	1	0.400
1	1	1	0.600

Enter either a 0 or 1 for each variable that you assign a value to. Upon rejecting a sample, enter its assigned value, and enter `none` for the remaining variables. For example, if C gets rejected, fill in `none` for D and E.

A:

Enter your answer here

B:

Enter your answer here

C:

Enter your answer here

D:

Enter your answer here

E:

Enter your answer here

Which variable will get rejected?

- A
- B
- C
- D
- E
- None of the variables will get rejected

Save Answer

Q5 Estimating Probabilities from Samples

6 Points

Below are a set of samples obtained by running rejection sampling for the Bayes' net from the previous question. Use them to estimate $P(C = 1 \mid B = 1, E = 1)$. The estimation cannot be made whenever all samples were rejected. In this case, input -1 into the box below.

Sample 1

	0	1	rejected
A		x	
B	x		x
C			
D			
E			

Sample 2

	0	1	rejected
A	x		
B		x	
C	x		
D	x		
E		x	

Sample 3

	0	1	rejected
A		x	
B		x	
C		x	
D	x		
E		x	

Sample 4

	0	1	rejected
A		x	
B	x		x
C			
D			
E			

Sample 5

	0	1	rejected
A	x		
B		x	
C		x	
D	x		
E	x		x

Estimation:

Enter your answer here

Save Answer

Save All Answers

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