Test

HW3

0 OF 20 QUESTIONS REMAINING

Test Content

Question 1

2 Points

Which of the following expressions is equivalent to $P(A|B,C,D)$?

A $\dfrac{P(A,B,C,D)}{P(B|C,D)P(D)P(C)}$

B $\dfrac{p(A,B,C,D)}{p(C|B,D)p(B|D)p(D)}$

C $\dfrac{p(A,B,C,D)}{p(B,C|D)p(B)p(C)}$

D $\dfrac{p(A,B,C,D)}{p(B,C)p(D)}$

$P(A|B,C,D) = \dfrac{P(A,B,C,D)}{P(D)P(B|D)P(C|B,D)}$

Question 2

4 Points

Suppose that A and B are independent Boolean variables. Determine the missing entries x and y in the joint distribution $P(A,B)$ shown below.

$P(A=T, B=T) = 0.15$ = P(A=T)P(B=T)
$P(A=T, B=F) = 0.45$ = P(A=T)P(B=F)
$P(A=F, B=T) = x$ = P(A=F)P(B=T)
$P(A=F, B=F) = y$ = P(A=F)P(B=F)

$0.15 + 0.45 + x + y = 1$

$\therefore x + y = 0.4$ (1)

See below

x = **0.1**
y = **0.3**

Blank 1 0.1

Blank 2 0.3

During Ramadan in the 40s, Maghrib prayer was rarely broadcasted on TV and sometimes not broadcasted on the right time. As a kid though, you may still now if it is time based on the yummy food smells. Particularly, the smell of **Sambousek (S)** which could be caused by either your iftar wishes and **Expectations (E)** or an actually approaching **Maghrib time (M)**. **Maghrib time (M)** could also cause the **broadcasting of the call to prayer (B)**. The Bayesian network and corresponding conditional probability tables for this situation are shown below. Use it to answer the following questions.

In all questions, report your answer to the fourth significant figure (e.g. 0.1234)

X	Y	P(X,Y)
T	T	0.15
T	F	0.45
F	T	x
F	F	y

$P(X=T) = 0.15 + 0.45 = 0.6$

$P(Y=T) = 0.15 + x$

$\therefore P(X)P(Y) = P(X,Y)$

$(0.6)(0.15 + x) = 0.15$

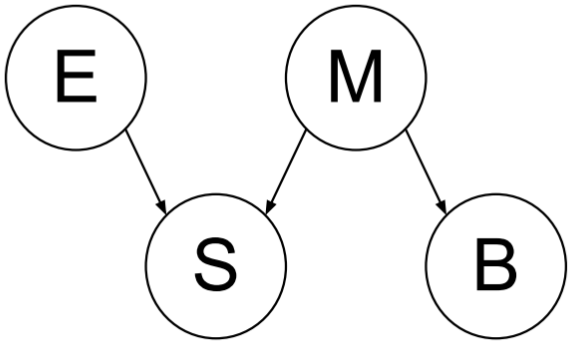
$\therefore x = \frac{1}{10}$

$\frac{1}{10} + y = 0.4$

$y = 0.3$

$P(E)$	
$+e$	0.4
$-e$	0.6

$P(S\|E,M)$			
$+e$	$+m$	$+s$	1.0
$+e$	$+m$	$-s$	0.0
$+e$	$-m$	$+s$	0.8
$+e$	$-m$	$-s$	0.2
$-e$	$+m$	$+s$	0.3
$-e$	$+m$	$-s$	0.7
$-e$	$-m$	$+s$	0.1
$-e$	$-m$	$-s$	0.9



$P(M)$	
$+m$	0.1
$-m$	0.9

$P(B\|M)$		
$+m$	$+b$	1.0
$+m$	$-b$	0.0
$-m$	$+b$	0.1
$-m$	$-b$	0.9

Question 3

2 Points

$P(E) \cdot P(S|E,M) P(M) P(B|M)$

$\underbrace{P(-e)}_{0.6}\ \underbrace{P(-s|-e,-m)}_{0.9}\ \underbrace{P(-m)}_{0.9}\ \underbrace{P(-b|-m)}_{0.9} = 0.4374$

What is the value of the joint distribution $P(\neg e, \neg s, \neg m, \neg b) = ?$

0.4374

Integer, decimal, or E notation allowed

Question 4

We want P(B). Only marginalize over M, since B depends on M

2 Points

What is the probability for the prayer to be broadcasted?

0.1900

Integer, decimal, or E notation allowed

$$P(B) = \sum_M P(B|M)P(M)$$

$$= \alpha \begin{bmatrix} P(+b|+m)P(+m) + P(+b|-m)P(-m) \\ P(-b|+m)P(+m) + P(-b|-m)P(-m) \end{bmatrix}$$

$$= \alpha \begin{bmatrix} 0.19 \\ 0.81 \end{bmatrix} \rightarrow P(+b) = 0.1900$$

Question 5

2 Points

What is the probability that it is Maghrib time given that the prayer is going to be broadcasted?

$P(M|B)$

$= \frac{P(B|M)}{P(B)} = \frac{P(+b|+m)P(+m)}{P(+b)} = \frac{0.1(1)}{0.19}$

0.5263

Integer, decimal, or E notation allowed

$= 0.5263$

Question 6

3 Points

What is the probability that it is Maghrib time, given that there is a smell of Sambousk, the prayer is being broadcasted, and you had high iftar expectations (+e)?

$P(M|S,B,E)$

$P(M)P(E)P(B|M)P(S|E,M)$

$= \alpha \begin{bmatrix} P(+m)P(+e)P(+b|+m)P(+s|+e,+m) \\ P(-m)P(+e)P(+b|-m)P(+s|+e,-m) \end{bmatrix}$

0.5814

Integer, decimal, or E notation allowed

$= \alpha \begin{bmatrix} (0.1)\cdot(0.4)(1)(1) \\ (0.9)(0.4)(0.1)(0.8) \end{bmatrix} = \alpha \begin{bmatrix} 0.04 \\ 0.0288 \end{bmatrix}$

Question 7

2 Points

What is the probability that you have high expectations given that Maghrib time is approaching?

$P(+e|+m)$

indep. so $P(+e) = P(+e|+m)$

$\therefore P(+e) = 0.4$

0.4000

Integer, decimal, or E notation allowed

Question 8

3 Points

evidence

Find the value of $P(S = +s | E = +e, B = +b)$ using Rejection Sampling. The prior samples are provided below

E	S	M	B
-e	-s	+m	-b
+e	+s	+m	-b
+e	+s	+m	+b
-e	-s	+m	+b

+e	+s	+m	+b
-e	-s	+m	-b
+e	-s	+m	+b
-e	-s	+m	+b
+e	+s	+m	+b

Keep 4 only.

3/4 cases have +s : 0.75

0.7500

Integer, decimal, or E notation allowed

Question 9

4 Points

Use likelihood weighting to estimate $P(S = +s | E = +e, B = +b)$ given the following samples that are consistent with the evidence. Calculate the weight for each sample.

Sample	Weight
0.4 +e, +s, +m, +b	0.4 x 1 = **0.4000**
0.4 +e, +s, -m, +b P(+b,-m)	0.4 x 0.1 = **0.04000**
0.4 +e, -s, +m, +b P(+b|+m)	0.4 x 1 = **0.4000**

The estimation for $P(S = +s | E = +e, B = +b)$ using likelihood weighting is **0.5238** (e.g. 0.1234)

Blank 1 0.4000

Blank 2 0.04000

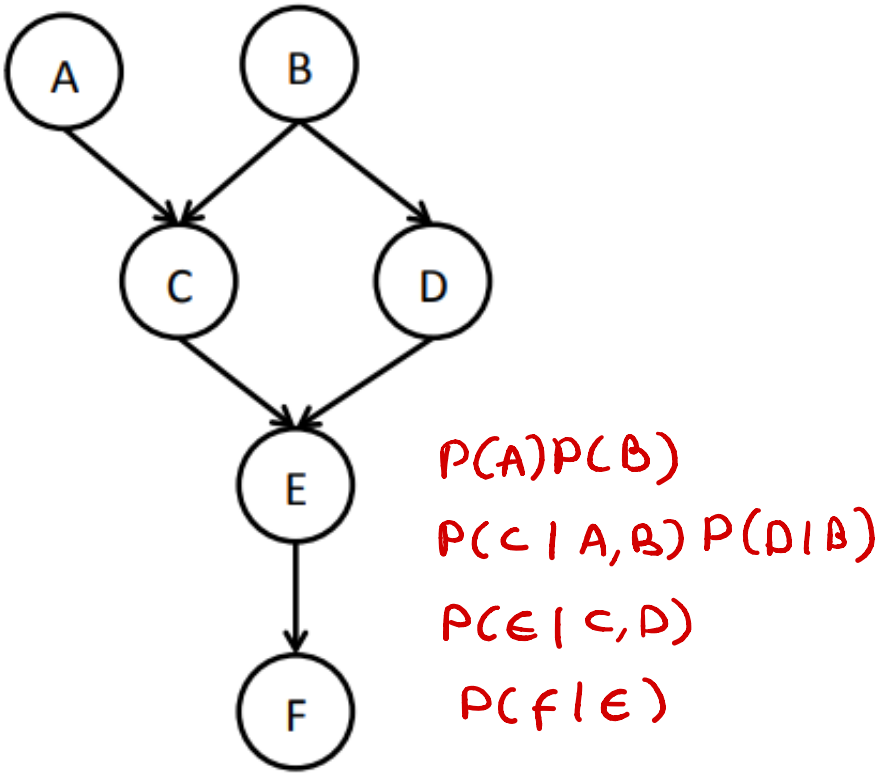
P(+s | +e, +b)

$$\frac{0.4 + 0.04}{0.4 + 0.04 + 0.4} = 0.5238$$

Blank 3 0.4000

Blank 4 0.5238

Use the Bayes Net below to answer the following questions



Question 10

2 Points

Which of the following is the factored joint distribution represented in the figure above?

A $P(A)P(B)P(C|A,B)P(D|B)P(E)P(F|E)$

B $P(A)P(B|A)P(C|A,B)P(D|B)P(E|C,D)P(F|E)$

C $P(A)P(B)P(C|A,B)P(D|B)P(E|C,D)P(F|E)$

D $P(A)P(B)P(C|A,B)P(D|B)P(E|B,C,D)P(F|E,C,D,B,A)$

P(A) P(B) P(C|A,B) P(D|B) P(E|C,D) P(F|E)
1 1 2^2 2 2^2 2
1 1 4 2 4 2

Question 11

3 Points

Assume the random variables in the graph shown are Boolean. What is the minimum number of parameters needed in total to fully specify this Bayesian network?

14

Integer, decimal, or E notation allowed

If. Keep in mind: 2^{givens}

Then sum.

Question 12

2 Points

A is marginally independent of B

A ⫫ B. Check: (A) (B)

A True

B False

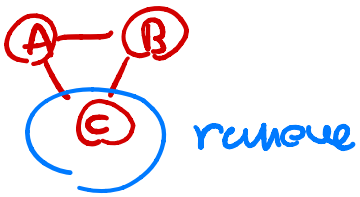
Clear selection

Question 13

2 Points

A is conditionally independent of B given C

A ⫫ B | C



A True

B False

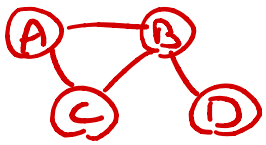
Clear selection

Question 14

2 Points

C is marginally independent of D

C ⫫ D.



Connected

A True

B False

Clear selection

Question 15

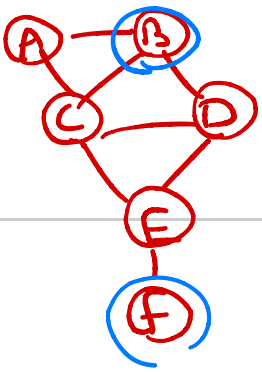
2 Points

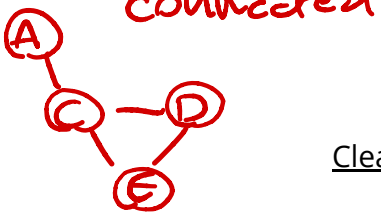
C is conditionally independent of D given B and F

C ⫫ D | B, F

A True

B False





Clear selection

Question 16

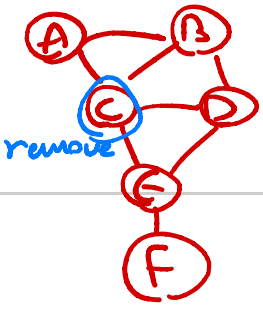
2 Points

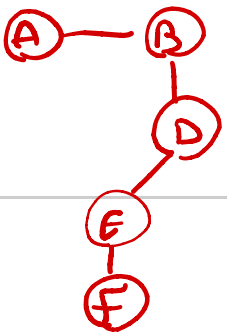
F is conditionally independent of B given C

F ⫫ B | C

A True

B False





Clear selection

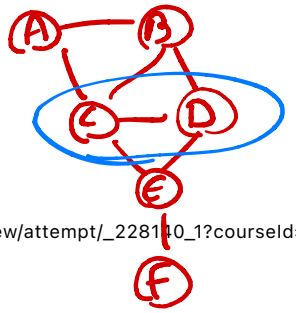
Question 17

2 Points

F is conditionally independent of B given C and D

F ⫫ B | C, D

A True

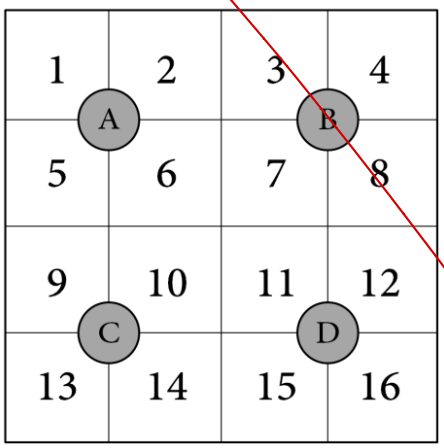


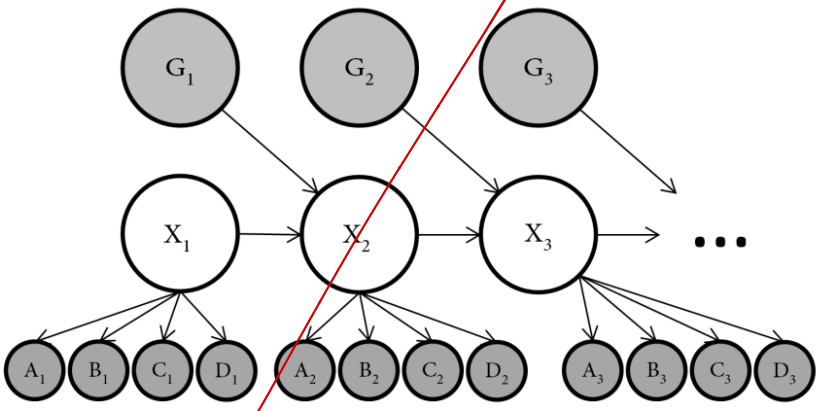
disconnected.

B False

Clear selection

Tesla has created a line of garbage collecting robots. They would like to track the location of their friendly garbage collecting robot, WZO. WZO lives in a 4x4 Manhattan grid city, as shown below. The structure of the HMM is given below, which includes X, the position of WZO; G, the readings from a garbage sensor; and (A,B,C,D), readings from the motion sensors.





The garbage sensor G takes on a value in {1, 2, ..., 16} corresponding to the square with the most garbage at time t. WZO is programmed to move toward the square with the most garbage, but he will only take an optimal action with probability 0.9. In each time step, WZO can either stay in the same square, or he can move to an adjacent square. In the case where multiple actions would move you equally close to the desired position, WZO has an equal probability of taking any of these actions. In the case that WZO fails to take an optimal action, he has an equal probability of taking any of the non-optimal actions. For example, if WZO is in square 2, the actions available to him are (EAST, SOUTH, WEST, STOP). If Gt = 15, the transition model will look like this:

X_{t+1}	$P(X_{t+1} \mid X_t = 2, G_t = 15)$
1	0.05
2	0.05
3	0.45
6	0.45

HMM31

The motion sensors, (A, B, C, D), take on a value in {ON, OF F}. At a time t, the sensor adjacent to the square that WZO is on always outputs ON. Otherwise, the sensor will output ON or OF F with equal probability. For example, the sensor tables would look like this if X = 6:

A	$P(A\|X=6)$
ON	1
OFF	0

B	$P(B\|X=6)$
ON	0.5
OFF	0.5

C	$P(C\|X=6)$
ON	0.5
OFF	0.5

D	$P(D\|X=6)$
ON	0.5
OFF	0.5

Use this information to solve the questions below

Question 18

3 Points

Initially, at t = 1, we have particles (X = 4, X = 2, X = 15). We observe that G1 = 6. Use the following random numbers to apply the time update to each of the particles. Assign square numbers to sample spaces in numerical order.

Random Numbers = 0.7349, 0.5324, 0.1670

Particle at t = 1	Particle after time update
X = 4	**8**
X = 2	**6**
X = 15	**11**

Blank 1 8

Blank 2 6

Blank 3 11

Question 19

3 Points

To decouple this question from the previous question, let's say the new particles you have after the time update are (X = 8, X = 14, X = 11). You get the following readings from your sensors A = OF F, B = ON, C = ON, D = OF F.

What is the weight for each particle?

Particle	Weight
X = 8	**0.1250**
X = 14	**0.1250**
X = 11	**0.0000**

Blank 1 0.1250

Blank 2 0.1250

Blank 3 0.0000

Question 20

3 Points

It seems, much to your dismay, that sensor C is broken, and will always give a reading of ON. Recalculate the weights with this new knowledge.

Particle	Weight
X = 8	**0.2500**
X = 14	**0.1250**

X = 11	**0.0000**

Blank 1 0.2500

Blank 2 0.1250

Blank 3 0.0000

Additional content

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Questions Filter (20)

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