CSC384 S19 A4 Module 2 (Version B)

Total points 20/20

This module is worth 20 points. Your last submission will be used for the final score. You may attempt this module 5 times without penalty. After 5 attempts, each additional attempt will result in a penalty of 5% (e.g., On your 7th attempt, you obtain a score of 18 points. Then, your final score for this module will be 18 - (2*1) = 16 points.)

If you encounter any problems with the assignment, please email zheweisun@cs.toronto.edu with [CSC384 A4] in the subject. Be sure to include the module number and version.

Section score 0/0

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Name *

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M2P1 - Conditional Probability

Harry spends a lot of time in coffee shops. He has noticed that coffee shops with dessert menus tend to have more positive ratings. He's also noticed that restaurants with free WiFi have more positive ratings. He decides to investigate and comes up with the following conditional probability table (CPT):

Section score 7/7

	W=wifi		*W=¬wifi*	
	R=review	*R=¬review*	*R=review*	*R=¬review*
D=dessert	0.340	0.051	0.098	0.057
D=¬dessert	0.090	0.019	0.095	0.250

The domain is made up of three boolean variables:
D: Coffee shop that offers dessert.
W: Coffee shop that allows a free WiFi connection.
R: Coffee shop with good reviews.

Calculate the following probabilities.

P(dessert) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.546

P(dessert v ¬dessert) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

1.000

P(dessert ∧ ¬dessert) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.000

P(dessert | wifi) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.782

P(dessert v review) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.731

P(¬wifi ∧ ¬review | dessert) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.104

P(wifi ∧ review) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.430

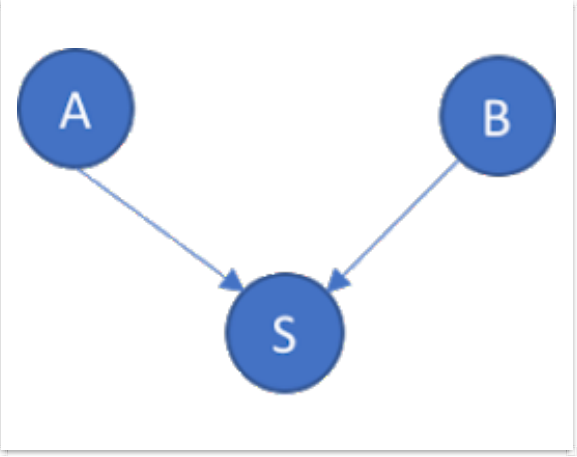
M2P2 – Bayes Net Representation

1. The Spacefleet collegiate has decided to create a class of cyborg students. 90% of these cyborgs study hard for their exams. Out of the cyborgs who study hard for an exam, 80% get an A. Out of the cyborgs who do not study, only half get an A. Cyborgs who study hard have a 75% probability of depleting their battery in less that a day. Cyborgs who do not study hard have a longer battery life: only 10% of them deplete their batteries within the next day.

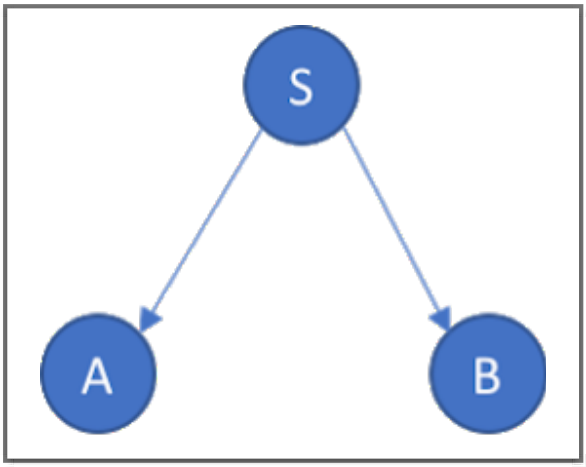
S = studying hard
B = depleting battery in less thana day
A = getting an 'A' on the exam

Section score 2/2

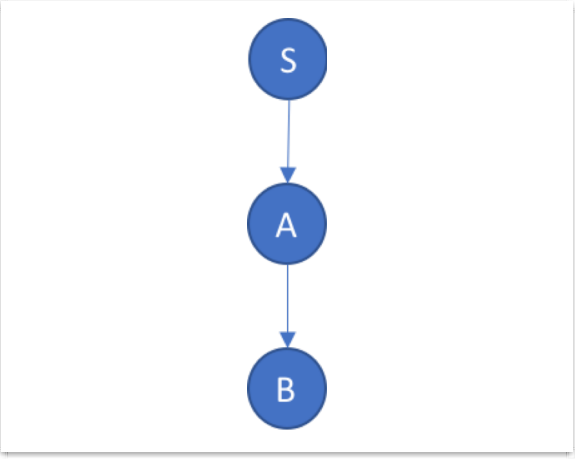
Which Bayes net correctly captures this problem? 1/1



Option 1



Option 2



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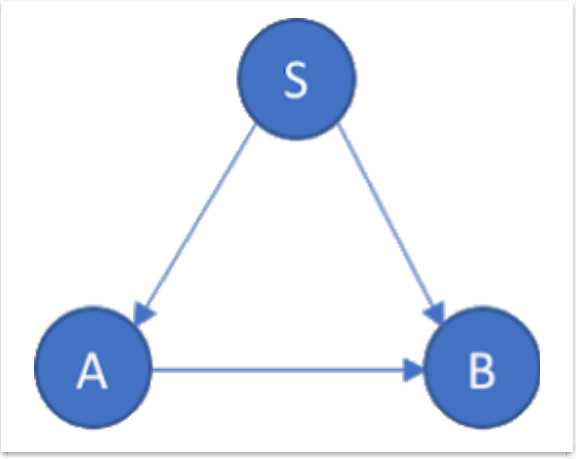
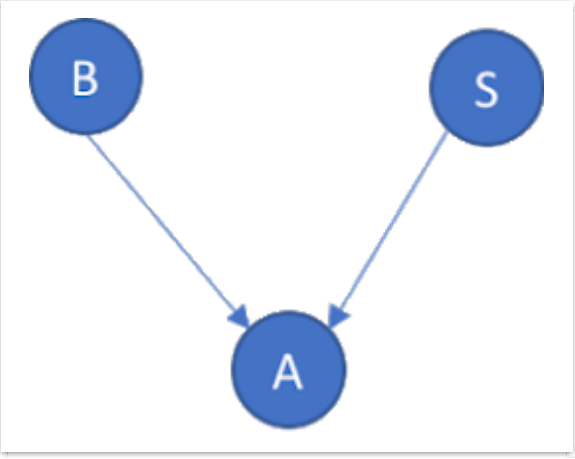


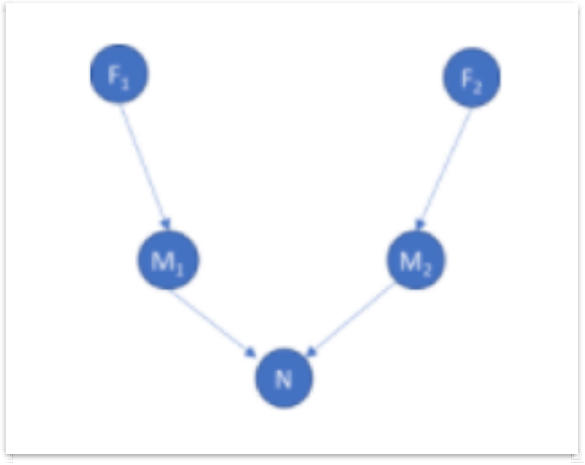
Option 4



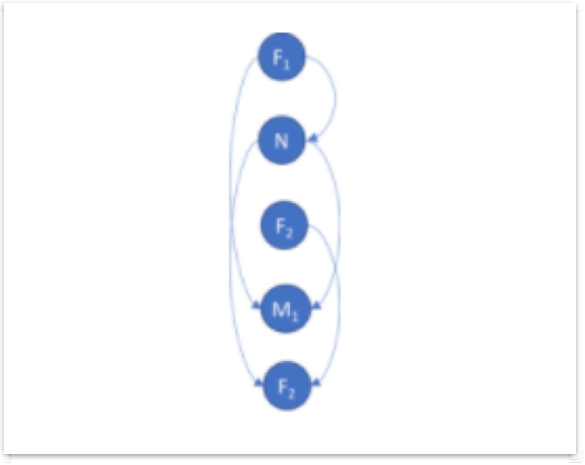
Option 5

2. Two astronomers in different parts of the world make measurements M1 and M2 of the number of stars N in some small region of the sky, using their telescopes. Normally, there is a small probability e or error of up to one star in each direction. Each telescope can also be badly out of focus with probability f. Let F1 and F2 be boolean variables with Fi = True being that the i-th telescope is out of focus. If the telescope is out of focus then the scientist will always undercount by 3 or more stars (or, if N is 3 or less, fail to detect any stars at all).

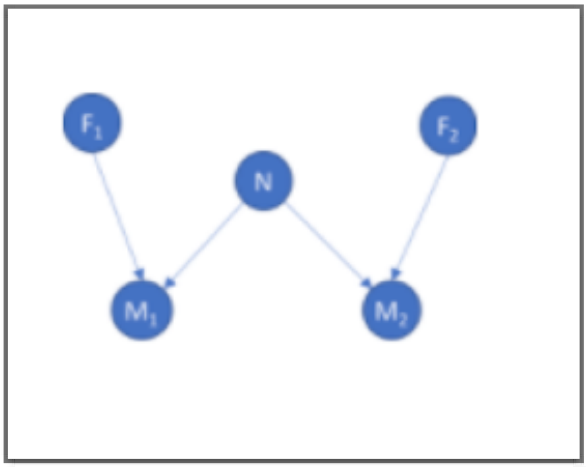
Which is the best network? 1/1



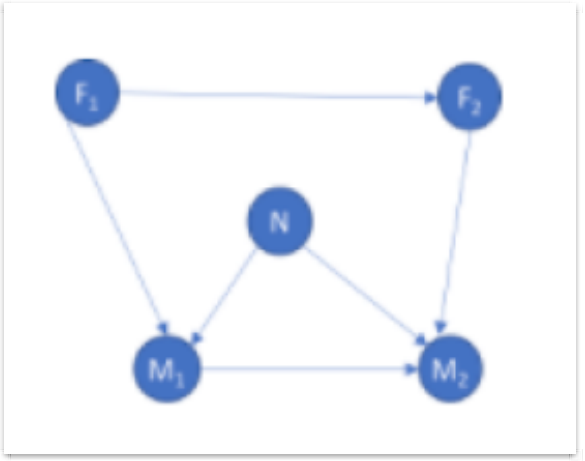
Option 1



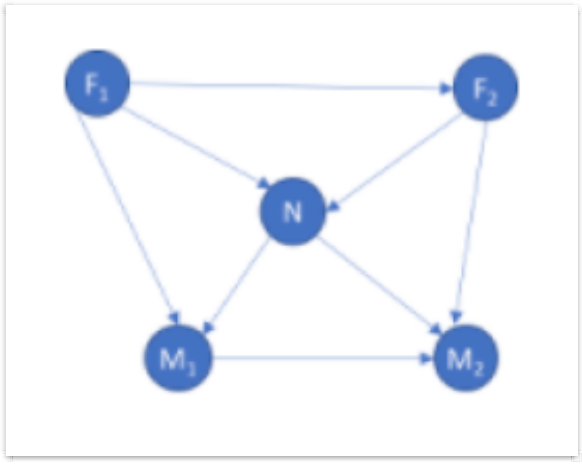
Option 2



Option 3



Option 4



Option 5

M2P3 – Gene Expression

You are given two different Bayesian network structures 1 and 2, each consisting of 5 binary random variables A, B, C, D, E. Each variable corresponds to a gene, whose expression can be either “ON” or “OFF”.

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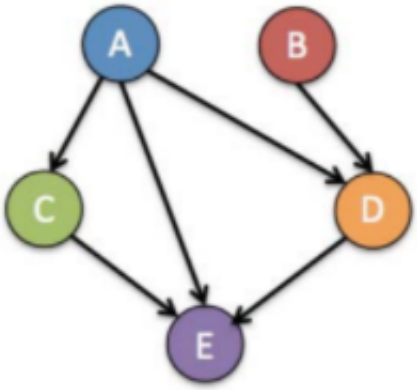
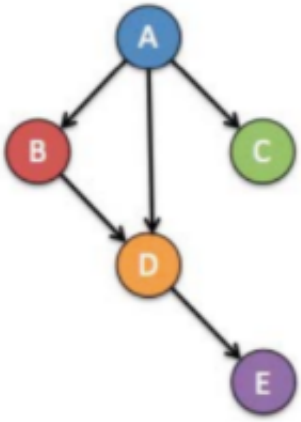


Network 1



Network 2

Which of these expressions describes P(A,B,C,D,E) for Network 1, given the structure of the network (i.e. which product decomposition is correct)? 1/1

- [x] P(A)P(B)P(C|A)P(D|A,B)P(E|A,C,D)
- [ ] P(A)P(B)P(C)P(D)P(E)
- [ ] P(A|C,D,E)P(C|A)P(E)P(D|E)P(B|D)
- [ ] P(A)P(B|A)P(C|A)P(D|A,B)P(E|D)

Which of these expressions describes P(A,B,C,D,E) for Network 2, given the structure of the network (i.e. which product decomposition is correct)? 1/1

- [ ] P(A)P(B)P(C|A)P(D|A,B)P(E|A,C,D)
- [ ] P(A)P(B|A)P(D|A,B)P(C|A)P(E|D,A,B)
- [ ] P(A)P(B)P(C)P(D)P(E)
- [x] P(A)P(B|A)P(C|A)P(D|A,B)P(E|D)

How many parameters will be needed to fully specify Network 1? 1/1

16

How many parameters will be needed to fully specify Network 2? 1/1

11

Using Network 2 and the probabilities given below, calculate the probability of the following:

$$P(A=ON)=0.6$$

$$P(B=ON\mid A)=\begin{cases}0.1, & A=OFF\\ 0.95, & A=ON\end{cases}$$

$$P(C=ON\mid A)=\begin{cases}0.8, & A=OFF\\ 0.5, & A=ON\end{cases}$$

$$P(D=ON\mid A,B)=\begin{cases}0.1 & A=OFF,B=OFF\\ 0.9 & A=ON,B=OFF\\ 0.3 & A=OFF,B=ON\\ 0.95 & A=ON,B=ON\end{cases}$$

$$P(E=ON\mid D)=\begin{cases}0.8, & D=OFF\\ 0.1, & D=ON\end{cases}$$

P(A=ON, B=ON, C=ON, D=ON, E=OFF) 1/1

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.244

P(E = OFF | A = ON) 3/3

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.863

P(A = ON | E = OFF)

3/3

Your answer should be between 0 and 1, rounded to 3 digits after the decimal (e.g. 0.120).

0.820

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