COMPSCI 383 – Spring 2022

Homework 4 Primer

Due Sunday, March 27th at 9pm

You are encouraged to discuss the assignment in general with your classmates, and may optionally collaborate with one other student. If you choose to do so, you must indicate with whom you worked. Multiple teams (or non-partnered students) submitting the same solutions will be considered plagiarism.

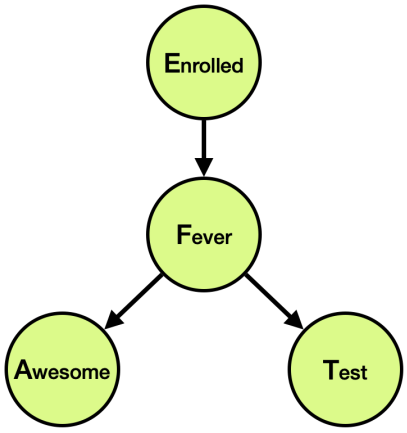
The goal of this assignment is to deepen your understanding of some of the topics covered in the lectures and readings. We will grade your answers based on whether they demonstrate an understanding of the concepts in each question. We will award partial credit for answers that demonstrate partial understanding, so show your work!

What to Submit

You should submit a file named `homework4primer.pdf`, containing your answers to the questions. You can record your answers on this document (preferred) or create your own.

383 Fever

Exposure to COMPSCI 383 is a known cause of "383 Fever", whose main symptom is excessive awesomeness. Over the years, scientists have developed a simple blood test to help confirm clinical diagnoses.



The *causal* Bayesian network DAG shown on the right describes the relationships between variables **Enrolled** (whether someone is taking 383), **Fever** (whether they have 383 Fever), **Awesome** (whether they are exhibiting an excessive amount of awesomeness), and **Test** (whether their blood sample tests positive). These are abbreviated **E**, **F**, **A**, and **T**, respectively.

The file `383_fever_data.csv` contains the results of a painstaking data collection effort carried out to study 383 Fever. One hundred twenty CICS students were screened for 383 Fever exposure and symptoms. Each row represents a different student, with the boolean value for each of the five variables above.

1. Custom Parachute Trousers, or Cherry Pomegranate Tea

Using the data found in `383_fever_data.csv`, construct an empirically derived conditional probability table (CPT) that agrees with both the causal DAG and the data. Hint: you may want to write a simple program that reads in the data file and counts different quantities for you! (12 points)

2. Listening to Bayes Nets

Consider a randomly selected CICS student named Yoshimi. Answer the following questions "qualitatively" by inspecting the Bayesian network above and drawing conclusions. For each, explain your answer in 1-2 sentences. ***You do not need to calculate the probabilities mentioned in order to formulate your answer. Boo, math!*** (15 points)

a. Knowing nothing else about Yoshimi, do you expect that she is enrolled in 383?

b. Knowing nothing else about Yoshimi, do you expect that she would have a positive test for 383 Fever?

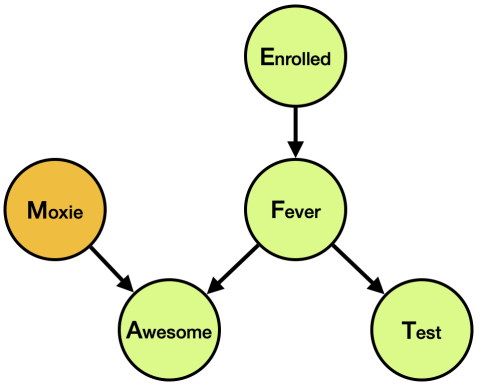
c. Which is greater: (a) the probability of Yoshimi being excessively awesome, or (b) the probability of Yoshimi being excessively awesome *and* testing positive for 383 Fever?

d. Which is greater: (a) the probability of Yoshimi being excessively awesome, or (b) the probability of Yoshimi being excessively awesome *or* testing positive for 383 Fever?

e. You see Yoshimi at the Blue Wall behaving in an excessively awesome manner and wonder if she is taking 383. She then tells you that she recently tested positive for 383 fever. Does this new evidence change your degree of belief that Yoshimi is enrolled? Why or why not?

3. Yet Another Moxie Question

Of course, in the real world, we all know that drinking Moxie can also lead to excessive awesomeness. For the following questions, consider the modified version of the causal DAG, where **Moxie** is an additional cause of **Awesome**. Explain your answers in terms of (non-)independence using d-separation and/or connectedness. (8 points)



a. Does seeing someone drink Moxie affect your belief that they are enrolled in 383?

b. Does seeing someone being excessively awesome affect your belief that they are enrolled in 383?

c. If you learn that someone enrolled in 383 drinks Moxie, does this fact affect your degree of belief that they will test positive? How?

d. If you learn that someone who is excessively awesome and enrolled in 383 drinks Moxie, does this fact affect your degree of belief that they will test positive? How?