LAB EXERCISE 2

QUESTION 1

A spam filter in an email system aims to identify whether an incoming email is spam or not. The filter is not perfect and may produce false positives and false negatives. The characteristics of the filter are as follows:

- The probability of classifying a legitimate email as spam is 0.01.
- The probability of classifying a spam email as not spam is 0.05.
- The prevalence of spam emails in the system is 0.03.

What is the probability that an email classified as spam is actually spam?

QUESTION 2

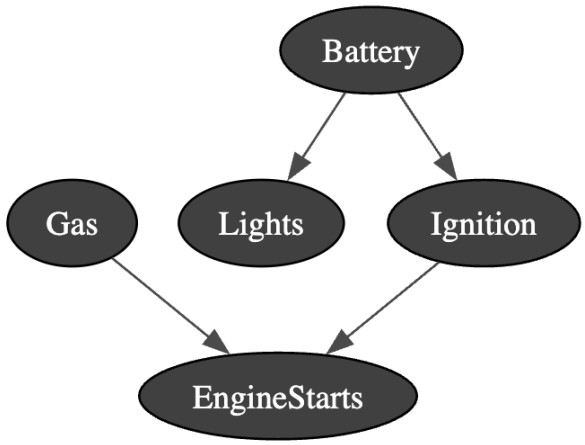
Mary has been trying to have a baby and suspects she is pregnant. She tests positive. What is the probability that Mary is pregnant P(pregnant | positive test)? Assumptions:

– The probability of true positive is 99%
– The probability of false positive is 2%
– Only women who suspect they might be pregnant take a test. So prior P(pregnant) = 0.2

a) Calculate the answer using Bayes' theorem.
b) Check your answer using PyAgrum.

QUESTION 3

In PyAgrum, create a Bayes network for a car electrical system using the following causal diagram, and the probability tables listed below:



Battery	
0	1
0.1000	0.9000

Gas	
0	1
0.2500	0.7500

	Ignition	
Battery	0	1
0	1.0000	0.0000
1	0.1000	0.9000

		EngineStarts	
Gas	Ignition	0	1
0	0	1.0000	0.0000
	1	1.0000	0.0000
1	0	1.0000	0.0000
	1	0.0500	0.9500

	Lights	
Battery	0	1
0	1.0000	0.0000
1	0.0500	0.9500

a) Compute the posterior probability that the car will start, assuming that we observe the lights turning on.
b) Compute the posterior probability that the car will start, assuming both that the lights are on and that the car has sufficient gas.