Assignment-2

Objective: Bayesian inference on the given data.

Problem: Bayesian network is a directed acyclic graphical representation of a set of variables and their conditional dependencies. Each variable is represented as a node in the graph and a directed edge between the nodes represents the parent-child relationship between the considered nodes. In this assignment we will estimate probability distributions or parameters of a given network. For this, we will make use of a dataset containing samples comprising of values observed for different variables.

Input

- Line 1: n : no. of variable or nodes (N_1, N_2, ..., N_n)
- Line 2 to Line $n + 1$: Comma separated list of all possible values of variables N_1 to N_n
- Line $n + 2$ to Line $2n + 1$: $n \times n$ matrix of 1's and 0's representing conditional dependencies, e.g. a value 1 at location (3,2) shows that N_2 is conditionally dependent on N_3
- Line $2n + 2$: m : no. of samples
- Line $2n + 3$ to Line $2n + 2 + m$: Comma separated values observed for all variables (N_1, N_2, ..., N_n) for each sample.

Sample input:
3
TRUE, FALSE
TRUE, FALSE
TRUE, FALSE
0 0 1
0 0 1
0 0 0
100
TRUE, FALSE, TRUE
FALSE, TRUE, FALSE
.
.
.
.

There are three binary variables (N_1, N_2, N_3) in this Bayesian network where N_3 is conditionally dependent on N_1 and N_2. In other words, N_1 and N_2 are the parents of N_3.

Output
Your program should learn the parameters (probability distributions of each variable) of the given network and return them in the following format

Output format: Print n lines where Line 1 will contain probability distribution of variable N_1, Line 2 will contain probability distribution of variable N_2 and so on. Round off the probability value upto 4 decimal places.
For the above problem the output is
0.2 0.8
0.4 0.6
0.2 0.4 0.3 0.5 0.8 0.6 0.7 0.5

This implies $P(N_1=TRUE) = 0.2$, and $P(N_1=FALSE) = 0.8$. Similarly $P(N_2=TRUE) = 0.4$, and $P(N_2=FALSE) = 0.6$. Further, $P(N_3=TRUE|N_1=TRUE, N_2=TRUE) = 0.2$, $P(N_3=TRUE|N_1=TRUE, N_2=FALSE) = 0.4$, $P(N_3=TRUE|N_1=FALSE, N_2=TRUE) = 0.3$ and so on.