

**School of Computer Science
The University of Adelaide**

**Artificial Intelligence
Assignment 3**

Semester 1, 2020
Due 11.59 pm, Monday 8 June 2020

Your task is to perform exact inference on a PGM and also manually conduct approximate inference and compare the results. You only need to deal with one (small) network, but you will need to compute the exact inference and also compute approximate inference manually (i.e. generate random numbers, use these to generate samples, count the samples, etc). You should submit a 2-3 page report of your working and findings.

More details are as below.

The task

There is no need to code, but you will need to work through the algorithm(s) manually on paper. The network below shows the conditional probability relationships between variables S (Sick), P (Pub), H (Headache), L (Lecture) and D (Doctor) which capture conditional probabilities relating whether or not a student has a Headache to whether they are Sick, whether they went to the Pub last night, whether they go to the 9am Lecture or not and whether they visit a Doctor.

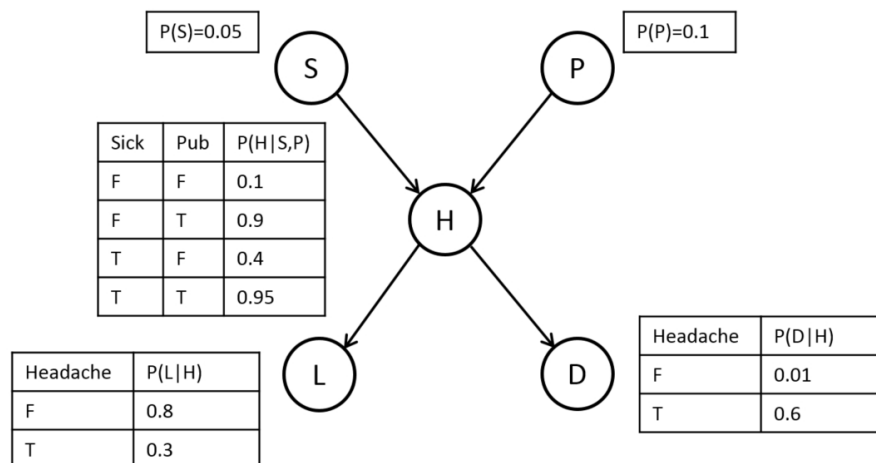


Figure 1: A Bayes Net representing the conditional relationships between illness, lecture attendance, pub and doctor visits.

The queries you must solve are:

$P(\text{Sick} | \text{Lecture}=\text{true}, \text{Doctor}=\text{true})$

$P(\text{Sick} | \text{Doctor}=\text{false})$

$P(\text{Pub} | \text{Lecture}=\text{false})$

$P(\text{Pub} | \text{Lecture}=\text{false}, \text{Doctor}=\text{true})$

You must produce exact results for the first two, and both exact and approximate results (by sampling) for the third and fourth queries. You will need to conduct manual sampling by any method you choose to generate the approximate results. For the exact results: **Undergrads** can choose any exact inference method; **Postgrads** will be eligible for full marks only if the exact results are generated using variable elimination.

To "implement" your manual sampling procedure you will need generate a set of samples. For example, for the first query you will need to generate 3 random values (to decide the true/false of Sick, Headache and Pub) for each sample¹. If you decide to generate 20 samples, you'll need 60 random values (3 per sample). You can do this by using a random value generator. Please set the range of random values to 0 to 1 and write down the random values and samples when performing inference.

Submission and Assessment

You should submit a **pdf** report of maximum 2-3 pages via **MyUni (Assignments)**. The report should briefly describe the algorithm you have chosen to implement, provide your exact working for each query and a table showing the results for each (**hand-written equations and tables will not be marked**). I recommend you tabulate results for 10 samples and for 20 samples and compare these to the exact results. Marks will be allocated according to the following rubric:

- Exact results and corresponding working: 30 marks
- Approximate inference results (with working): 40 marks
- Report coherence including description of approximate inference algorithm used: 30 marks

As noted above, **Postgraduates** are expected to use variable elimination to generate their exact results. If a postgrad chooses not to use variable elimination they can achieve up to 15/30 on that component. Full marks will be awarded for complete and correct results, and a coherent description of the sampling method used. If you present results in your report that are inconsistent with the sampling method you have attempted, and you do not acknowledge this in your report, you will automatically be given zero marks for the Assignment and referred for academic dishonesty.

Due date and late submission policy

This assignment is due 11.59pm on Monday 8th June 2020. If your submission is late the maximum mark you can obtain will be reduced by 25% per day (or part thereof) past the due date or any extension you are granted.

¹ If you choose rejection sampling you'll need to generate random values for all five random variables, and then reject any sample that does not match Lecture=false and Doctor=true