CPS 570: Artificial Intelligence

Homework 4: Probabilistic reasoning and Bayesian networks (due before class Nov. 8)

Please read the rules for assignments on the course web page (http://www.cs.duke.edu/courses/fall17/compsci570/). Use Piazza (preferred) or directly contact Shuzhi (shuzhiyu@cs.duke.edu), Rui-Yi (ryzhang@cs.duke.edu), or Vince (conitzer@cs.duke.edu) for any questions.

We are going to take the perspective of an instructor who wants to determine whether a student has understood the material, based on the exam score. Figure 1 gives a Bayes net for this. As you can see, whether the student scores high on the exam is influenced both by whether she is a good test taker, and whether she understood the material. Both of those, in turn, are influenced by whether she is intelligent; whether she understood the material is also influenced by whether she is a hard worker.

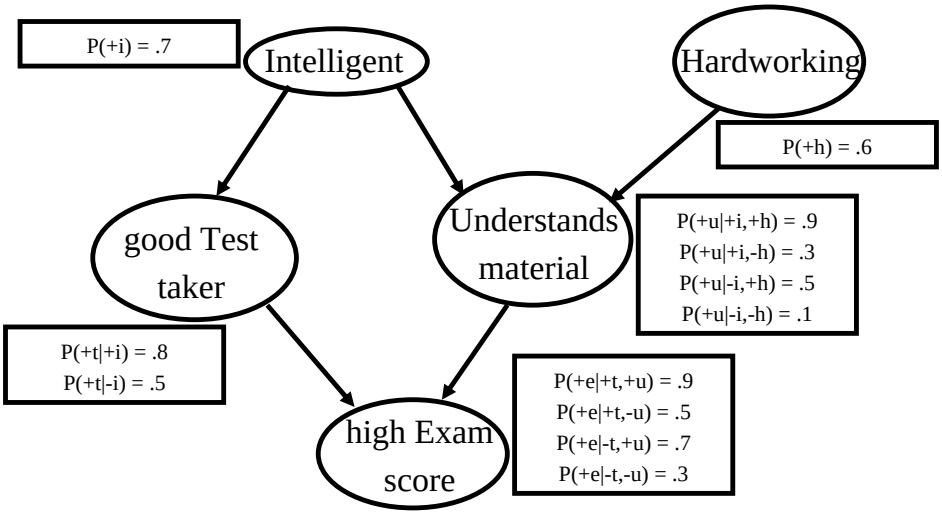

Figure 1: A Bayesian network representing what influences an exam score.

1 (50 points).

Using variable elimination (by hand!), compute the probability that a student who did well on the test actually understood the material, that is, compute $P(+u| + e)$.

2 (50 points.)

For the above Bayesian network, label the following statements about conditional independence as true or false. For this question, you should consider only the structure of the Bayesian network, not the specific probabilities. Explain each of your answers.

1. T and U are independent.

2. T and U are conditionally independent given I, E, and H.

3. T and U are conditionally independent given I and H.

4. E and H are conditionally independent given U.

5. E and H are conditionally independent given U, I, and T.

6. I and H are conditionally independent given E.

7. I and H are conditionally independent given T.

8. T and H are independent.

9. T and H are conditionally independent given E.

10. T and H are conditionally independent given E and U.