

Homework 1

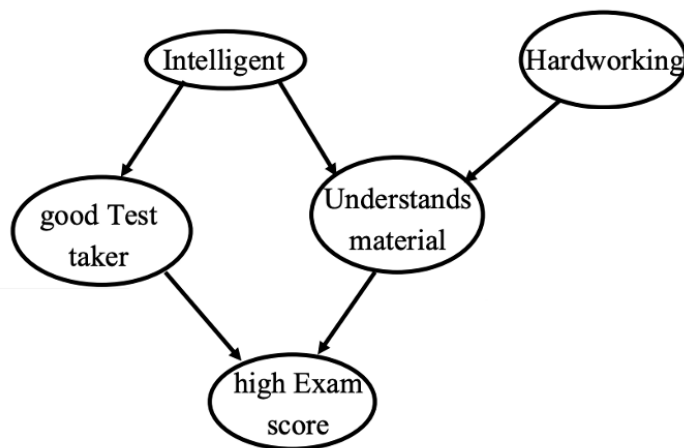
ECE 285

Due: 11:59 pm PT on Jan 17

1. (25 points) For the following Bayesian network, judge whether the following statements are true or false. And give a brief explanation for each of your answer.

(I: Intelligent; H: Hardworking; T: good Test taker; U: Understands material; E: high Exam score)

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



2. (15 points) For the above Bayesian network, construct local conditional probability tables. Assume all variables are binary (1 for true and 0 for false). For example, $p(E=1 | T=1, U=1) = 0.8$. And give a brief explanation for your specified probabilities. For example, if a student is a good test taker and understands the material well, the student is very likely to have a high exam score.

3. (10 points) For the above Bayesian network, write down the joint distribution of all variables.

4. (15 points) Calculate $P(E=1 | \text{Hardworking}=1)$.

5. (35 points) Consider a task: based on the infected cases in the past week, predict the number of infected COVID-19 cases for all cities in San Diego County for tomorrow. Design a Markov random field model to perform this task. In the model, capture the correlation between cities: nearby cities have similar number of infected cases.