# Probabilistic Modelling and Reasoning, Tutorial Question Sheet 2 (for Week 4)

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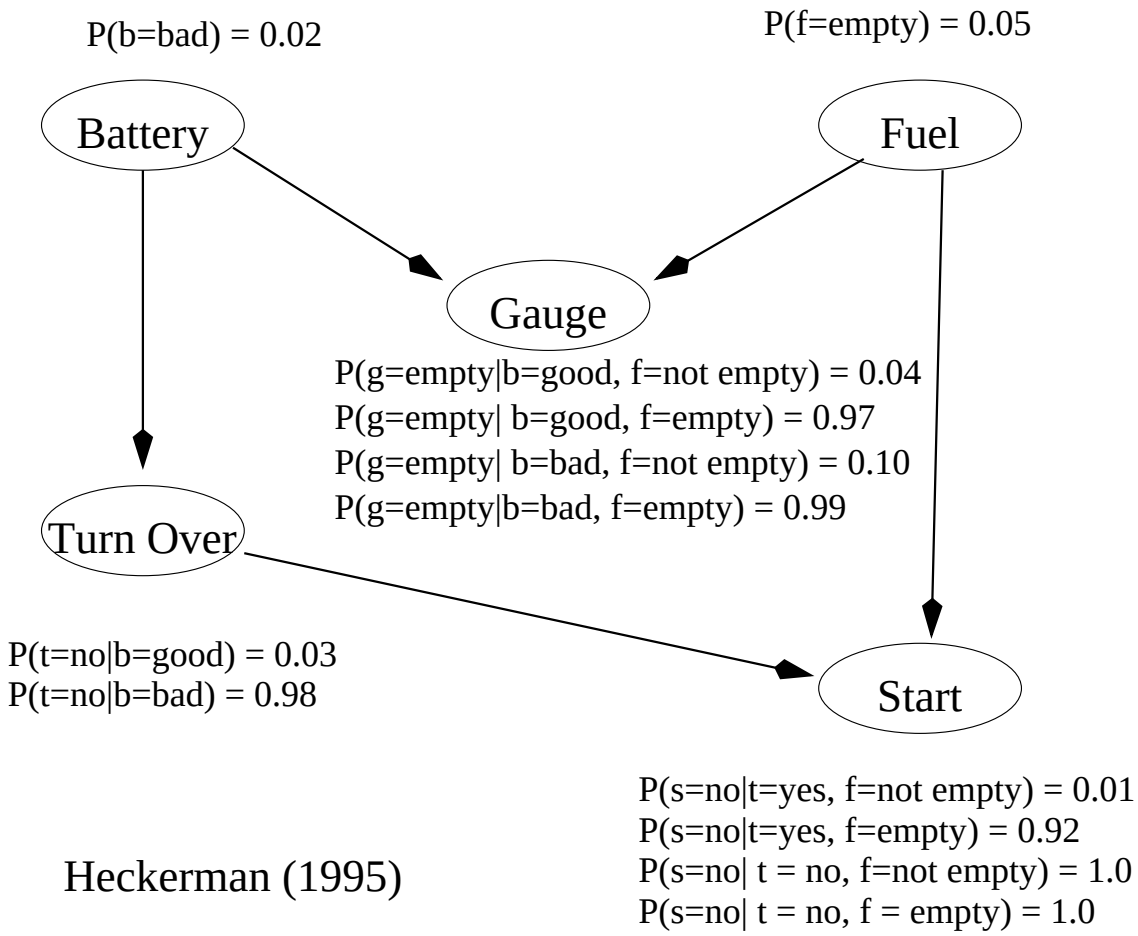
Prob. Sheet. ID: 22704.1
Thanks to Chris Williams for some of the questions.

1. Consider the belief network given below, which concerns the probability of a car starting.

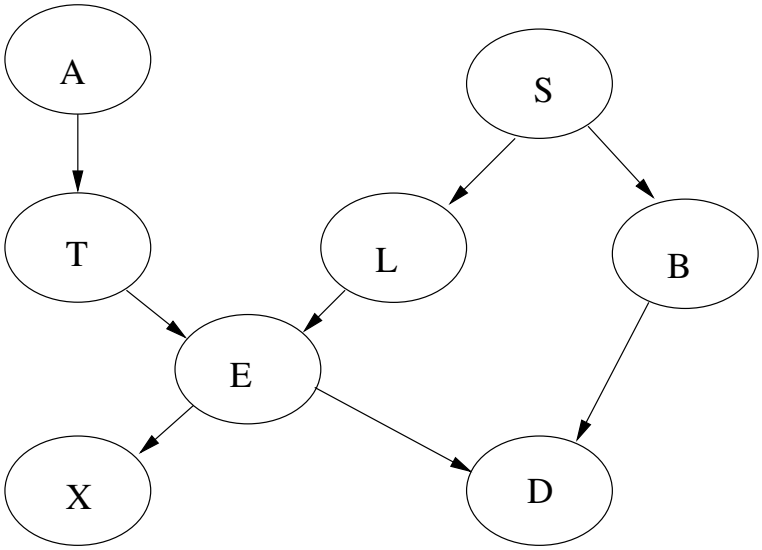



Calculate $P(f = empty|s = no)$, the probability of the fuel tank being empty conditioned on the observation that the car does not start. Do this calculation "by hand", i.e. do not use or create a computer program to do this.

2. Try out the JavaBayes software, or use another Belief Net/Bayes Net toolbox, by setting

up a belief network with the given structure and CPTs. Condition on the evidence and verify your calculation from question 1 above. Information on the JavaBayes software can be found by visiting the JavaBayes website.

3. . The belief network shown below is the famous "Asia" example of Lauritzen and Speigelhalter (1988). It concerns the diagnosis of lung disease (T=tuberculosis, L=lung cancer, or both, or neither). In this model a visit to A=Asia is assumed to increase the probability of tuberculosis.




State if the following conditional independence relationships in the "Asia" graph are true or false

$I(T, S|D)$,
$I(L, B|S)$,
$I(A, S|L)$
$I(A, S|L, D)$

4. Transform the network in Q1 into an undirected graphical model (Markov Network) that captures as many of the conditional independencies of the directed model as possible without introducing extra unnecessary independencies. Write down the directed network in Q1 as an undirected factor graph, and say what the factors are in terms of the original conditional probabilities. Now draw the factor graph corresponding to the undirected graphical model. What is a possible configuration of the factors of this graph? Is this unique? - Discuss.