

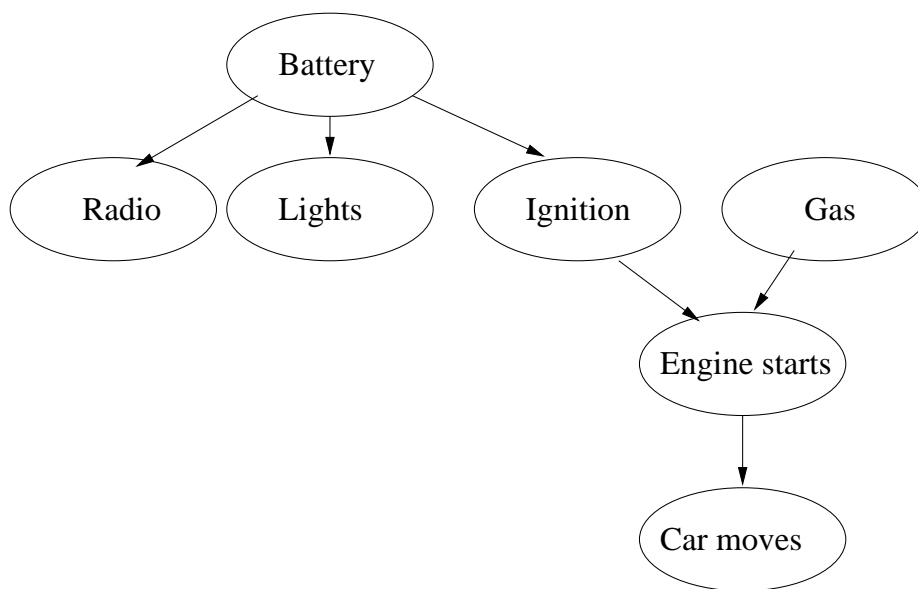
Problem assignment 7

Due: Wednesday, November 19, 2008

Bayesian belief networks

Problem 1. Independences

Assume the Bayesian belief network for the diagnosis of car's electrical system.



The belief network structure encodes conditional and marginal independences in graphical terms. Give at least four examples of conditional and one example of marginal independences encoded in the network structure.

Problem 2. Complexity

Assume the same Bayesian belief network as used in Problem 1.

Part a. Assume that all variables in the network are binary (have two possible values). What is the number of probabilities of the full joint distribution?

Part b. Again assume that all the variables are binary. What is the number of parameters defining the belief network in the figure?

Part c. Give the expression for the full joint probability over variables using the Bayesian belief network and its parameters. Assume we are interested in calculating the joint probability for: Battery=T, Radio=F, Light=T, Ignition=T, Gas=T, EngineStarts=F, Carmoves=F.

Problem 3. Inference

Once again we will rely on the BBN from Problem 1.

Part a. Assume we want to compute the probability of Car not moving, that is $P(\text{Carmoves} = \text{False})$. Write down the expression for computing the probability from conditionals via blind approach. What is the inference cost? The inference cost should be expressed in terms of the number of additions and the number of products used.

Part b. Propose a more efficient solution for computing $P(\text{Carmoves} = \text{False})$ that interleaves sums and products similarly to the approach used in the lecture. Write down the new expression and give its inference cost.

Part c. Assume you want to calculate $P(\text{Car moves})$ using the variable elimination method. Assume the elimination order is: Battery, Gas, Radio, Lights, Ignition, Engine starts. Assess the cost of calculations in terms of size of factors. Is there an ordering of variables that leads to a better computational cost?