

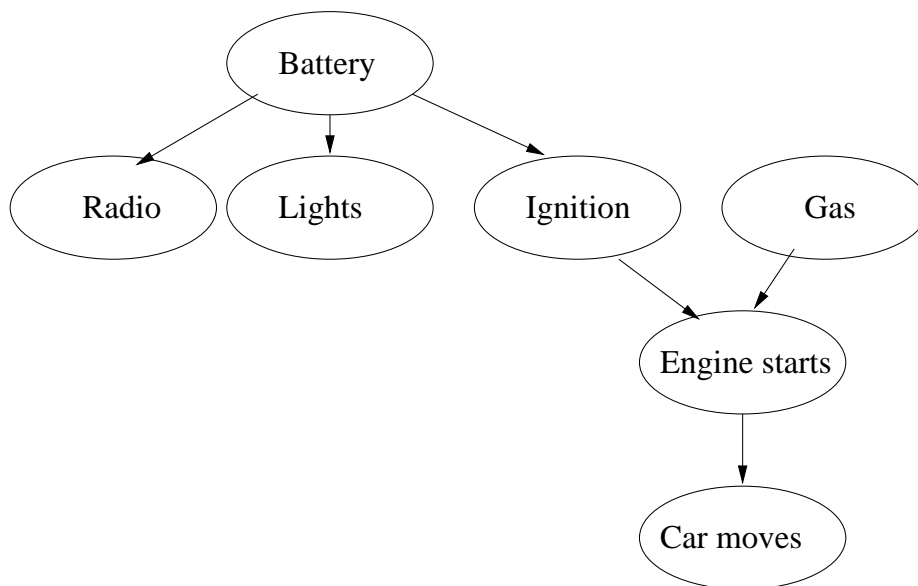
## Problem assignment 8

*Due: Wednesday, November 26, 2008*

### Bayesian belief networks

#### Problem 1. Monte Carlo sampling

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



**Part a.** Briefly explain how would you calculate the probability  $P(\text{Ignition} | \text{Car moves} = F, \text{Radio} = T)$  using rejection sampling. What is the deficiency of the method.

**Part b.** Briefly explain how would you calculate the probability  $P(\text{Ignition} | \text{Car moves} = F, \text{Radio} = T)$  using the likelihood weighting approach.

**Part c.** Assume that the likelihood weighting sampling process generated the following example:  $\text{Battery} = T, \text{Radio} = T, \text{Ignition} = T, \text{Light} = T, \text{EngineStatus} = \text{Fail}, \text{Gas} =$

$T, Carmoves = F$ . Show how to calculate the weight associated with this example. Your formula should use the conditional probabilities that are defined by the BBN.

**Problem 2. Decision-making in the presence of uncertainty.**

Assume you have to invest  $10K$  for 2 investment periods. Your options are the stock market and the bank. The probability of a stock going up in the first period is: 0.4. The probability of a stock going up in the second period depends on the first period stock outcomes and equal:  $P(2nd = up | 1st = up) = 0.35$  and  $P(2nd = up | 1st = down) = 0.45$ . The monetary returns for different scenarios are defined as follows:

- (A1: stock, S1: up, A2: stock, S2: up): 22K
- (A1: stock, S1: up, A2: stock, S2: down): 12.5
- (A1: stock, S1: up, A2: bank, S2: any): 14.5K
- (A1: stock, S1: down, A2: stock, S2: up): 11K
- (A1: stock, S1: down, A2: stock, S2: down): 6K
- (A1: stock, S1: down, A2: bank, S2: any): 8K
- (A1: bank, S1: any, A2: stock, S2: up): 13.5
- (A1: bank, S1: any, A2: stock, S2: down): 8K
- (A1: bank, S1: any, A2: bank, S2: any): 10.5K

where A1 denotes action 1, S1 the movement of the stock in period 1, A2 action 2 and S2 the movement of the stock in period 2.

Please draw a decision tree corresponding to the above investment problem. Use the tree to calculate the optimal investment plan for the two investment periods.