Bayes networks

SMU

Exercise 1 (Eugene Charniak): Construct Bayesian network (without CPTs) given following statements:

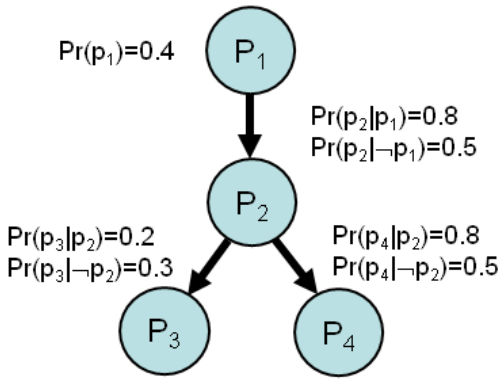
- There is a family, a dog, a light, and the family house.
- Now, often when the family leaves the house, they turn on an outdoor light. However, the light is turned on when the family expects a guest.
- When nobody is home, the dog is put in the back yard. The same is true if the dog has bowel troubles.
- Finally, if the dog is in the backyard, it probably can be heard barking, but sometimes it can be confused by other dogs barking.

See, there are the following events: family in the house, the light turned on, a sick dog, the dog in the back yard, and the dog barking.

Compute the number of parameters of this network.

Consider a different scenario: we want to model full joint distribution by an n-dimension table for the same number of binary variables. How many parameters would need then?

Exercise 2 (Klema): Compute $Pr(\neg p_3)$ and $Pr(p_2|\neg p_3)$ using variable elimination method.



Exercise 3: Implement likelihood weighting.

In order to estimate $Pr(Y_j = y|Z)$, likelihood weighting firstly generates M samples $D = \{((x_1^1, \ldots, x_n^1), w^1), \ldots, (x_1^m, \ldots, x_n^m), w^m)\}$ using algorithm 1. Finally, it estimates the probability as $\frac{\sum_{k=1}^{m} w_k * \mathbb{1}(x_j^k = y)}{\sum_{k=1}^{m} w_k}$.

Data: Bayes network N with topological ordering $X_1, \ldots, X_n$, evidence set Z
Result: sample $(x_1, \ldots, x_n)$, weight (probability) of the sample w
$w \leftarrow 1$;
for $i = 1, \ldots, n$ **do**
  if $X_i \in Z$ **then**
    $x_i \leftarrow$ value of X_i from Z ;
    $w \leftarrow w * Pr(x_i | Par(x_1, \ldots, x_{i-1}))$;
  else
    $x_i \leftarrow$ sample from $Pr(X_i | Par(x_1, \ldots, x_{i-1}))$;
  end
  return $(x_1, \ldots, x_n), w$
end

Algorithm 1: Pseudocode for generating a single sample within likelihood weighting