Homework 6: Bayesian Networks
class in "Machine Learning", Fall 2016/17

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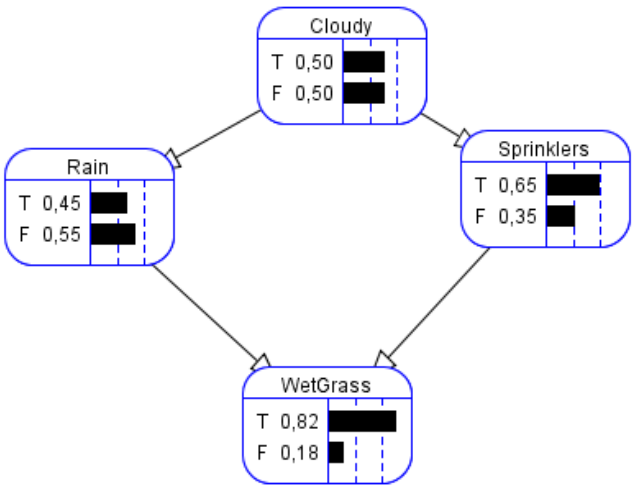
Contents

1 Assignment 1

1.1 Part 1

In the next figure there is the Bayesian network corresponding to the exercise:



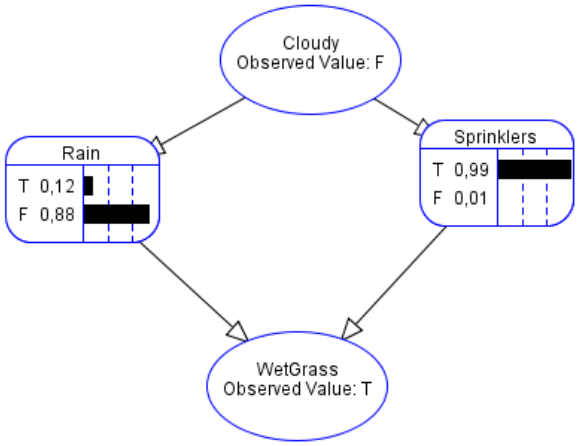
1.2 Part 2

The joint probability function is:

$$P(c, r, s, w) = P(c)P(r|c)P(s|c)P(w|r, s)$$

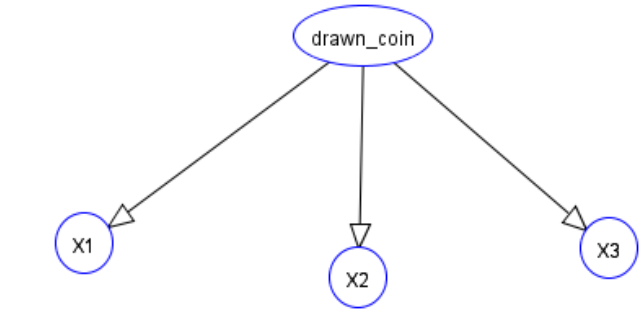
1.3 Part 3

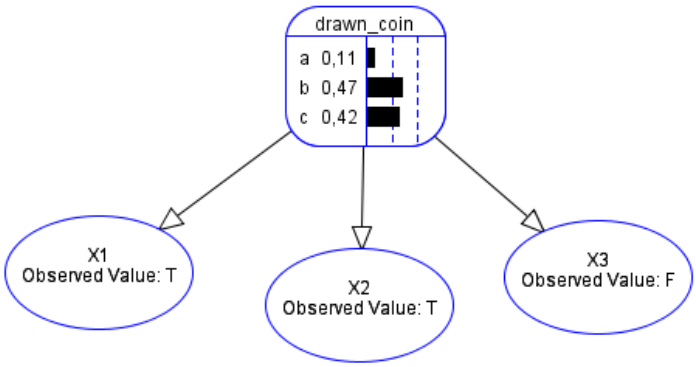
Just use the functionalities of the tool: The probability it rained is 0.12, while the probability the sprinklers were on is 0.99.


Cloudy
Observed Value: F
Rain
T 0,12
F 0,88
Sprinklers
T 0,99
F 0,01
WetGrass
Observed Value: T

2 Assignment 2

In the first figure I show the Bayesian network model for the problem; then I "made observations" and I set two of the toss to true and the other one to false. The most

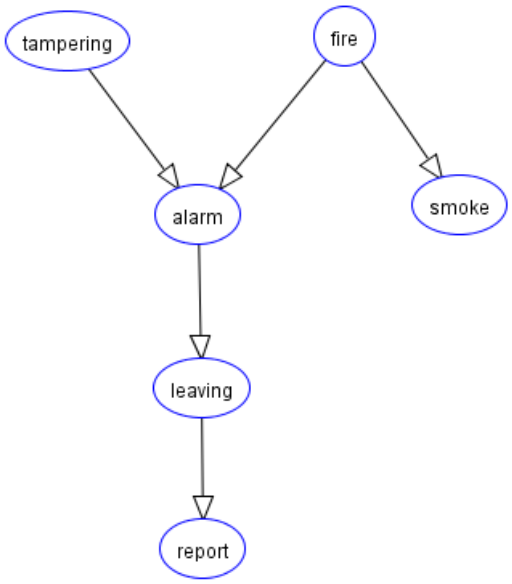




likely coin is the coin b, with probability 0.47.

3 Assignment 3

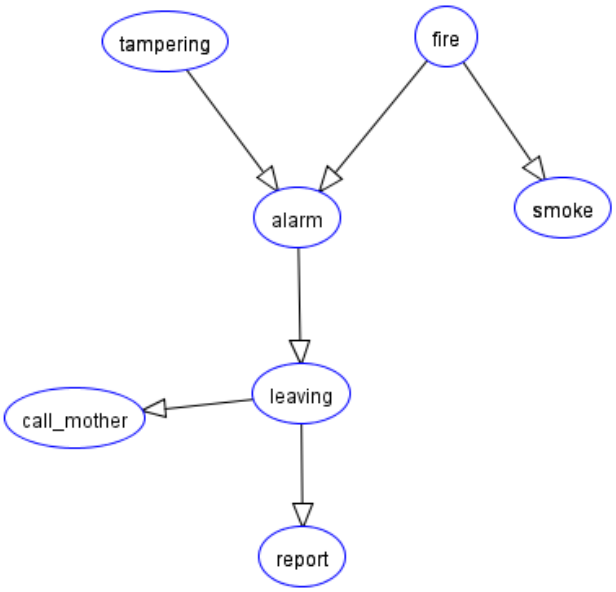
The sample problem "Fire Alarm Belief Network" is shown: The joint probability

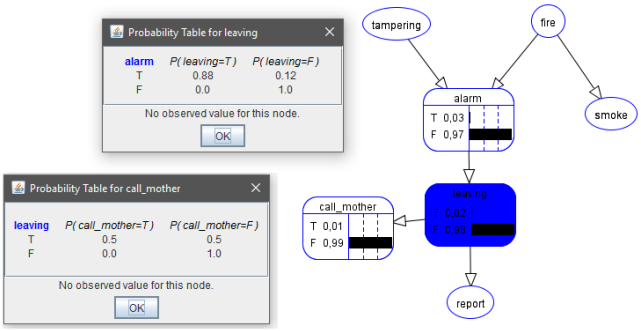


function is:

$$P(r, l, a, t, f, s) = P(r|l)P(l|a)P(a|t, f)P(s|f)P(t)P(f)$$

For representing the probability that someone will call their mother if the alarm goes off with *only one node* I did in this way: Where the node *call_mother* represent that event. In particular, I observed that the probability of *leaving* given alarm is false is zero. So, I put another node depending on leaving that given leaving false this node is certainly false.


tampering
fire
alarm
smoke
leaving
call_mother
report


Probability Table for leaving
alarm P(leaving=T) P(leaving=F)
T 0.88 0.12
F 0.0 1.0
No observed value for this node.
OK
Probability Table for call_mother
leaving P(call_mother=T) P(call_mother=F)
T 0.5 0.5
F 0.0 1.0
No observed value for this node.
OK
tampering
fire
alarm
T 0,03
F 0,97
smoke
call_mother
T 0,01
F 0,99
leaving
T 0,02
F 0,98
report

It might seem a little tricky, but let say that, a certain moment, the alarm is off. Then the situation is as in figure 1. Now for sure leaving and call_mother are false.

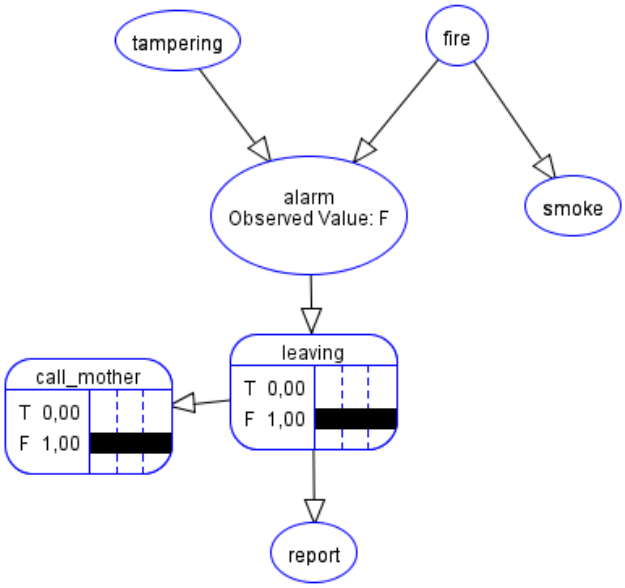


Figure 1:

Now suppose that alarm is true; the situation is represented in figure 2. We have that with some probability call_mother is true. Now let's consider that, after the alarm is true, leaving is true; The situation is in figure 3: If now the alarm *goes off*, there is a probability that call_mother is true (fig. 4):

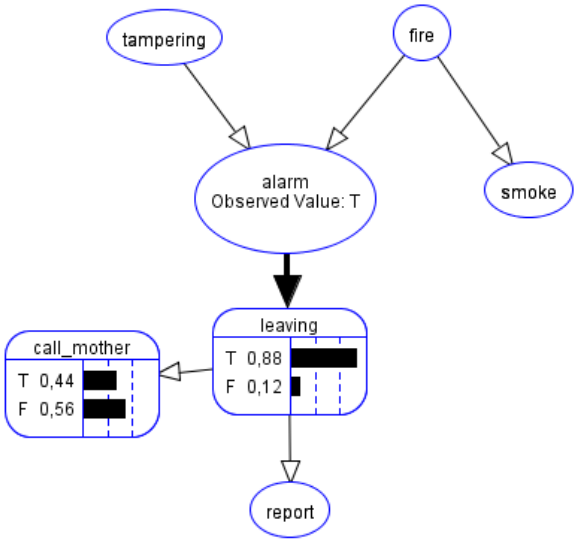


Figure 2:

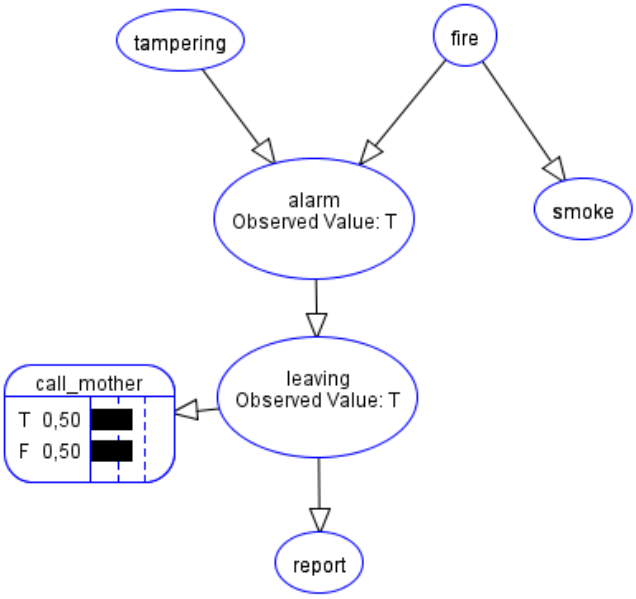


Figure 3:

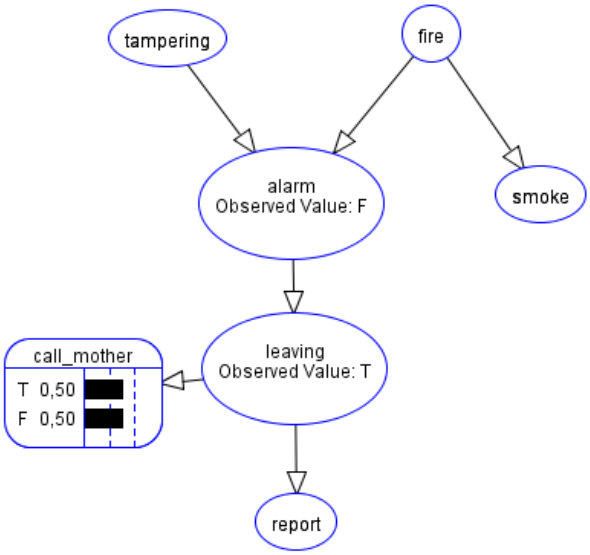

tampering
fire
alarm
Observed Value: F
smoke
call_mother
T 0,50
F 0,50
leaving
Observed Value: T
report

Figure 4: