



FACULTY OF SCIENCES OF THE UNIVERSITY
OF LISBON

Advanced Machine Learning Assignment 7 - Bayesian Networks

55761 · António Rebelo

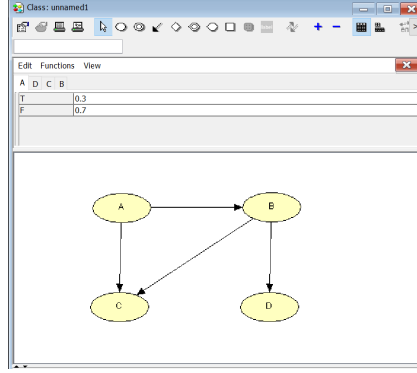
55877 · Marco Mercier

taught by
Professor Luis CORREIA

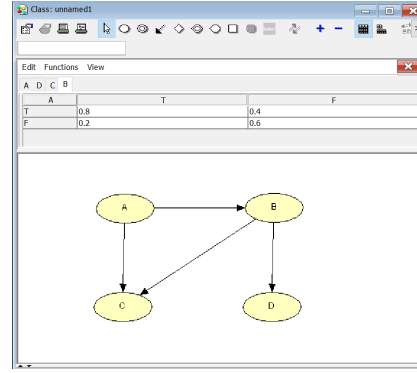
March 28, 2021

1 Causal Net

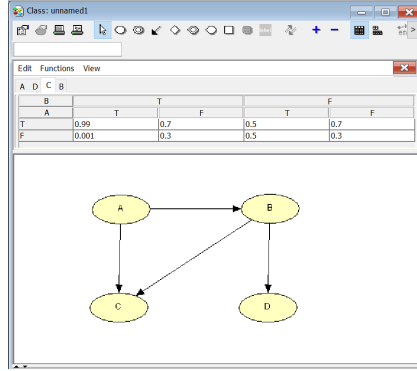
We started by getting the causal net ready on Hugin Lite, as ini figure 1:



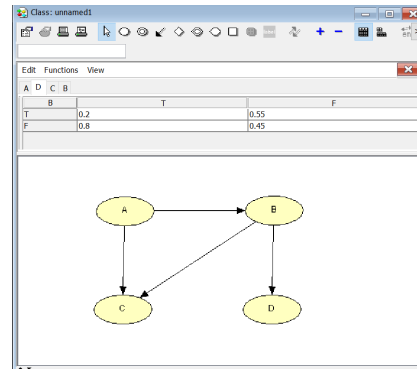
(a) Causal Net and node A's truth table.



(b) Causal Net and node B's truth table.



(c) Causal Net and node C's truth table.



(d) Causal Net and node D's truth table.

Figure 1: Causal Net setup in Hugin

Afterwards, the model was compiled and the calculation started.

1.1 $P(A = T | C = T, D = T)$

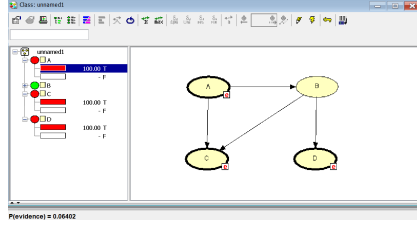
Using the Bayes rule, one knows that $P(A, B) = P(A|B)P(B)$, thus:

$$P(A = T | C = T, D = T) = \frac{P(A=T, C=T, D=T)}{P(C=T, D=T)}$$

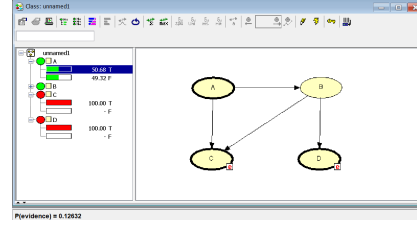
One can provide evidence to the model by double-clicking on it. The probability of the evidence in the model is then given in Hugin in the left lower corner,

as one can see from figure 2. In red are the known evidences.

$$P(A = T|C = T, D = T) = \frac{0.06402}{0.12632} = 0.5068 = 50.68\%$$



(a) $P(A = T, C = T, D = T)$



(b) $P(C = T, D = T)$

Figure 2: Probabilities of evidence in Hugin in the lower left corner.

1.2 $P(A = T|D = F)$

The answer is found in figure 4, which is $P(A = T|D = F) = 34.65\%$

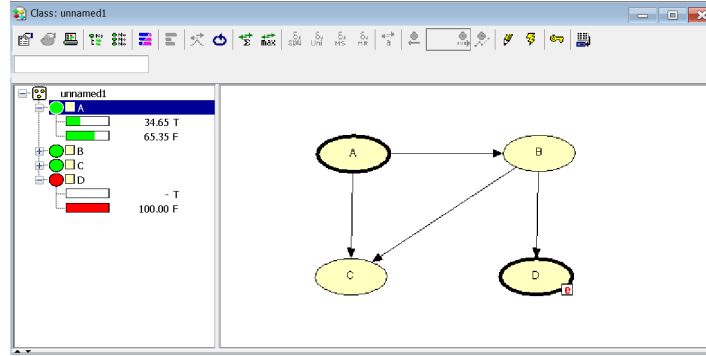


Figure 3: $P(A = T|D = F)$

1.3 $P(B = T|C = T)$

The answer is found in figure 4, which is $P(B = T|C = T) = 85.76\%$

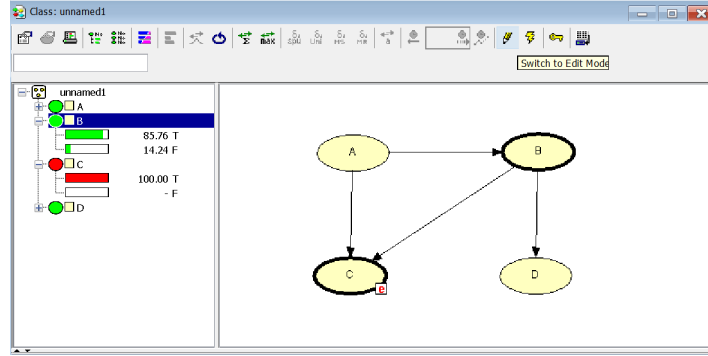
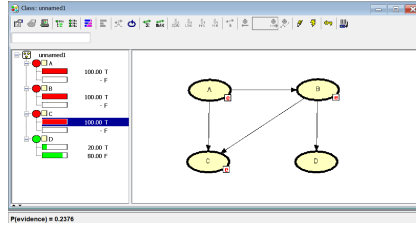


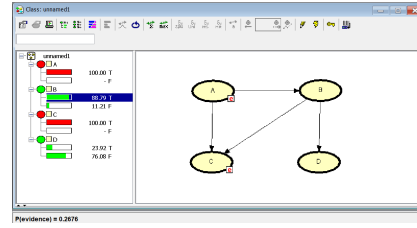
Figure 4: $P(B = T|C = T)$

1.4 $P(B = T|A = T, C = T)$

$$P(B = T|A = T, C = T) = \frac{P(B=T, A=T, C=T)}{P(A=T, C=T)} = \frac{0.2376}{0.2676} = 88.79\%$$



(a) $P(B = T, A = T, C = T)$

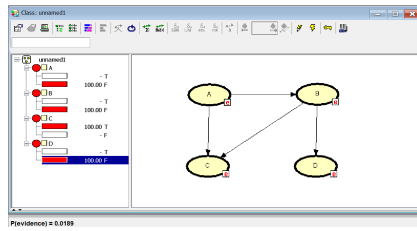


(b) $P(A = T, C = T)$

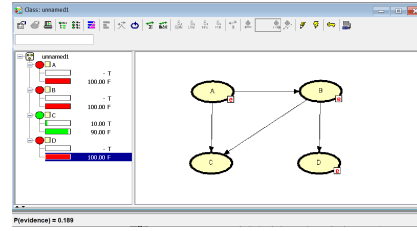
Figure 5: Probabilities of evidence in Hugin in the lower left corner.

1.5 $P(C = T|A = F, B = F, D = F)$

$$P(C = T|A = F, B = F, D = F) = \frac{P(C=T, A=F, B=F, D=F)}{P(A=F, B=F, D=F)} = \frac{0.0189}{0.189} = 10\%$$



(a) $P(C = T, A = F, B = F, D = F)$



(b) $P(A = F, B = F, D = F)$

Figure 6: Probabilities of evidence in Hugin in the lower left corner.