

FIT5047 Tutorial on Bayesian Networks

Exercise 1: *Bayesian Networks, Netica*

You have a three-node Bayesian Network, which correspond to three events: Alarm = the fire alarm in your apartment sounds, Fire = there was a fire in your apartment, and Tampering = your smoke detector was tampered with. Fire affects Alarm (a fire increases the probability of the alarm sounding) and Tampering also affects Alarm (if someone tampered with your smoke detector, your alarm is more likely to sound when there is no fire, and less likely to sound when there is a fire). The probabilities in your Bayes Net correspond to the following tables:

P(Tampering) = T	P(Tampering) = F
.02	.98

P(Fire=T)	P(Fire)=F
.01	.99

	P(Alarm=T Tampering,Fire)	P(Alarm=F Tampering,Fire)
Tampering=T, Fire=T	.5	.5
Tampering=T, Fire=F	.85	.15
Tampering=F, Fire=T	.99	.01
Tampering=F, Fire=F	0	1

Use Netica to answer the following questions (validate Netica's answers by performing your own calculations):

- What is the marginal probability that your fire alarm will sound?
- Let's assume that you have observed that your smoke detector has not been tampered with. What is the posterior probability that the alarm will sound?
- Still assuming that you have observed that your smoke detector has not been tampered with, what is the posterior probability that there was a fire in your apartment?
- Now let's assume that you have observed that your smoke detector has not been tampered with, and that the fire alarm has sounded. What is the posterior probability that there was a fire in your apartment?

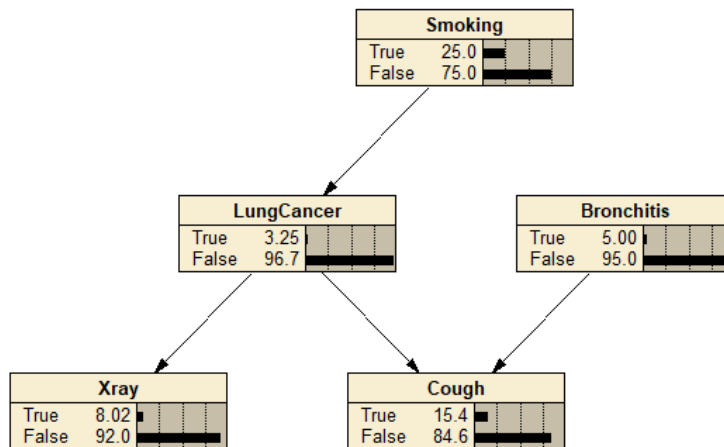
Exercise 2: *Bayesian Networks, Netica*

Dr. Ann Nicholson spends 60% of her work time in her office. The rest of her work time is spent elsewhere. When Ann is in her office, half the time her light is off (when she is trying to hide from students and get research done). When she is not in her office, she leaves her light on only 5% of the time. 80% of the time she is in her office, Ann is logged onto the computer. Because she sometimes logs onto the computer from home, 10% of the time she is not in her office, she is still logged onto the computer.

- Construct a Bayesian Network to represent the *Lecturer's Life* scenario just described. Indicate clearly the CPTs.
- Enter your BN in Netica.
- Suppose a student checks Dr. Nicholson's login status and sees that she is logged on. Use Netica to determine the effect this has on the student's belief that Dr. Nicholson's light is on?

Exercise 3: *D-separation*

Consider the following Bayesian network for another version of the medical diagnosis example, where B=Bronchitis, S=Smoker, C=Cough, X=Positive X-ray, and L=Lung cancer and all nodes are Booleans. Suppose that the prior for a patient being a smoker is 0.25, and the prior for the patient having bronchitis is 0.05.



List the pairs of nodes that are conditionally independent in the following situations, **omitting the nodes that are set**:

- There is no evidence for any of the nodes.
- The cancer node is set to true (and there is no other evidence).
- The smoker node is set to true (and there is no other evidence).
- The cough node is set to true (and there is no other evidence).