

Exercise 1. Sally lives and works in a seismic region. Whilst at work, her neighbour calls saying that her burglar alarm is buzzing. While driving home to investigate, the local radio reports a small earthquake; That earthquake might have set off the buzzer, she thinks.

Introduce the following random variables :

- $\rightsquigarrow B$: A burglar is in the house
- $\rightsquigarrow A$: The alarm is sounding
- $\rightsquigarrow C$: The neighbour calls to report a sounding alarm
- $\rightsquigarrow E$: A small earthquake occurs nearby
- $\rightsquigarrow R$: The radio reports a nearby earthquake

Assume that the joint probability factorises as $p(B, E, A, R, C) = p(B)p(E)p(A|B, E)p(C|A)p(R|E)$.

Consider the following values for the probabilities:

- Burglar and earthquake probabilities¹
 - $p(B = 1) = \beta$ (say, $\beta = 0.001$)
 - $p(E = 1) = \varepsilon$ (say, $\varepsilon = 0.001$)
- Alarm probability, the alarm will sound if any of the following events occurs:
 - A burglar is in the house and the alarm triggers (say, $\alpha_b = 0.99$ is the alarm reliability)
 - An earthquake occurs and the alarm triggers (say, $\alpha_e = 0.01$ is the alarm sensibility)
 - Another event occurs and the alarms triggers (say, $f = 0.001$ is the false alarm rate)

$$\begin{aligned}
 p(A = 0|B = 0, E = 0) &= (1 - f) \\
 p(A = 0|B = 1, E = 0) &= (1 - f)(1 - \alpha_b) \\
 p(A = 0|B = 0, E = 1) &= (1 - f)(1 - \alpha_e) \\
 p(A = 0|B = 1, E = 1) &= (1 - f)(1 - \alpha_b)(1 - \alpha_e)
 \end{aligned}$$

- Neighbours do not call if the alarm is not buzzing
 - $p(C = 1|A = 0) = 0$
- Radio stations do not report inexistent earthquakes
 - $p(R = 1|E = 0) = 0$

¹Assume that earthquake are independent of burglars (and vice versa): $p(E, B) = p(E)p(B)$.

We are interested in calculating the probability that Sally's house is getting burglarised.

1. What is the probability that Sally's house is getting burglarised, given the initial evidence (the neighbour's call)?
2. What is the probability that Sally's house is getting burglarised, given the initial and extra evidence (the news on the radio)?
3. Draw the belief network for the problem.
4. Indicate the Markov blanket of each of the variables.

Instructions

[*Deadline*]: Submissions via SIGAA close Friday December 08, 2017 at 23:59:59 (Fortaleza Time).

[*Delays*]: Delayed submissions via email to `fcorona@ufc.br`. Delays will be penalised.

[*Solutions*]: You can write your solutions in either Portuguese or English language. Solutions must be submitted in PDF (`.pdf`) format; Other formats (`.doc`, `.docx`, `.rtf` etc.) will not be considered. The L^AT_EX template available at the course website is recommended, though not obligatory.

[*Others*]: Collaborations and solutions inspired by other people's work will be tolerated only within the limits explained in the website. Plagiarism will not be tolerated and will be reported to the UFC.