Bayesian Networks and Influence Diagrams: A Guide to Construction and Analysis

Uffe B. Kjærulff and Anders L. Madsen

Answers to Exercises

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Answer to Exercise 9.1:

(a) The set of evidence is $\varepsilon = \{\varepsilon_W, \varepsilon_S\} = \{W = \mathsf{yes}, S = \mathsf{no}\}$. The conflict measure $\mathrm{conf}(\varepsilon)$ is computed as:

$$\begin{aligned}\mathrm{conf}(\varepsilon) &= \log \frac{P(W = \mathsf{yes})P(S = \mathsf{no})}{P(\varepsilon)} \\ &= \log \frac{0.2440 \cdot 0.7875}{0.0863} = 0.8.\end{aligned}$$

The value of the conflict measure is $\mathrm{conf}(\varepsilon) = 0.8$. This implies a possible conflict in the evidence.

(b) The set of evidence is $\varepsilon = \{\varepsilon_W, \varepsilon_S, \varepsilon_R\} = \{W = \mathsf{yes}, S = \mathsf{no}, R = \mathsf{yes}\}$. The conflict measure $\mathrm{conf}(\varepsilon)$ is computed as:

$$\begin{aligned}\mathrm{conf}(\varepsilon) &= \log \frac{P(W = \mathsf{yes})P(S = \mathsf{no})P(R = \mathsf{yes})}{P(\varepsilon)} \\ &= \log \frac{0.2577 \cdot 0.7875 \cdot 0.01}{0.0015} = 0.315.\end{aligned}$$

The value of the conflict measure is $\mathrm{conf}(\varepsilon) = 0.8$. This implies a possible conflict in the evidence.

(c) The prior probability of $F = \mathsf{yes}$ is 0.001 whereas the posterior probability of $F = \mathsf{yes}$ is 0.4744. The conflict measure $\mathrm{conf}(\varepsilon \cup \{h_F\})$ is

$$\begin{aligned}\mathrm{conf}(\varepsilon \cup \{h_F\}) &= \log \frac{P(W = \mathsf{yes})P(S = \mathsf{no})}{P(\varepsilon)} + \log \frac{P(F = \mathsf{yes})}{P(F = \mathsf{yes} \mid \varepsilon)} \\ &= 0.315 + \log \frac{0.001}{0.4744} \\ &= 0.315 - 6.162 = -5.85.\end{aligned}$$

Thus, $h_F : F = \mathsf{yes}$ is a hypothesis that may explain the evidence as a rare case. Similarly, hte hypothesis $h_A : A = \mathsf{yes}$ may explain the evidence as a rare case. As the alarm sounding will most likely be caused by a flood we conclude that a flood is the most likely hypothesis explaining the evidence as a rare case.

(d) The partial conflicts are:

$$\begin{aligned}\mathrm{conf}(\varepsilon_W, \varepsilon_S) &= 0.846, \\ \mathrm{conf}(\varepsilon_W, \varepsilon_R) &= -0.219, \\ \mathrm{conf}(\varepsilon_R, \varepsilon_S) &= 0.\end{aligned}$$

Thus, the source of the conflict in ε is $\{\varepsilon_W, \varepsilon_S\}$.

Answer to Exercise 9.2:

(a)

(b)