

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

Uffe B. Kjærulff and Anders L. Madsen  
Answers to Exercises

July 27, 2009

**Answer to Exercise 9.1:**

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

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

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

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

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

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

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

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

Thus,  $h_F : F = \text{yes}$  is a hypothesis that may explain the evidence as a rare case. Similarly, the hypothesis  $h_A : A = \text{yes}$  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:

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

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

**Answer to Exercise 9.2:**

- (a)  
(b)