Tutorial Examples Uncertainty

December 1, 2017
Assessing Nets

Two astronomers in different parts of the world make measurements $M_1$ and $M_2$ of the number of stars $N$ in some small region of the sky, using their telescopes. Normally, there is a small probability $e$ or error of up to one star in each direction. Each telescope can also be badly out of focus with probability $f$. Let $F_1$ and $F_2$ be boolean variables with $F_i = true$ being that the $i$-th telescope is out of focus. If the telescope is out of focus then the scientist will always undercount by 3 or more stars (or, if $N$ is 3 or less, fail to detect any stars at all).

(i) (ii) (iii)

(a) Which of these Bayesian Networks can correctly representation the preceeding information? (Note that additional edges in a network do not make the network incorrect, they only make the network redundant).

(b) Which is the best network? Explain.

(c) Write out the CPT for $Pr(M_1 | N, F_1)$ for the case where $M_1 \in \{0, 1, 2, 3, 4\}$ and $N \in \{1, 2, 3\}$. Express the entries in terms of $e$ and $f$.

(d) Use your CPT for $Pr(M_1 | N, F_1)$ to compute the CPT for $Pr(M_1 | N)$ (again expressed in terms of $e$ and $f$).

(e) Suppose $M_1 = 1$ and $M_2 = 3$. What are the possible numbers of stars.

4. Consider the Bayes net given below.

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(a) What is the product decomposition specified by this network?

(b) Say that variable $X_7$ has 3 possible values, $X_6$ has 2 possible values, and $X_4$ has 4 possible values. How many values will be contained in the conditional probability table for $X_6$.

(c) Are $X_1$ and $X_5$ conditionally independent given $X_2$, given $X_7$, given $X_6$, given $X_4$?

(d) What are the relevant variables given the query $X_3$ and the evidence items $X_6$, given evidence $X_5$, given evidence $X_4$?
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4. Use your CPT for $Pr(M_1|N, F_1)$ to compute the CPT for $Pr(M_1|N)$ (again expressed in terms of $e$ and $f$).

5. Suppose $M_1 = 1$ and $M_2 = 3$. What are the possible numbers of stars.