Note Title 3/2/2009

The problem called Most-Probable Explanation (MPE) in the text is usually called Maximum A-Posteriory assignment (MAP).

Chapter 4 – Belief updating

Fig. 4.1

$$P(A_1, \dots, A_6) = P(A_1) \times P(A_2 | A_1) \times \underbrace{P(A_3 | A_1)}_{\phi_3(A_1, A_3)} \times P(A_4 | A_2) \times$$
$$\times P(A_5 | A_2, A_3) \times P(A_6 | A_3)$$

by the chain rule for BNs.

Each of the functions is a potential.

Each potential has a domain, which is just the set of its variables.

E.g., $dom(\varphi_3) = \{A_1, A_2\}$ $\qquad \varphi \equiv \phi$

Calculate $P(A_4)$

$$P(A_4) = \sum_{A_1, A_2, A_3, A_5, A_6} * = \sum_{A_1, A_2, A_3, A_5, A_6} \phi_1 \cdot \phi_2 \cdot \phi_3 \cdot \phi_4 \cdot \phi_5 \cdot \phi_6 =$$

$$= \sum_{A_1} \phi_1(A_1) \sum_{A_2} \phi_2(A_1, A_2) \sum_{A_3} \phi_3(A_1, A_3) \sum_{A_4} \phi_4(A_2, A_4) \sum_{A_5} \underbrace{\phi_5(A_2, A_3, A_5) \sum_{A_6} \phi_6(A_3, A_6)}_{= 1} =$$

$$\phi_6'(A_3) \quad (+)$$

$$= \sum_{A_1} \phi_1(A_1) \sum_{A_2} \phi_2(A_1, A_2) \sum_{A_3} \phi_3(A_1, A_3) \sum_{A_4} \phi_4(A_2, A_4) \underbrace{\sum_{A_5} H_6(A_2, A_3, A_5)}_{}$$

$$= \ldots \underbrace{H_5(A_2, A_3, A_4)}_{} =$$

$$= \ldots \underbrace{H_4(A_1, A_2, A_3)}_{} =$$

$$= \sum_{A_1} \phi_1(A_1) \sum_{A_2} H_3(A_1, A_3) =$$

$$= H_2(A_1) \qquad \text{stop.}$$

$$(+) = \sum_{A_1} \ldots \sum_{A_5} \phi_5(A_2, A_3, A_5)\, \phi_6'(A_3) =$$

$$= \sum_{A_1} \ldots \phi_6'(A_3) \sum_{A_5} \phi_5(A_2, A_3, A_5)$$