Reminders

- Homework
- Presentation group
- Papers to present

- Causal (top-down) inference

$$P(m \mid e) = \alpha \sum_{B,G} P(m, e, B, G)$$

(B, G: hidden variables)

$$= \alpha \sum_{B,G} P(m \mid B, e)\, P(G \mid B)\, P(B)\, P(e)$$

($P(e)$: to α)

$$= \alpha \sum_{B} P(m \mid B, e)\, P(B) \sum_{G} P(G \mid B)$$

($\sum_G P(G \mid B) = 1$)

$$= \alpha \sum_{B} P(m \mid B, e)\, P(B) \qquad \alpha \langle \uparrow, \uparrow \rangle$$

$$P(m \mid b, e)\, P(b) + P(m \mid \neg b, e)\, P(\neg b)$$

$$= 0.9 \times 0.95 + 0 \times 0.05$$

$$= 0.855$$

$$P(\neg m \mid b, e)\, P(b) + P(\neg m \mid \neg b, e)\, P(\neg b)$$

$$= 0.1 \times 0.95 + 1 \times 0.05 = 0.145$$

$$P(M \mid e) = \langle 0.855, 0.145 \rangle$$

$$P(m \mid e) = 0.855$$

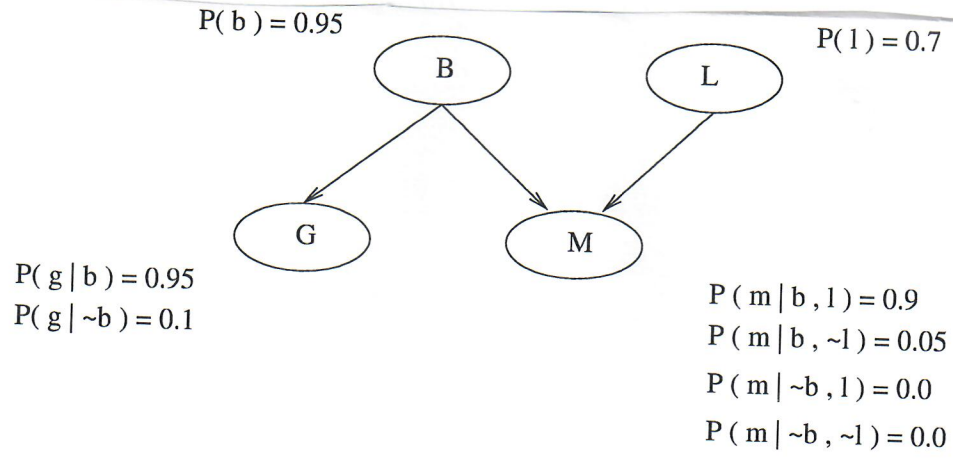
$$P(m) = \sum_{B,L,G} P(G, m, B, L)$$

prior

$$= 0.6$$

$$P(m \mid e) = 0.855$$

posterior (given evidence)



$P(m \mid e)$

working on questions

(3)

$$P(v_1 \mid v_2)$$

$$P(v_1 \mid v_2, v_3)$$

$$+$$

$$P(v_1 \mid v_2, \neg v_3)$$

$$P(a,b,c,d) = P(a \mid b,c,d)\, P(b,c,d)$$

$$P(b \mid c,d)\, P(c,d)$$

$$P(c \mid d)\, P(d)$$

A, B, ...

$$\sum_A P(b, A) = P(b, a) + P(b, \neg a)$$

$$P(b) = P(b,a) + P(b, \neg a)$$

$$\sum_G P(G \mid B)$$

$$P(g \mid b) + P(\neg g \mid b)$$

$$\sum_G P(G \mid b)$$

$$\sum_G P(G \mid \neg b)$$

$$P(g \mid \neg b) + P(\neg g \mid \neg b)$$

- Diagnostic (bottom-up) inference

$P(\neg \ell \mid \neg m) = ?$

$$P(\neg \ell \mid \neg m) = \sum_{B,G} (\neg m, \neg \ell, B, G)$$

$$= \alpha \sum_{B,G} P(\neg m \mid B, \neg \ell)\, P(G \mid B)\, P(B)\, P(\neg \ell)$$

$P(\neg \ell)$ cannot move to α here

$$= \alpha \sum_{B} P(\neg m \mid B, \neg \ell)\, P(B)\, P(\neg \ell) \sum_{G} P(G \mid B)$$

$\sum_{G} P(G \mid B) = 1$

$P(\neg m \mid b, \neg \ell)\, P(b)\, P(\neg \ell) + P(\neg m \mid \neg b, \neg \ell)\, P(\neg b)\, P(\neg \ell)$

$0.95 \times 0.95 \times 0.3 \quad 1 \times 0.05 \times 0.3$

$= 0.28575$

For the other component of the vector (with ℓ)

$P(\neg m \mid b, \ell)\, P(b)\, P(\ell) + P(\neg m \mid \neg b, \ell)\, P(\neg b)\, P(\ell)$

$\langle \_\_ , \_\_ \rangle$

$0.1 \times 0.95 \times 0.7 + 1 \times 0.05 \times 0.7$

$= 0.1015$

prior $P(\ell) = 0.7$

$\langle 0.7379, 0.2621 \rangle$

$P(\neg \ell \mid m) \quad P(\ell \mid m)$