CS 472 HW 7

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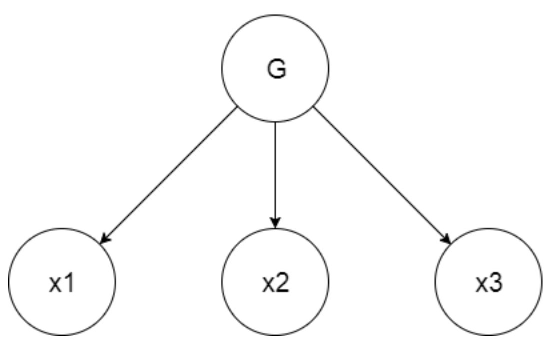
14.1) a.)



b.) First apply Bayes Rule to reverse the dependency.

$$P(G|2 \text{ heads, } 1 \text{ tail}) = P(2 \text{ heads, } 1 \text{ tails}|G)P(G)/P(2 \text{ heads, } 1 \text{ tails}) \quad (1)$$
$$P(2 \text{ heads, } 1 \text{ tails}|G) \quad (2)$$

G	P(G)
a	1/3
b	1/3
c	1/3

(a) The CPC for G

G	X_i	P(G)
a	heads	0.2
b	head	0.6
c	heads	0.8

(b) The CPC for x_i given G

x_1, x_2 and x_3 are conditionally independent of given G (they are d separated by G). The highest conditionally probability in question can then calculated, where there are 3 choose 2 combinations of the event for a.

$$P(x_1 = tails|G = a)P(x_2 = heads|G = a)P(x_3 = heads|G = a) = 0.032 \tag{3}$$

$$P(\text{2 heads, 1 tails}|G = a) = 3 * 0.032 = 0.096 \tag{4}$$

$$\tag{5}$$

It follows that.

$$P(\text{2 heads, 1 tails}|G = b) = 0.432 \tag{6}$$

$$P(\text{2 heads, 1 tails}|G = c) = 0.384 \tag{7}$$

$$\tag{8}$$

The condition $G = b$ provides the highest conditionally probability.

14.6) a). The network c represent represents the expression. The independence of genes is asserted.
b). a and b both consistent with the claim. However, b may have some unnecessary dependencies based on the description.
c.) a is the best representation for reasons stated above.
d.)

Table 1: CPC for handedness

G_{mother}	G_{father}	P($G_{child} = l$— –)	P($G_{child} = r$— –)
l	l	1-m	m
l	r	0.5	0.5
r	l	0.5	0.5
r	r	m	1-m

e.)

$$P(G_{child}=l) = \sum_{g_m,g_f} P(G_{child}=l|g_m,g_f)P(g_m,g_f) \quad (9)$$

$$= \sum_{g_m,g_f} P(G_{child}=l|g_m,g_f)P(g_m)P(g_f) \quad (10)$$

$$= (1-m)q^2 + 0.5q(1-q) + 0.5(1-q)q + m(1-q)^2 \quad (11)$$

$$= q + m - 2mq \quad (12)$$

f.) left-handedness is humans is fairly uncommon ($\approx$ 10% according to Google). For equilibrium, $P(G_{child}=l) = P(G_{mother}=l) = P(G_{father}=l)$. This implies that $q+m-2mq = q, \quad q = 0.5$. This seems too high for current global statistics.

14.14) a.) ii, and iii are asserted by the network. b.)$P(b,i,\neg m,g,j) = P(b)P(\neg m)P(i|b,\neg m)P(g|b,i,\neg m)P(j|g) = 0.9*0.9*0.5*0.8*0.9 = 0.2916$ c.) B, I and M are given as evidence with values of *true*. This gives G a prior of 0.9. The probability of going to jail is:

$$P(J|b,i,m) = \alpha \sum_{g} P(J,g) \quad (13)$$

$$= \alpha(P(J,g) + P(J,\neg g)) \quad (14)$$

$$= \alpha(\langle P(j,g), P(\neg j,g)\rangle + \langle P(j,\neg g), P(\neg j,\neg g)\rangle) \quad (15)$$

$$= \langle 0.81, 0.19\rangle \quad (16)$$

$$= \alpha(\langle 0.81, 0.09\rangle + \langle 0, 0, 1\rangle) = \langle 0.81, 0.19\rangle \quad (17)$$

The probability of jail is 0.81.
Markov Blanket for variable M in the network includes M's parents, children and its childrens' other parents: I, G, B