CS 440/ECE448 Homework 5

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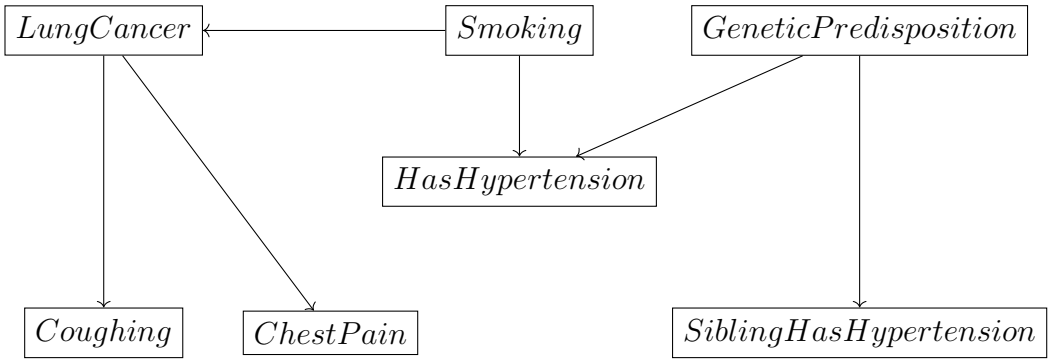
Problem 1

a)



b) 14 parameters are the minimum needed to encode this Bayes net.

c) $2^7 - 1$ parameters are needed for the full joint probability distribution.

d) New phone, who dis.

Problem 2

a) The values a through h are as follows:

$$a = .3$$
$$b = .6$$
$$c = .3$$
$$d = .5$$
$$e = .4$$
$$f = .7$$
$$g = .5$$
$$h = .4$$

b)

$$\begin{aligned}\mathbf{P}(D=T|A=F) = \mathbf{P}(D=T|C=T)\mathbf{P}(C=T|A=F,B=T)\mathbf{P}(B=T)\\ +\mathbf{P}(D=T|C=T)\mathbf{P}(C=T|A=F,B=F)\mathbf{P}(B=F)\\ +\mathbf{P}(D=T|C=F)\mathbf{P}(C=F|A=F,B=T)\mathbf{P}(B=T)\\ +\mathbf{P}(D=T|C=F)\mathbf{P}(C=F|A=F,B=F)\mathbf{P}(B=F)\end{aligned}$$

This then leads to:

$$\mathbf{P}(D=T|A=F) = geb + gf(1-b) + h(1-e)b + h(1-f)(1-b)$$

c)

$$\mathbf{P}(B=F|A=T) = \mathbf{P}(B=F)$$

This then leads to:

$$\mathbf{P}(B=F|A=T) = 1-b$$

d) From Part B:

$$\mathbf{P}(D=T|A=F) = geb + gf(1-b) + h(1-e)b + h(1-f)(1-b)$$

The values found in part A can be substituted in:

$$\mathbf{P}(D=T|A=F) = (0.5)(0.4)(0.6) + (0.5)(0.7)(0.4) + (0.4)(0.6)(0.6) + (0.4)(0.4)(0.4)$$

Thusly:

$$\mathbf{P}(D=T|A=F) = 0.452$$

Problem 3

a) The number of parameters need to represent the full joint for all 6 Bayes nets is:

$$N_A N_B N_C N_D N_E N_F - 1$$

b) The minimum number of parameters needed for to represent each of the 6 Bayes nets is as follows:

(1)

$$(N_A - 1) + N_A(N_C - 1) + N_C(N_E - 1) + (N_B - 1) + N_B(N_D - 1) + N_D(N_F - 1)$$

(2)

$$(N_A - 1) + N_A(N_C - 1) + N_C(N_E - 1) + (N_B - 1) + N_B(N_D - 1) + N_C N_D(N_F - 1)$$

(3)

$$(N_A - 1) + N_A(N_C - 1) + N_C(N_E - 1) + (N_B - 1) + N_A N_B(N_D - 1) + N_D(N_F - 1)$$

(4)

$$(N_A - 1) + N_A(N_C - 1) + N_C(N_E - 1) + (N_B - 1) + N_A N_B(N_D - 1) + N_C N_D(N_F - 1)$$

(5)

$$(N_A - 1) + N_B N_A(N_C - 1) + N_C(N_E - 1) + (N_B - 1) + N_A N_B(N_D - 1) + N_D(N_F - 1)$$

(6)

$$(N_A - 1) + N_B N_A(N_C - 1) + N_C(N_E - 1) + (N_B - 1) + N_A N_B(N_D - 1) + N_C N_D(N_F - 1)$$