Assignment 3 Machine Learning COS4852

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1 Question 1

Given Bayes' theorem where

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} \tag{1}$$

We need to calculate the probability of Joe being a librarian (L) given that he has glasses. (G) This can be expressed as follows using Bayes' theorem from above

$$P(L|G) = \frac{P(G|L)P(L)}{P(G)} \tag{2}$$

We know that $P(G|L)$ is the probability that a librarian is wearing glasses, $P(L)$ is the probability that a man is a librarian an $P(G)$ is just the probability of a man wearing glasses. These probabilities are provided. Thus putting them into the above equation gives

$$\begin{aligned} P(L|G) &= \frac{P(G|L)P(L)}{P(G)} \\ &= \frac{(1)(\frac{1}{12000})}{0.12} \\ &= 0.00069 \end{aligned} \tag{3}$$

The probability that Joe is a librarian is 0.00069

Following the same argument we need to determine the probability that Joe is a salesman (S) given that he wears glasses. Using Bayes' theorem again we have

$$P(S|G) = \frac{P(G|S)P(S)}{P(G)} \tag{4}$$

$P(G|S)$ is the probability that a salesman wears glasses. $P(S)$ is the probability that a man is a salesman and $P(G)$ is again the probability that a person wears glasses. We are given this information. We now work out $P(S|G)$

$$\begin{aligned} P(S|G) &= \frac{P(G|S)P(S)}{P(G)} \\ &= \frac{(\frac{1}{25})(\frac{1}{200})}{0.12} \\ &= 0.00166 \end{aligned} \tag{5}$$

We find that it is much more likely for Joe to be a salesman than a librarian. This is not what we would expect. We would expect for him to be a librarian given that every librarian wears glasses. Without more information there is no better way to calculate whether Joe is a librarian or a salesman.

2 Question 2

2.1 Question 2a

The network has 5 nodes namely Smoker (named variable S), Lung Cancer (named variable C), Pollution (named variable P), X-Ray (named variable X) and Dyspnoea (named variable D). Refer to Figure 1.

Smoker (S) has 2 states: Yes (y) and No (n)

Lung Cancer (C) has 2 states: True (t), False (f)

Pollution (P) has 2 states: High (h) and low (l)

X-Ray has 2 states: Abnormal (a) and Normal (n)

Dyspnoea has 2 states: Present (p) and Absent (a)

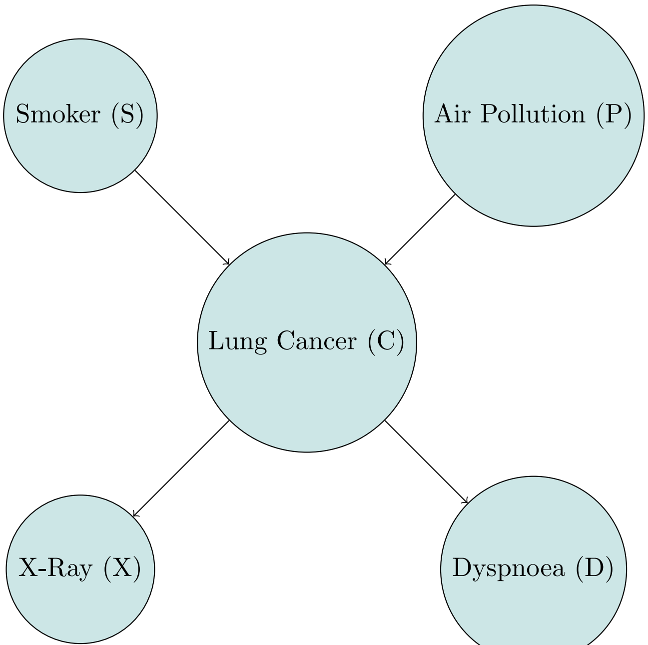
Lung Cancer is dependant on Smoker and Pollution. While X-Ray and Dyspnoea is dependant on Lung Cancer. This relationship can be seen in Figure 1.

2.2 Question 2b

The bayesian network is described by Figure 1

P(S=y)	P(S=n)
0.33	0.66

P(P=h)	P(P=l)
0.91	0.09



S	P	C	P(C|S,P)
n	l	f	0.999
n	l	t	0.001
n	h	f	0.97
n	h	t	0.03
y	l	f	0.98
y	l	t	0.02
y	h	f	0.96
y	h	t	0.04

X	C	P(X|C)
n	f	0.83
n	t	0.05
a	f	0.17
a	t	0.95

D	C	P(D|C)
a	f	0.75
a	t	0.3
p	f	0.25
p	t	0.7

Figure 1: Bayesian Network

3 Question 3

3.1 A Report on Genetic Algorithms and how they are affected by population size and population density

3.2 Abstract

3.3 Introduction

3.4 Methodology

3.5 Findings

3.5.1 How do Genetic Algorithms work?

3.5.2 How does the choice of initial population affect Genetic Algorithms?

3.5.3 How does the diversity of the population affect Genetic Algorithms?

3.6 Conclusion

References