CS 6364 HW 4

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1 QUALIFYING UNCERTAINITY

Problem 13.21 from the Textbook at page 509. (It should start with (Adapted from Pearl (1988)). Suppose you are a witness to a nightime....
(a) 10 points
(b) 10 points

1.1 a)

SOLUTION

Random variable information :

1. B : Taxi was blue
2. LB : Taxi looked blue

Given reliability information :

$$P(LB|B) = 0.75, P(\neg LB|\neg B) = 0.75$$

Given hint : Distinguish between proposition that taxi is blue and proposition that it appears blue

We need to know the probability that taxi was blue given that it looked blue.

$$P(B|LB) = \alpha P(LB|B)P(B) = 0.75\alpha P(B) \;\; where \;\; \alpha = Normalization \;\; constant$$

$$P(\neg B|LB) = \alpha P(LB|)P() = 0.25\alpha(1 - P(B))$$

Here we are not presented with enough information reach a conclusion.
Any information about prior probabilities shall suffice.

1.2 b)

SOLUTION

Given 9 out of 10 are green.

$$P(B) = 1 - 0.9 = 0.1$$

Thus giving us the following values:

$$P(B|LB) = 0.75 * 0.1\alpha = 0.075\alpha$$
$$P(\neg B|LB) = 0.25 * 0.9\alpha = 0.225\alpha$$
$$\alpha = \frac{1}{0.075 + 0.225} = \frac{10}{3} = 3.33$$

$$P(B|LB) = 0.75 * 0.1\alpha = 0.075\alpha = 0.25$$
$$P(\neg B|LB) = 0.25 * 0.9\alpha = 0.225\alpha = 0.75$$

2 NAIVE BAYESIAN REASONING

Consider a traveler that wants to climb the Everest. He gets to Nepal in summer and also finds an experienced guide. Use Naive Bayesian reasoning to decide if the traveler will climb to 1000 ft from the top of the Everest based (15 points) on the following information:

1. 10% of all climbers get to 1000 ft from the top of the Everest.

2. Among all travelers who get to 1000 ft from the top of the Everest, 90% went to Nepal in summer and 80% used an experienced guide.

3. 50% of climbers that cannot get to 1000 ft from the top of the Everest went to Nepal in summer and 30% were able to find an experienced guide.

Explain your conclusion. (10 points)

SOLUTION

Random variables :

1. C : a boolean variable for can be a climbers who get to 1000ft from top of the everest
2. N : a boolean variable for went to Nepal in summer
3. G : a boolean variable for usage of experienced guide

Given information

$$P(C) = 0.1$$
$$P(N|C) = 0.9, P(G|C) = 0.8$$
$$P(N|\neg C) = 0.5, P(G|\neg C) = 0.3$$

To answer : $P(C|N, G)$

We assume that going to Nepal and finding an experienced guide are conditionally independent given climber gets to 1000ft from top of the everest.

$$P(C|N, W) = \frac{P(N, W|C)P(C)}{P(N, W)}$$

$$P(N, W|C) = P(N|C)P(W|C)$$

$$P(C|N, W) = \frac{P(N|C)P(W|C)P(C)}{P(N, W)}$$

$$P(C|N, W) = \frac{(0.9)(0.8)(0.1)}{P(N, W)}$$

$$P(C|N, W) = \frac{(0.072)}{P(N, W)}$$

$$But \quad P(N, W) = P(N, W|C)P(C) + P(N, W|\neg C)P(\neg C)$$

$$P(N, W|\neg C)P(\neg C) = P(N|\neg C)P(W|\neg C)P(\neg C)$$

$$P(N, W|\neg C)P(\neg C) = P(N|\neg C)P(W|\neg C)P(\neg C)$$

$$P(N, W|\neg C)P(\neg C) = (0.5)(0.3)(0.9) = 0.135$$

$$\implies P(N, W) = 0.135 + 0.072 = 0.207$$

$$\implies P(C|N, W) = \frac{(0.072)}{0.207} = 0.347$$