CSE3013 – Artificial Intelligence (ETP)

(C2+TC2)

Digital Assignment – 2

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Question 1:

On an airport all passengers are checked carefully. Let T with t ε {0, 1} be the random variable indicating whether somebody is a terrorist (t = 1) or not (t = 0) and A with a ε {0, 1} be the variable indicating arrest. A terrorist shall be arrested with probability P(A = 1|T = 1) = 0.98, a non-terrorist with probability P(A = 1|T = 0) = 0.001. One in hundred thousand passengers is a terrorist, P(T = 1) = 0.00001. What is the probability that an arrested person actually is a terrorist?

Ans.

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Ans.1: Given:

Random variable indicating whether somebody is terrorist (t=1) or not (t=0) $= T, t \in \{0,1\}$;

Random variable indicating arrest $= A, a \in \{0,1\}$;

P(terrorist shall be arrested) $= P(A=1|T=1) = 0.98$;

P(non-terrorist shall be arrested) $= P(A=1|T=0) = 0.001$;

P(a terrorist among passengers) $= P(T=1) = 0.00001$

Now,

P(arrested person is actually a terrorist) $= P(T=1|A=1)$

$$P(T=1|A=1) = \frac{P(A=1|T=1)\cdot P(T=1)}{P(A=1)}$$

$$= \frac{P(A=1|T=1)\cdot P(T=1)}{P(A=1|T=1)\cdot P(T=1) + P(A=1|T=0)\cdot P(T=0)}$$

$$= \frac{(0.98 \times 0.00001)}{(0.98 \times 0.00001) + (0.001 \times (1-0.00001))}$$

$$= \frac{(0.98 \times 0.00001)}{(0.98 \times 0.00001) + (0.001 \times (1 - 0.00001))}$$

$$= 0.0097$$

$$\approx \frac{0.00001}{0.001} = \underline{0.01}$$

Even though, for any passenger it can be decided with high reliability (98% and 99.9%) whether she/he is a terrorist or not, if somebody gets arrested as a terrorist, he/she is most likely NOT a terrorist (with a probability of 99%).

Ans.

Question 2:

In an oral exam you have to solve exactly one problem, which might be one of three types, A, B, or C, which will come up with probabilities 30%, 20%, and 50%, respectively. During your preparation you have solved 9 of 10 problems of type A, 2 of 10 problems of type B, and 6 of 10 problems of type C.

Ans.

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Ans. (2) Given:

P(getting a problem of type A) = P(A) = 30%.
P(getting a problem of type B) = P(B) = 20%.
P(getting a problem of type C) = P(C) = 50%.

P(solving a problem of type A) = P(solved | A) = 9/10
P(solving a problem of type B) = P(solved | B) = 2/10
P(solving a problem of type C) = P(solved | C) = 6/10

(a) P(solving the problem in exam)

$= \sum \begin{bmatrix} P(\text{getting a problem of certain type}) \times \\ P(\text{solving a problem of that type}) \end{bmatrix}$

$= P(\text{solved}|A) \cdot P(A) + P(\text{solved}|B) \cdot P(B) + P(\text{solved}|C) \cdot P(C)$

$= \left(\frac{9}{10} \times 30\%\right) + \left(\frac{2}{10} \times 20\%\right) + \left(\frac{6}{10} \times 50\%\right)$

$= \frac{27}{100} + \frac{4}{100} + \frac{30}{100} = \frac{61}{100}$

$\Rightarrow \boxed{P(\text{solving the problem in exam}) = \underline{0.61}}$

(b) P(solved problem is of type A)

$= P(A|\text{solved}) = \frac{P(\text{solved}|A) \cdot P(A)}{P(\text{solved})}$

$= \frac{\left(\frac{9}{10} \times 30\%\right)}{\left(61/100\right)} = \frac{27/100}{61/100} = \frac{27}{61}$

$\Rightarrow \boxed{P(\text{solved problem is of type A}) = \underline{0.442}}$

Given, we've solved the problem, posteriori probability that the problem was of type-A > priori probability of 30%. ⇒ problems of type A are relatively easy to solve

Ans.