ASSIGNMENT

1. Provide an example of the concepts of Prior, Posterior, and Likelihood.

2. What role does Bayes&#39; theorem play in the concept learning principle?

3. Offer an example of how the Nave Bayes classifier is used in real life.

4. Can the Nave Bayes classifier be used on continuous numeric data? If so, how can you go about

doing it?

5. What are Bayesian Belief Networks, and how do they work? What are their applications? Are they

capable of resolving a wide range of issues?

6. Passengers are checked in an airport screening system to see if there is an intruder. Let I be the

random variable that indicates whether someone is an intruder I = 1) or not I = 0), and A be the

variable that indicates alarm I = 0). If an intruder is detected with probability P(A = 1|I = 1) = 0.98

and a non-intruder is detected with probability P(A = 1|I = 0) = 0.001, an alarm will be triggered,

implying the error factor. The likelihood of an intruder in the passenger population is P(I = 1) =

0.00001. What are the chances that an alarm would be triggered when an individual is actually an

intruder?

7. An antibiotic resistance test (random variable T) has 1% false positives (i.e., 1% of those who are

not immune to an antibiotic display a positive result in the test) and 5% false negatives (i.e., 1% of

those who are not resistant to an antibiotic show a positive result in the test) (i.e. 5 percent of those

actually resistant to an antibiotic test negative). Assume that 2% of those who were screened were

antibiotic-resistant. Calculate the likelihood that a person who tests positive is actually immune

(random variable D).

8. In order to prepare for the test, a student knows that there will be one question in the exam that

is either form A, B, or C. The chances of getting an A, B, or C on the exam are 30 percent, 20%, and

50 percent, respectively. During the planning, the student solved 9 of 10 type A problems, 2 of 10

type B problems, and 6 of 10 type C problems.

1. What is the likelihood that the student can solve the exam problem?

2. Given the student&#39;s solution, what is the likelihood that the problem was of form A?

9. A bank installs a CCTV system to track and photograph incoming customers. Despite the constant

influx of customers, we divide the timeline into 5 minute bins. There may be a customer coming into

the bank with a 5% chance in each 5-minute time period, or there may be no customer (again, for

simplicity, we assume that either there is 1 customer or none, not the case of multiple customers). If

there is a client, the CCTV will detect them with a 99 percent probability. If there is no customer, the

camera can take a false photograph with a 10% chance of detecting movement from other objects.

1. How many customers come into the bank on a daily basis (10 hours)?

2. On a daily basis, how many fake photographs (photographs taken when there is no

customer) and how many missed photographs (photographs taken when there is a customer) are

there?

3. Explain likelihood that there is a customer if there is a photograph?

10. Create the conditional probability table associated with the node Won Toss in the Bayesian Belief

network to represent the conditional independence assumptions of the Nave Bayes classifier for the

match winning prediction problem in Section 6.4.4.

SOLUTIONS

1.Prior, Posterior, and Likelihood are concepts used in Bayesian statistics. The Prior refers to the initial belief or probability distribution of an event or hypothesis before any new evidence is considered. The Likelihood refers to the probability of the observed data given a particular hypothesis or event. The Posterior refers to the updated probability distribution or belief after considering the observed data.

For example, let's consider a coin flip. Suppose we have a prior belief that the coin is fair, so the probability of getting heads is 0.5. We flip the coin ten times and observe seven heads and three tails. The likelihood of observing seven heads and three tails given that the coin is fair is (0.5)^10, which is approximately 0.001. Using Bayes' theorem, we can update our belief about the fairness of the coin and calculate the posterior probability of getting heads based on the observed data.

2.Bayes' theorem plays a crucial role in the concept learning principle by providing a framework for updating prior beliefs or probabilities based on new evidence or data. In machine learning, Bayes' theorem is used to derive the posterior probability of a hypothesis or model given the observed data. This allows for probabilistic reasoning and decision-making, which is essential in many applications such as natural language processing, computer vision, and recommender systems.

3.The Nave Bayes classifier is a simple probabilistic algorithm used for classification tasks, such as email spam detection and sentiment analysis. It is based on Bayes' theorem and assumes that the features are conditionally independent given the class. For example, in email spam detection, the features may include the presence or absence of certain keywords, the sender's email address, and the email's length. The classifier calculates the likelihood of observing the features given the class and the prior probability of each class. It then selects the class with the highest posterior probability as the predicted class.

4.Yes, the Nave Bayes classifier can be used on continuous numeric data by assuming a probability distribution for each feature. One common approach is to assume a Gaussian or normal distribution for each feature, given the class. The mean and variance of the distribution can be estimated from the training data, and the classifier can calculate the likelihood of observing a particular value of the feature given the class.

5.Bayesian Belief Networks (BBNs) are graphical models that represent the probabilistic relationships between variables using a directed acyclic graph. Each node in the graph represents a random variable, and the edges represent conditional dependencies between the variables. BBNs can be used for probabilistic inference and decision-making in many domains, such as medical diagnosis, risk assessment, and fraud detection. BBNs can handle uncertainty and incomplete information, and they can be used to make predictions, explain relationships, and identify causal factors.

6.The probability of triggering an alarm when an individual is actually an intruder can be calculated using Bayes' theorem:

P(I=1|A=1) = P(A=1|I=1) \* P(I=1) / P(A=1)

where P(A=1) is the total probability of triggering an alarm, given by:

P(A=1) = P(A=1|I=1) \* P(I=1) + P(A=1|I=0) \* P(I=0)

Substituting the given values, we get:

P(I=1|A=1) = 0.98 \* 0.00001 / (0.98 \* 0.00001 + 0.001 \* 0.99999) ≈ 0.0097 or 0.97%

So the chances of triggering an alarm when an individual is actually an intruder are about 0