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

Example: In medical testing, the prior probability (P(Disease)) is the prevalence of the disease, likelihood (P(Test+|Disease)) is the probability of a positive test if the disease is present, and posterior probability (P(Disease|Test+)) is the probability of having the disease given a positive test result.

2. What role does Bayes' theorem play in the concept learning principle?

Bayes' theorem updates the probability estimate for a hypothesis as more evidence or information becomes available. It combines prior probability with likelihood to produce the posterior probability, guiding the learning process in concept learning.

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

Example: The Naïve Bayes classifier is used in email spam filtering, where it calculates the probability of an email being spam based on the frequency of certain words and phrases within the email.

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

Yes, the Naïve Bayes classifier can handle continuous data by using techniques such as Gaussian Naïve Bayes, which assumes that the continuous values associated with each class are distributed according to a Gaussian distribution.

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?

Bayesian Belief Networks are graphical models representing probabilistic relationships among variables. They work by using Bayes' theorem for inference. Applications include medical diagnosis and risk assessment. They are versatile and can address many complex issues.

6. What are the chances that an alarm would be triggered when an individual is actually an intruder?

Given \( P(A = 1|I = 1) = 0.98 \) and \( P(I = 1) = 0.00001 \), the probability that an alarm is triggered when an individual is an intruder is \( 0.98 \times 0.00001 = 0.0000098 \).

7. Calculate the likelihood that a person who tests positive is actually immune.

Given:

- False positive rate \( P(T=1|D=0) = 0.01 \)

- False negative rate \( P(T=0|D=1) = 0.05 \)

- Prevalence \( P(D=1) = 0.02 \)

\[ P(D=1|T=1) = \frac{P(T=1|D=1) \cdot P(D=1)}{P(T=1)} \]

8. What is the likelihood that the student can solve the exam problem? Given the student's solution, what is the likelihood that the problem was of form A?

1. The likelihood of solving the problem is \(0.3 \times 0.9 + 0.2 \times 0.2 + 0.5 \times 0.6 = 0.62\).

2. Given the solution, the likelihood that the problem was of form A is \( \frac{0.3 \times 0.9}{0.62} \approx 0.435 \).

9. Explain the likelihood that there is a customer if there is a photograph.

Given:

- Probability of a customer per 5 minutes: 5%

- CCTV detection accuracy: 99%

- False detection: 10%

1. Customers per day (10 hours) = \( 10 \times 12 \times 0.05 = 6 \).

2. False photographs: \( 10 \times 12 \times 0.95 \times 0.10 = 11.4 \). Missed photographs: \( 10 \times 12 \times 0.05 \times 0.01 = 0.06 \).

3. Likelihood of a customer given a photograph:

\[ P(Customer|Photograph) = \frac{P(Photograph|Customer) \cdot P(Customer)}{P(Photograph)} \]

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 Naïve Bayes classifier for the match winning prediction problem.

| Won Toss | Won Match | Probability |

|-----------|-----------|-------------|

| Yes | Yes | 0.6 |

| Yes | No | 0.4 |

| No | Yes | 0.3 |

| No | No | 0.7 |

This table represents the relationship between winning the toss and winning the match, assuming conditional independence of other factors.