CIS 365 Uncertainty in AI Part Two

Dr. Denton Bobeldyk

Problem 1: Medical Test

Suppose a certain disease affects 1% of the population. A test for this disease is 95% accurate when identifying those who have the disease (true positive), and it is 90% accurate when identifying those who do not have the disease (true negative). If a person tests positive for the disease, what is the probability that they actually have the disease?

Problem 2 Spam Mail

A company uses a spam filter to classify emails. Based on past data:

- 5% of all emails are spam.
- The spam filter is 99% accurate at identifying spam emails (i.e., it labels spam correctly 99% of the time).
- However, the spam filter has a false positive rate of 2%, meaning that 2% of non-spam emails are incorrectly labeled as spam.

If an email is classified as spam, what is the probability that the email is actually spam?

Problem 3: Machine Failure and Sensors

Suppose a factory has two machines, Machine A and Machine B, and they work together to produce items. Each machine has its own failure rate, and there is a sensor that detects failures. However, the sensor is not perfect and can give false readings. Here's the information we have:

- Machine A is responsible for **60%** of the items produced, and Machine B is responsible for **40%**.
- Machine A fails on **5%** of the items it produces, while Machine B fails on **10%** of the items it produces.
- The sensor is **90%** accurate in detecting failures correctly for both machines.
- However, the sensor has a **5% false positive rate**, meaning it detects a failure when no failure actually occurred in 5% of the cases.

Now, assume the sensor detects a failure. What is the probability that Machine A caused the failure?