1. **A spam filter is designed by looking at commonly occurring phrases in spam. Suppose that 80% of email is spam. In 10% of the spam emails, the phrase “free money” is used, whereas this phrase is only used in 1% of non-spam emails. A new email has just arrived, which does mention “free money”. What is the probability that it is spam?**

Ans- Let A denote the event that the email is spam, and B denote the event that the email contains the phrase "free money". We want to find P(A|B), the probability that the email is spam given that it contains the phrase "free money".

By Bayes' theorem, we have:

P(A|B) = P(B|A) \* P(A) / P(B)

We are given that P(A) = 0.8, P(B|A) = 0.1, and P(B|A') = 0.01, where A' denotes the complement of A (i.e., the event that the email is not spam). We can use the law of total probability to compute P(B):

P(B) = P(B|A) \* P(A) + P(B|A') \* P(A') = 0.1 \* 0.8 + 0.01 \* 0.2 = 0.082

Substituting the given values into Bayes' theorem, we get:

P(A|B) = 0.1 \* 0.8 / 0.082 ≈ 0.97

Therefore, the probability that the email is spam given that it contains the phrase "free money" is approximately 0.97.