**ML Numericals for Mid Term**

1. Consider a linear-regression model with N=3 and D=1 with input-output pairs as follows:

**y1=22, x1=1, y2=3, x2=1, y3=3, x3=2**

What is the gradient of mean-square error (MSE) with respect to β1 (when β0=0 and β1=1)? Give your answer correct to two decimal digits.

2. Text

Description automatically generated

3. Text

Description automatically generated

4. Consider the following data matrix, representing the marks of 4 students in 2 subjects such as Mathematics (M), English (E).

|  |  |  |
| --- | --- | --- |
| Students | Maths (M) | English € |
| 1 | 90 | 60 |
| 2 | 90 | 90 |
| 3 | 60 | 60 |
| 4 | 60 | 60 |

Compute the Principle Component.

5. By using NLP, I can detect spam e-mails in my inbox. Assume that the word ‘offer’ occurs in 80% of the spam messages in my account. Also, let’s assume ‘offer’ occurs in 10% of my desired e-mails. If 30% of the received e-mails are considered as a scam, and I will receive a new message which contains ‘offer’, what is the probability that it is spam?

6. I want to solve one more example from a popular topic as Covid-19. As you know, Covid-19 tests are common nowadays, but some results of tests are not true. Let’s assume; a diagnostic test has 99% accuracy and 60% of all people have Covid-19. If a patient tests positive, what is the probability that they actually have the disease?

7. Suppose I have 10,000 emails in my mailbox out of which 200 are spam detection system detects 150 mails as spams, out of which 50 actually spams, what is the precision and recall of my spam detection system.