# Selected Topics in CS

# Assignment 1

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## Introduction:

The dataset used for this assignment was taken from the UCI repository's **'Banknote authentication Data Set'**. It contains 4 continuous attribute variables and there are only 2 possible classifications (0 or 1).

## Fischer's Linear Discriminant-

In this method we view a linear discrimination modelling through the lens of dimensionality reduction where a D dimensional x vector is reduced to 1 dimension by the equation.

$$y = wTx$$

The training example is classified as C1 if $y > w0$

Else it is classified as C2

Confusion Matrix

| | 0 | 1 |
|---|---|---|
| 0 | 227 | 0 |
| 1 | 5 | 180 |

Recall: 0.9730

Precision: 1

Accuracy: 0.9878

## Probabilistic Generative Model-

We have assumed that –

- The class-conditioned densities p(x|Ck) are Gaussian and that the 2 classes share the same covariance matrix
- the posterior probabilities are given by a sigmoid function

We then use Bayes theorem to calculate the value of p(Ck|x) and choose the classification that has higher probability

Confusion Matrix

| | 0 | 1 |
|---|---|---|
| 0 | 216 | 11 |
| 1 | 0 | 185 |

Recall: 1

Precision: 0.9439

Accuracy: 0.9733

## Logistic Regression (Probabilistic Discriminative Model)-

We tried **5** different learning rates when trying out the Logistic Regression

**1.Learning Rate = 0.0015**

Confusion Matrix

| | 0 | 1 |
|---|---|---|
| 0 | 227 | 0 |
| 1 | 1 | 184 |

Recall: 0.9946

Precision: 1

Accuracy: 0.9976

**2.Learning Rate: 0.005**

Confusion Matrix

| | 0 | 1 |
|---|---|---|
| 0 | 227 | 0 |
| 1 | 4 | 181 |

Recall: 0.9784

Precision:  1

Accuracy: 0.9902

**3.Learning Rate: 0.01**

Confusion Matrix

| | 0 | 1 |
|---|---|---|
| 0 | 225 | 2 |
| 1 | 5 | 180 |

Recall: 0.9730

Precision: 0.9890

Accuracy: 0.9830

**4.Learning Rate: 0.03**

Confusion Matrix

| | 0 | 1 |
|---|---|---|
| 0 | 224 | 3 |
| 1 | 3 | 182 |

Recall: 0.9838

Precision:  0.9838

Accuracy: 0.9854

**5.Learning Rate: 2**

Confusion Matrix

| | 0 | 1 |
|---|---|---|
| 0 | 224 | 3 |
| 1 | 3 | 182 |

Recall: 0.9838

Precision:  0.9838

Accuracy: 0.9854

**Conclusion:**

With high values of learning rate, there is no perceptible difference in the values of the different indicators, then as the values decreases the precision, accuracy and recall values generally increase and then plateau off.