# Name/Roll No: Himanshu Ruhela 2018IMT-039 Course: IMT Course Code: ITIT - 4107

Assignment Number: 2 (a)  
Deadline for Submission: 23:59 25h September 2021  
  
**Aim**

To download the MNIST dataset from <http://yann.lecun.com/exdb/mnist/> and subsequently implement a crude Naive Bayes classifier (do not use library function for naive-bayes) on MNIST data set.

The MNIST data comprises of digital images of several digits ranging from 0 to 9. Thus, the data set has 10 levels of classes. Each image is 28 x 28 pixels and hence you can flatten the matrix into vector form.

To implement the classifier model with the training dataset without using smoothing and test it on the test dataset.

**Procedure/Algorithm**

Naive Bayes is among one of the very simple and powerful algorithms for classification based on **Bayes** Theorem with an assumption of independence among the predictors. The Naive Bayes classifier assumes that the presence of a feature in a class is not related to any other feature.

Assume we have a Hypothesis(H) and evidence(E), then according to Bayes theorem, the relationship between the probability of Hypothesis before getting the evidence represented as P(H) and the probability of the hypothesis after getting the evidence represented as P(H|E) is:

P(H|E) = P(E|H)\*P(H)/P(E)

Where,

Prior probability = P(H) is the probability before getting the evidence

Posterior probability = P(H|E) is the probability after getting evidence

In general,

P(class|data) = (P(data|class) \* P(class)) / P(data)

**Results**

The overall and class wise accuracies are as follows:

1. Naïve Bayes

Overall accuracy : 0.10

Class wise accuracy:

0 - 0.098010 5 - 0.910791

1 - 0.886489 6 - 0.904190

2 - 0.896790 7 - 0.897290

3 - 0.898990 8 - 0.902590

4 - 0.901790 9 - 0.899090

1. Naïve Bayes with Smoothing

Overall accuracy: 0.79

Class wise accuracy:

0 - 0.982598 5 - 0.955996

1 - 0.978798 6 - 0.973397

2 - 0.959796 7 - 0.970597

3 - 0.957196 8 - 0.931393

4 - 0.949095 9 - 0.925693

Jupyter Notebook:

<https://github.com/verdantfire/2018IMT-039_ML_Assignment2/blob/main/2018IMT-039%20ML%20Assignment%202.ipynb>

Repository:

<https://github.com/verdantfire/2018IMT-039_ML_Assignment2/>

**Inference**

If one of the conditional probability is zero, then the entire expression becomes zero. So, here the concept of smoothing helps by adding virtual counts. Thereby getting better posterior probabilities and thus increases the accuracy of the model.