

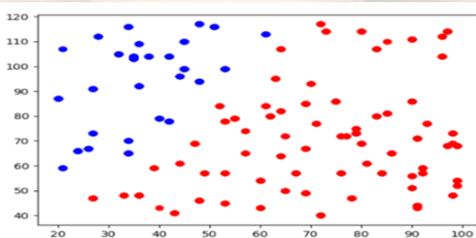
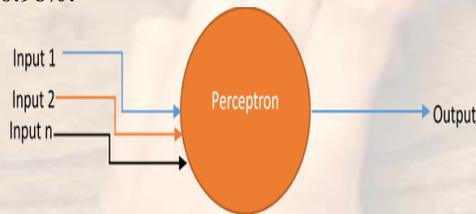
Hand Written Digits Classification and Recognition Using Convolutional Neural Networks by implementing the techniques of MLP and SVM

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Introduction

In this research, we are Convoluting Neural Network (CNN) for hand written digital pattern recognition and data classification. We have also analyzed the perception of neural network required for hand written digits' recognition. A CNN can provide a very thrilling revolutionary and crucial role in today's computer science field. We have also developed a multi-layered perceptron (MLP) and support vector machine (SVM) to support CNN to recognize and classify hand written digits. Multi-layered perceptron is used as a hidden layer having 15 units for hand written digits' recognition. The testing has been controlled from popular obtainable MNIST recognition images. After processing the data in MLP, it is observed that multi-layered CNN has an accuracy of 0.92% and with SVM has 0.96%.



The weighted values are manifest during a training point as the network discovers to identify specific clump by the characteristics of particular input data.

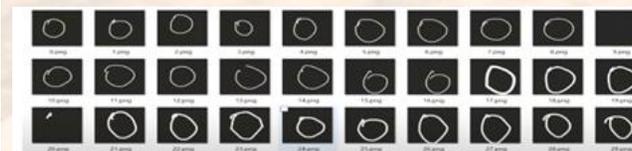
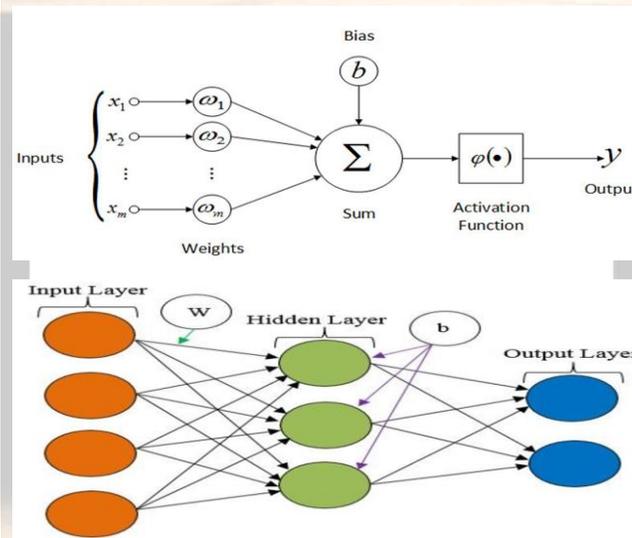
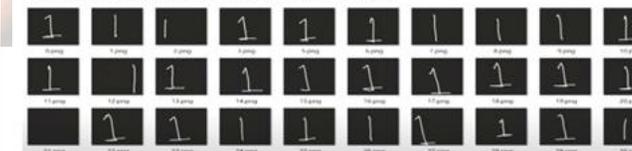


Fig 8 load the images in MNIST database for digit 0



Extract the features and labels

```
list_hog = []
for feature in data:
    fd = hog(feature.reshape ((28,28)), orientations = 9,
    pixels_per_cell= (14,14), cells_per_block= (1,1), visualise
    = false)
    list_hog.append(fd)
hog_features=np.array(list_hog, 'float 64')
```

Machine Learning models (SVM VS MLP Classifiers)

```
# Extract the features and labels
Features = np.array (dataset. Data, 'int 16')
Labels - np.array (dataset. target, 'int')
#Extract the hog features
List_hog_fd= [ ]
for feature in features:
    fd = hog (features. Reshape (( 28,28)), orientations - 9
    pixels_per_cell = (14, 14), cells_per_block = (1,-1),
    visualize=false)
    list_hog_fd.append(fd)
hog_features=np.array(list hog fd, 'float 64')
print ("count of digits in dataset", counter(labels))
```

