Character Recognition System Mini-Project

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Guide

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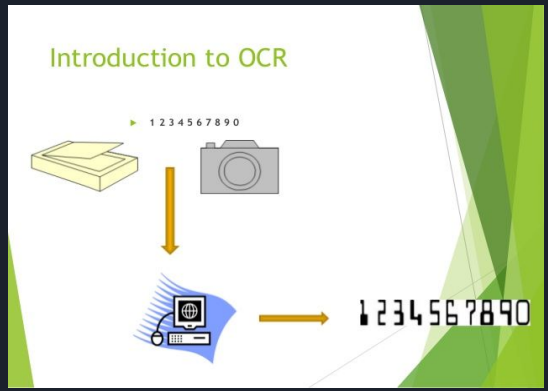
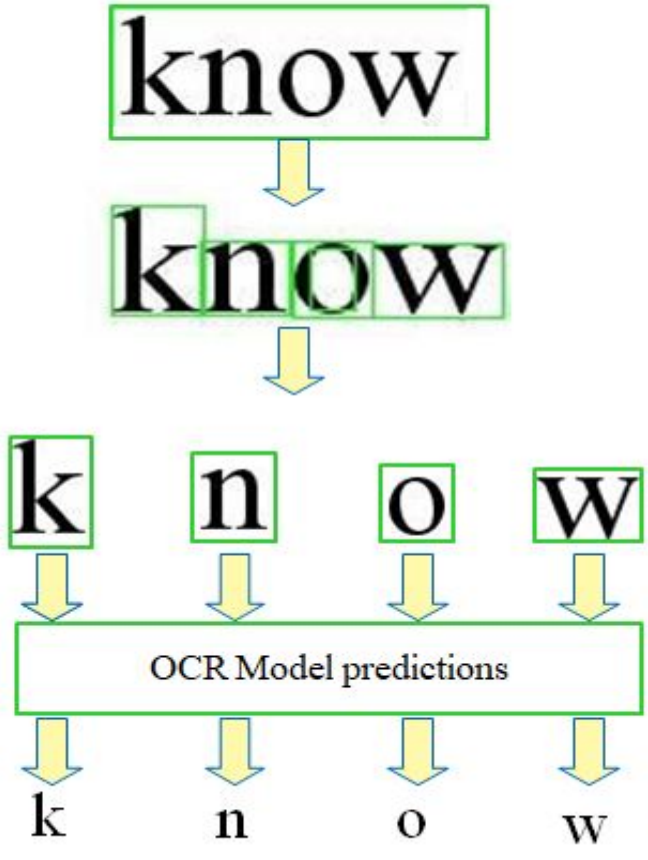
What is Character Recognition?

Process which allows computers to recognize written or printed characters such as numbers or letters and to change them into a form that the computer can use.

Converts a scanned document to an electronic file.



Optical Character Recognition flow diagram



I. Differentiate **word Contours** associated with **Image**.

OpenCV contours, Image cropping

II. Differentiate **letter Contours** associated with **word Contour Image**.

OpenCV contour dilation, Image cropping

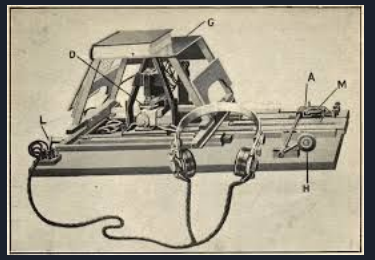
III. Preprocess letter images according to **trained OCR** input.

keras Framework in Detecting, PIL library in Image processing

IV. Consolidate predictions associated **OCR** model to text :-) .

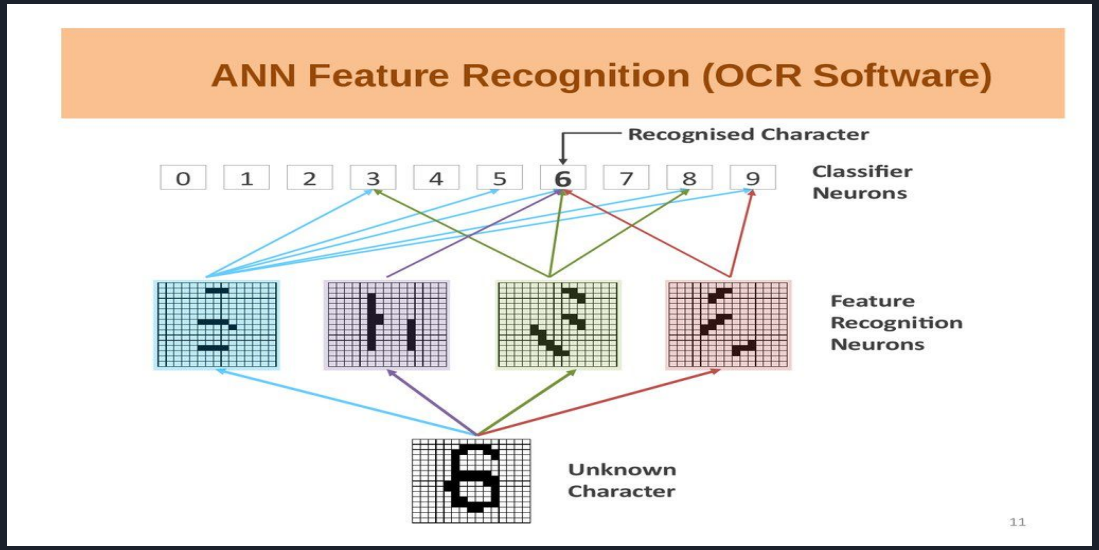
PIL library in Image processing, Python in consolidation

Approaches for character recognition



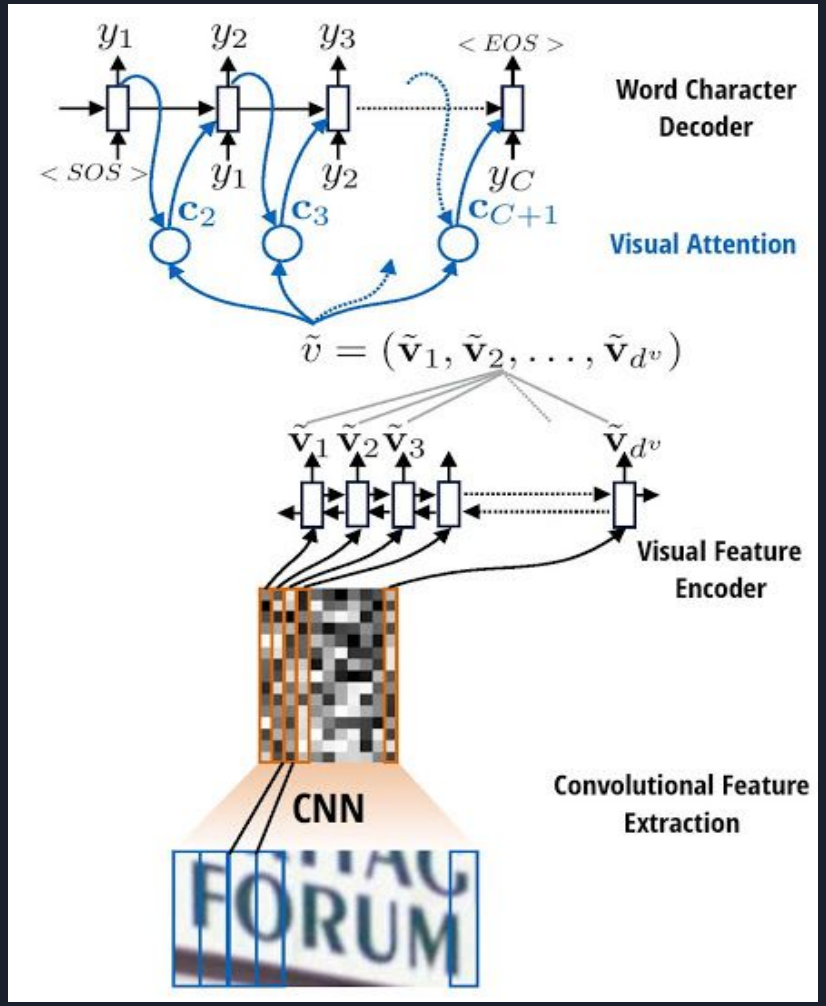
Traditional Optophone

- ANN *Analog Neural Networks*



- CNN

Convolutional Neural Networks



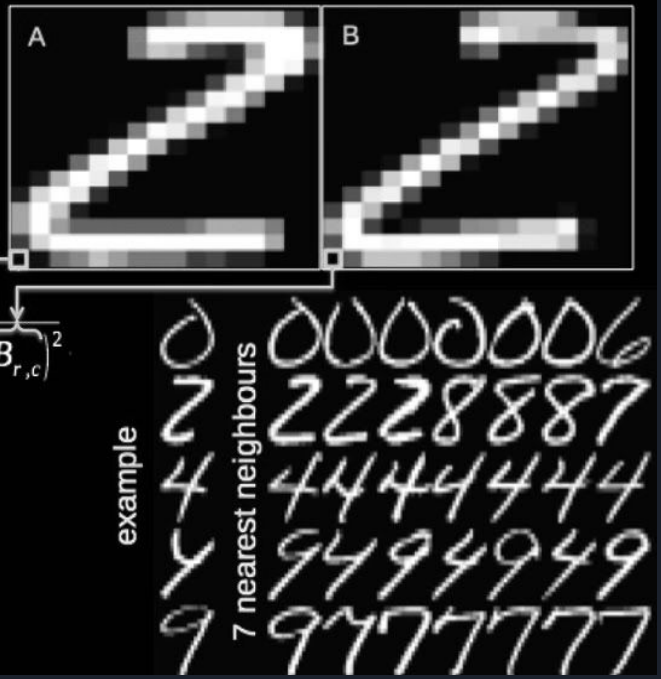
--Approaches for character recognition

- k-NN *K-nearest neighbours*

- 16x16 bitmaps
- 8-bit grayscale
- Euclidian distance
  - over raw pixels

$$D(A,B)=\sqrt{\sum_r \sum_c \left(A_{r,c}-B_{r,c}\right)^2}$$

- Accuracy:
  - 7-NN ~ 95.2%
  - SVM ~ 95.8%
  - humans ~ 97.5%

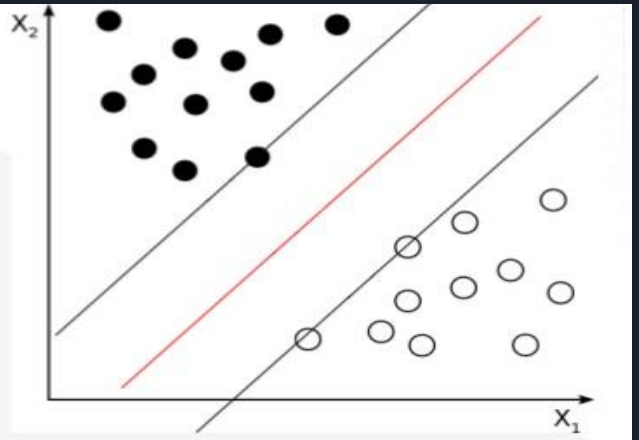


--Approaches for character recognition

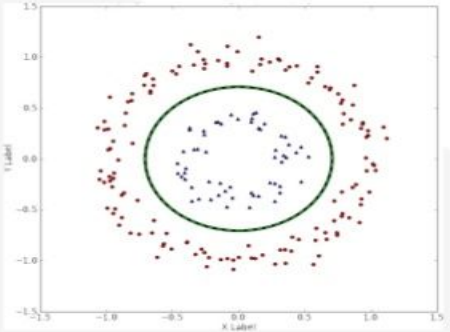
- SVM

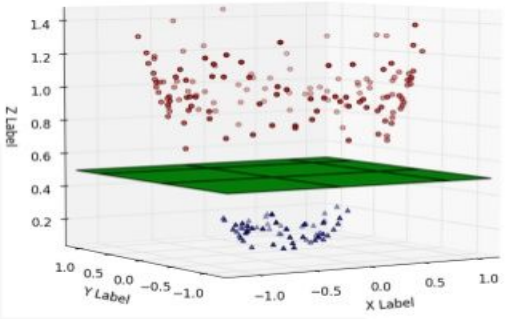
Support Vector Machines

- Optimal hyperplane
- Linear classifier
- Maximum margin
- Classification



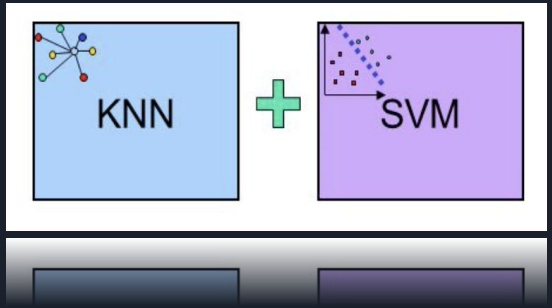
The kernel trick

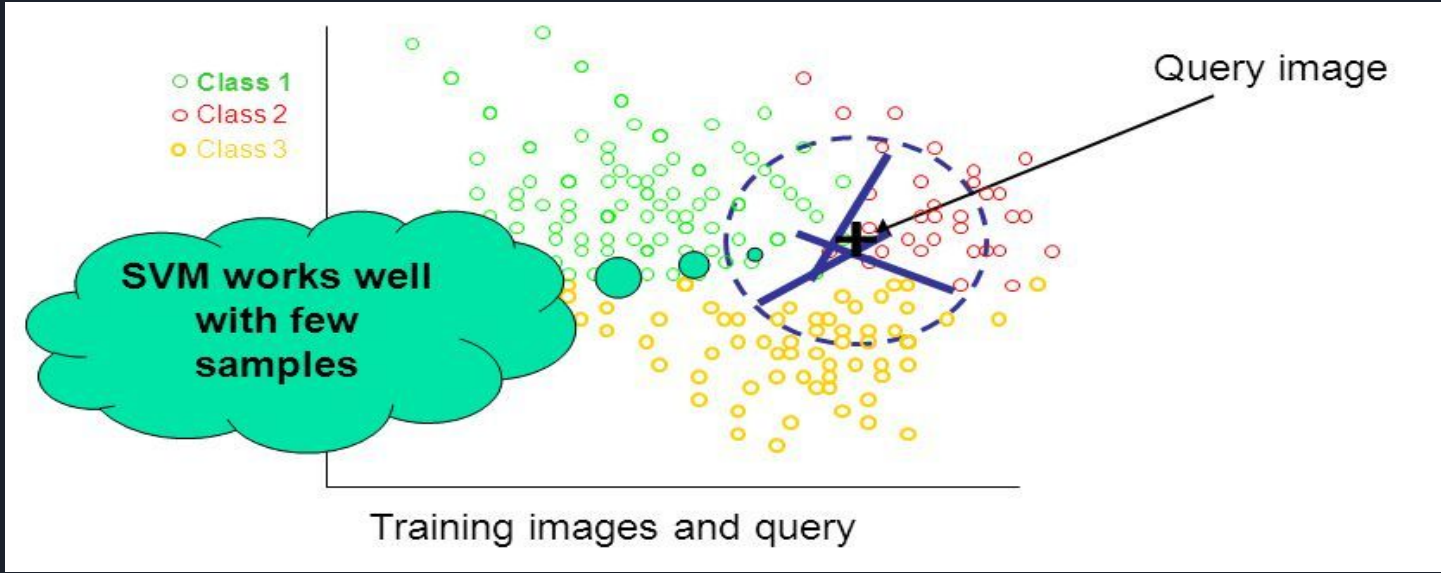




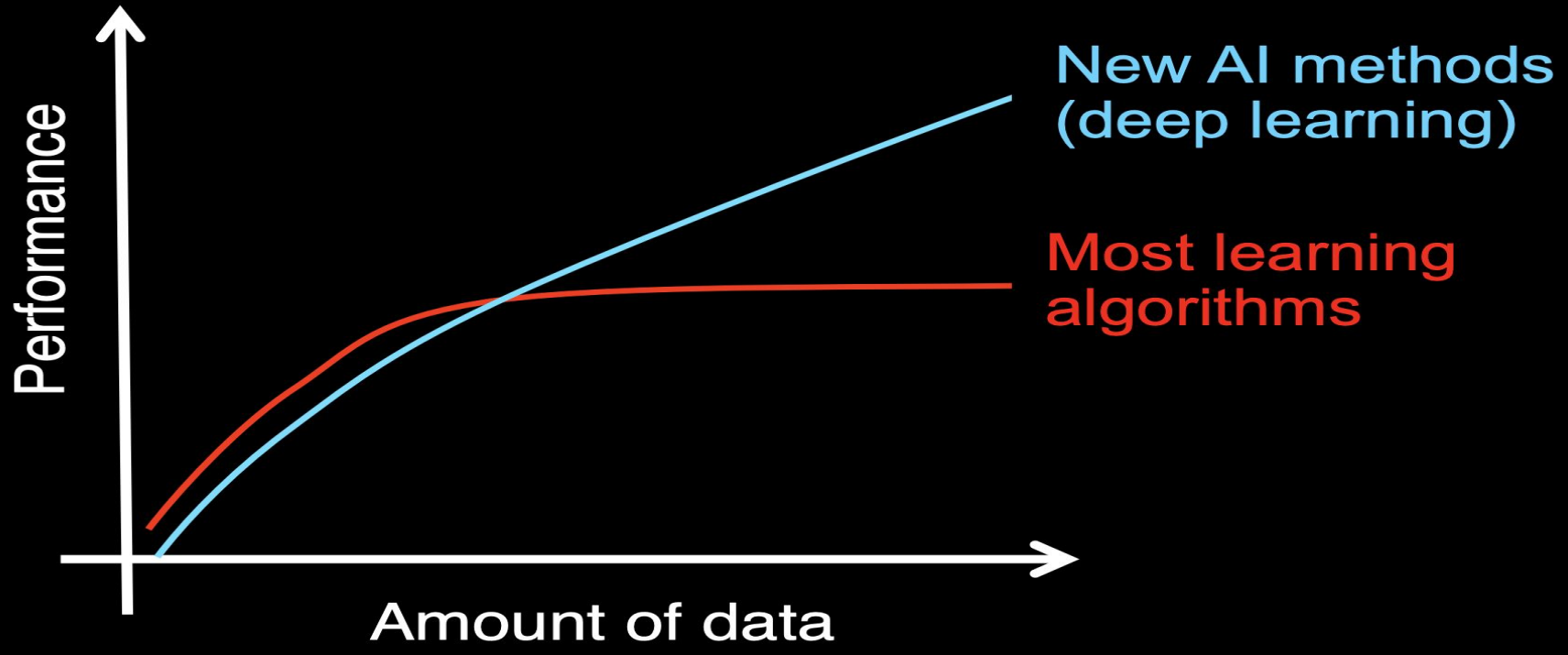
--Approaches for character recognition

- What have we used?

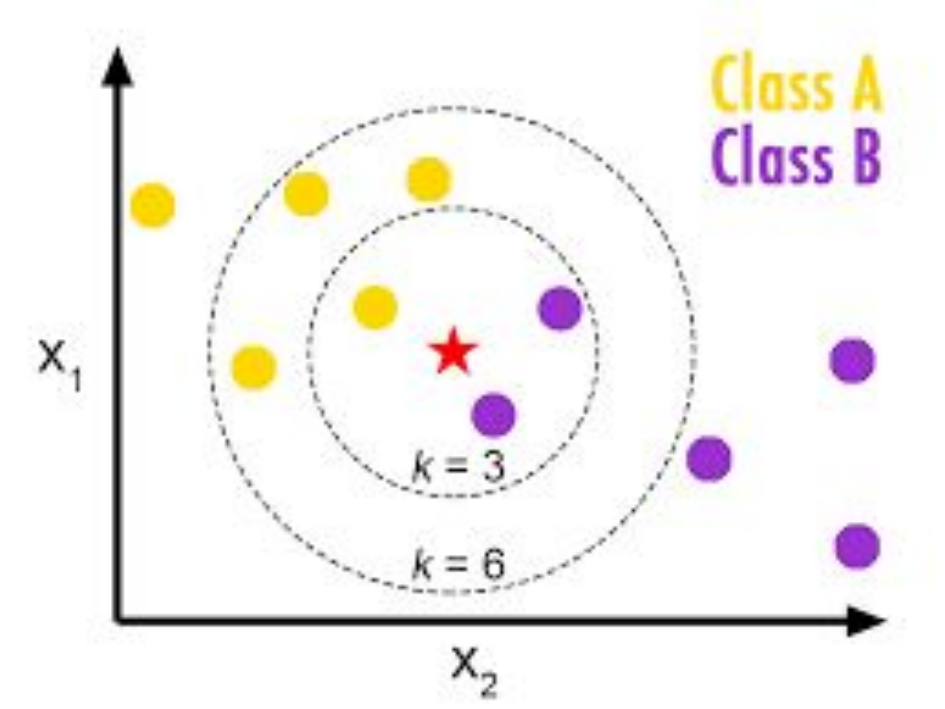




Data and machine learning



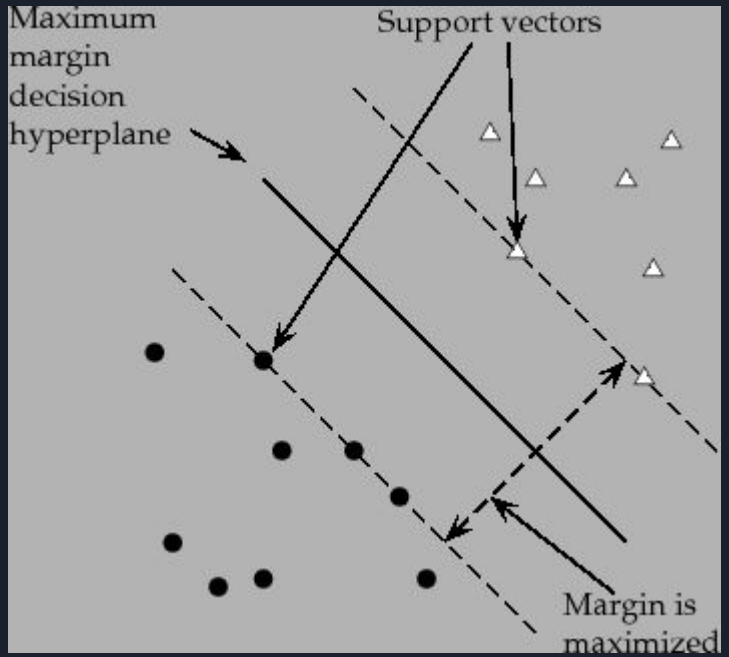
What is KNN?



- K-nearest neighbours Algorithms.
- Instance-based learning
- A Lazy-learning Algorithm
- Uses k-nearest neighbours
- Used for high dimensional data with huge dataset
- The decision boundary in KNN is a convex polygon

--Algorithms Used

What is SVM?



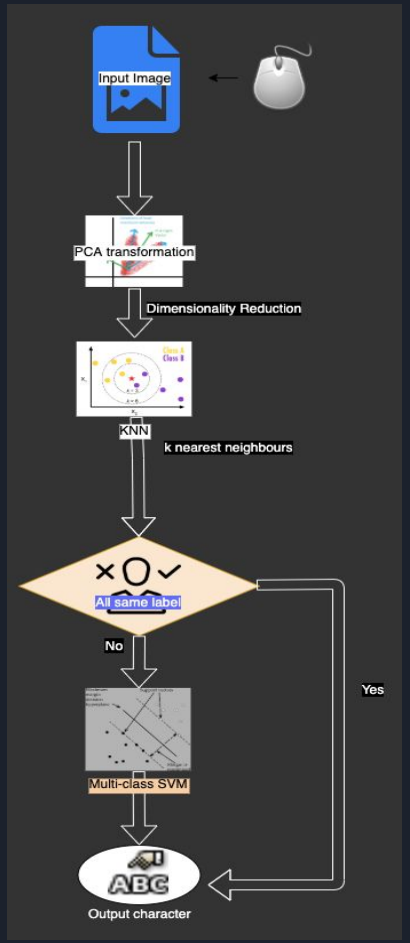
- Supervised learning algorithm.
- SVMs can efficiently perform linear and non-linear classification.
- Objective is to find a hyperplane in a N-dimensional space that distinctly classifies the data points.
- Used for small dataset and low dimensional feature.

--Algorithms Used

How they work Together?

Algorithms Working:-

1. Draw the character for recognition.
2. Apply K-nearest neighbours (k=3)
3. If all neighbours are of same class,
   each neighbour indicate same class label.
   Else
   Apply Multiclass-SVM with
   - ➢ K-neighbours as training data
   - ➢ RBF as kernel function
4. Acquire the Class Label and map the output character.



About our Dataset

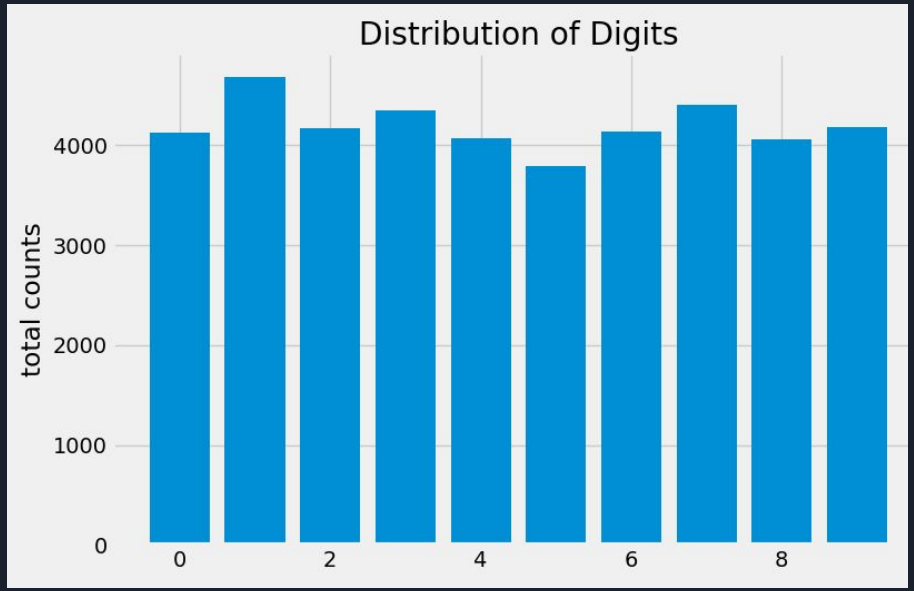
Dataset Used: Emnist -dataset(Character Recognition) & Mnist dataset(Digit Recognition) .

Digit Class:

Image-Size:- 28 X 28

No of bands: 1(Gray Scale)

No of Classes: 10(0.....9)

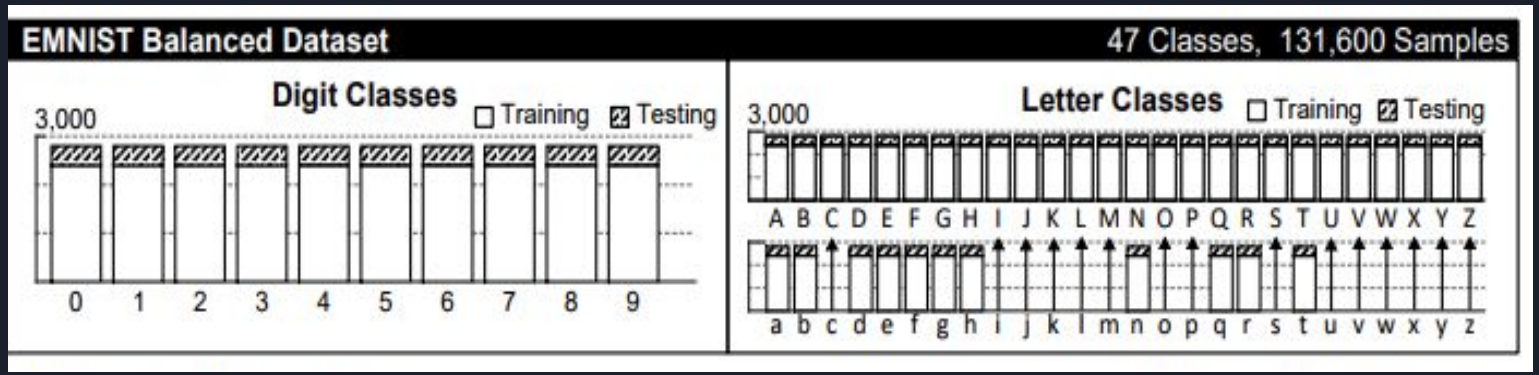


Character Class:

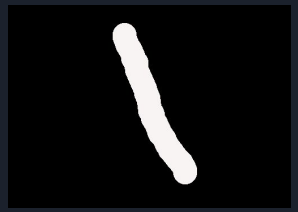
Image-Size: 28 X 28

No of bands: 1(Gray Scale)

No of Classes: 47 (0..9,A..Z,a...Z)



Training



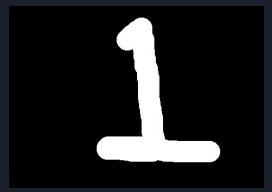
Input Image

Applying K-nearest neighbours

Each Nearest neighbour of same class

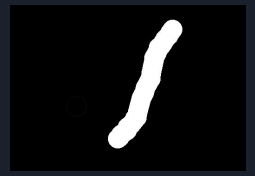
Predicted Output : 1(one)

Training



Input Image

Applying K-nearest neighbours



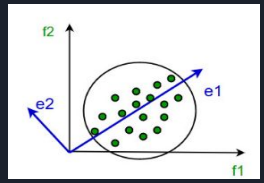
Each Nearest neighbour of different class

Training data for SVM

SVM CLASSIFIER

Predicted Output : 1(one)

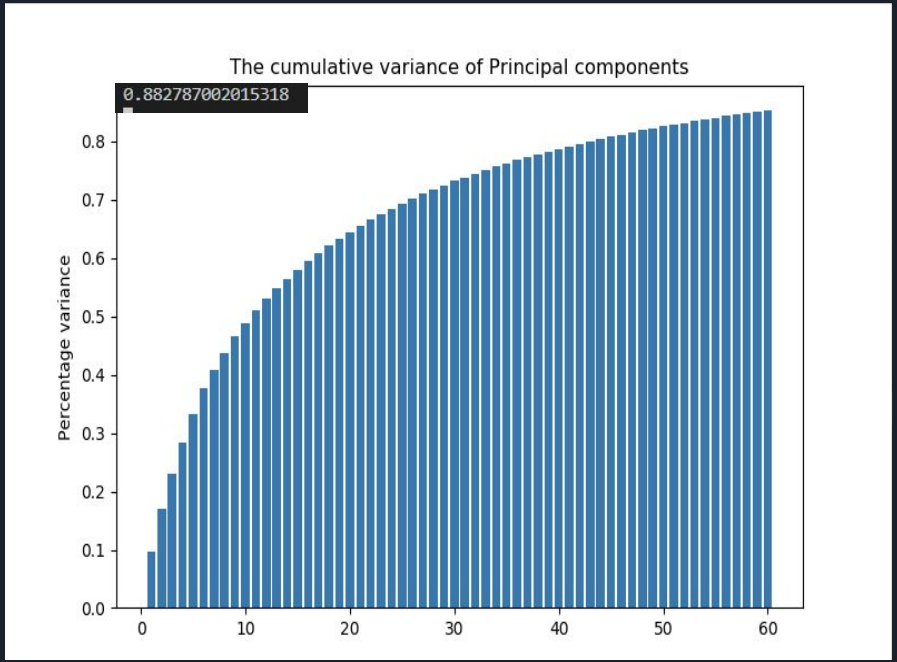
Data Preprocessing: Principal Component Analysis (PCA)



- Reduces data from n-dimensions to k-dimensions.
- Selects the top dimensions with maximum variance.
- Requires every attribute to be equally scaled.

Application in our project:

- Reduces 28 X 28 = 784 pixels of an image to 60 principal components with variance of ~88%.



Some things to be done:
Image Resizing

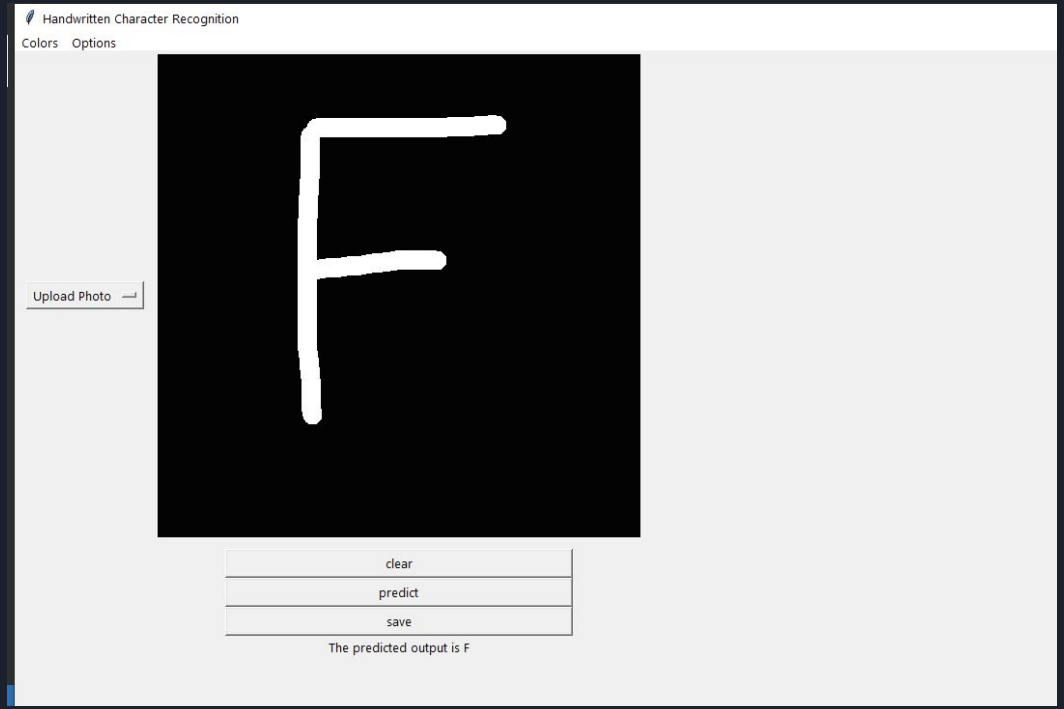
500 X 500 px

Resized by
PIL.image.new

Resized To

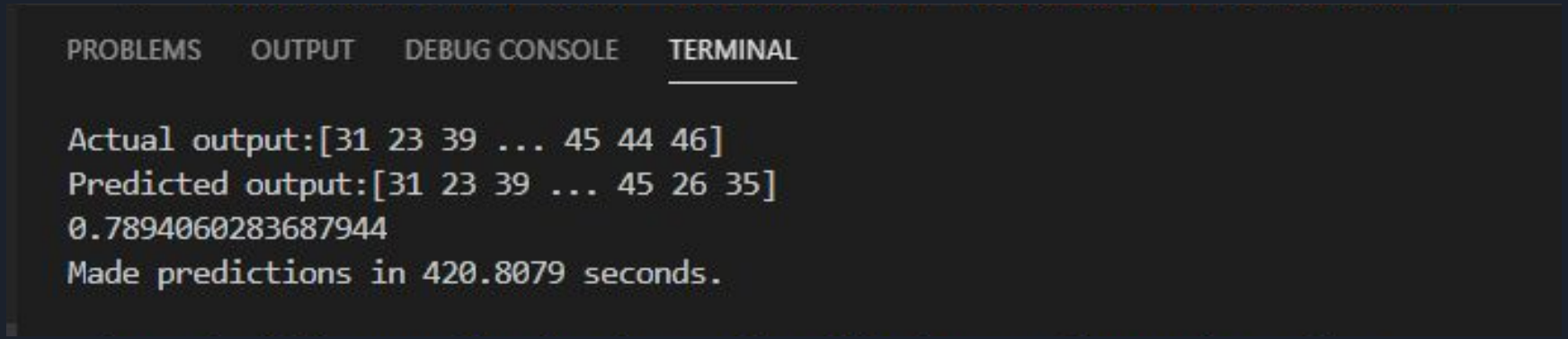
28 X 28 px

App-in Reality



Results

- 98% accuracy on Digit Recognition
- 78% accuracy on Character Recognition.
- ~0.02 second for classification



Limitations

- Similar classes

Class ‘U’

Class ‘J’

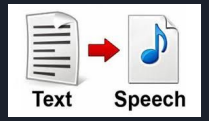
Class ‘n’

- Large Dataset requirements
- Works mediocre with noisy data.

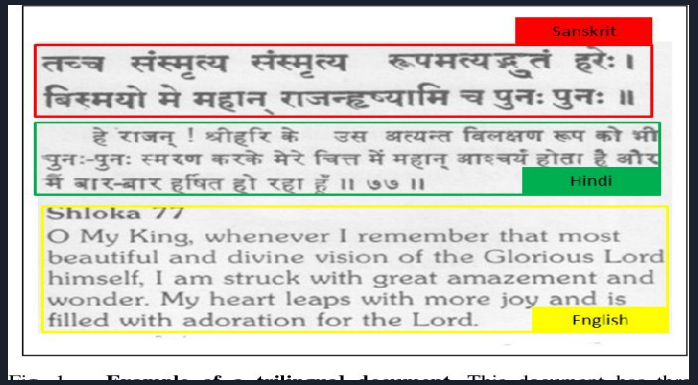
Future Scope

Signboard Translation

A Bilingual or multilingual script OCR



Text-to-Speech Conversion.



Conclusion

- In this report, we proposed a hybrid of SVM and k-NN, which deals naturally with multiclass problems.

- The algorithm works best when the input image is **not**:
  - ➢ A mirrored image,
  - ➢ A water image,
  - ➢ An image rotated at angle >45° .

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