



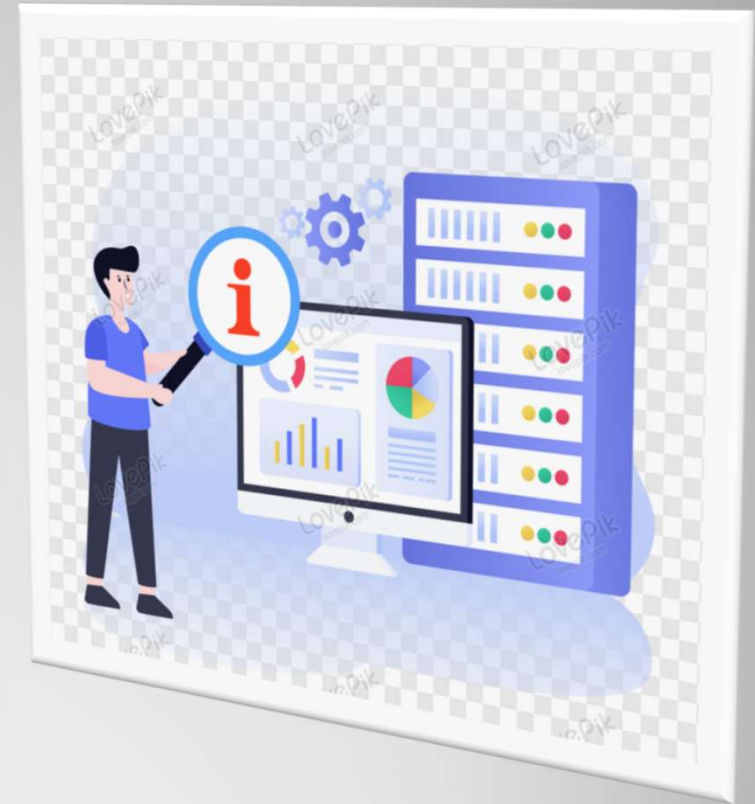
INNOVATION. AUTOMATION. ANALYTICS

# **PROJECT ON** HAND WRITTEN IMAGE PREDICTION

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# Image Classification Introduction

- Classification between the objects is easy task for humans but it has proved to be a complex problem for machines.
- Image Classification System consists of database that contains predefined patterns that compares with detected object to classify in to proper category.

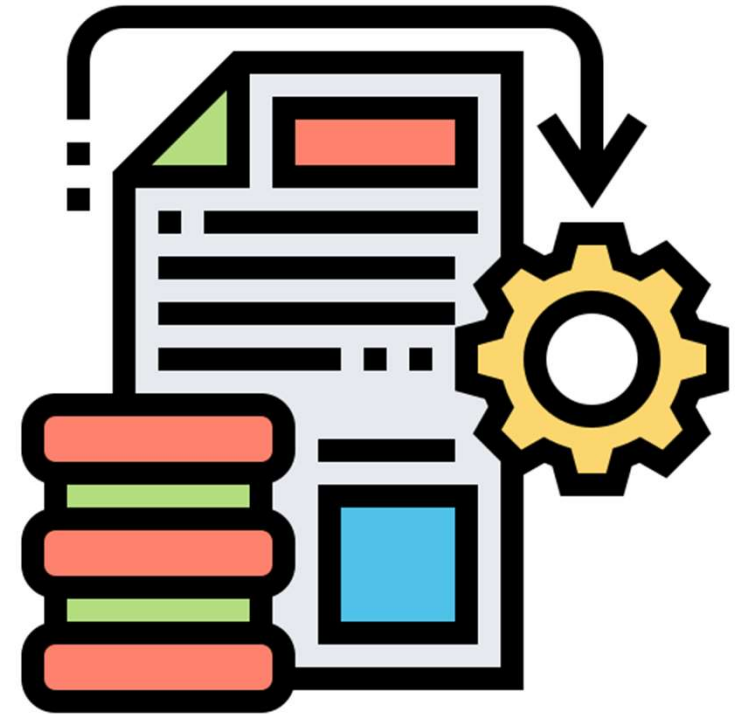


# Normalization And Greyscale

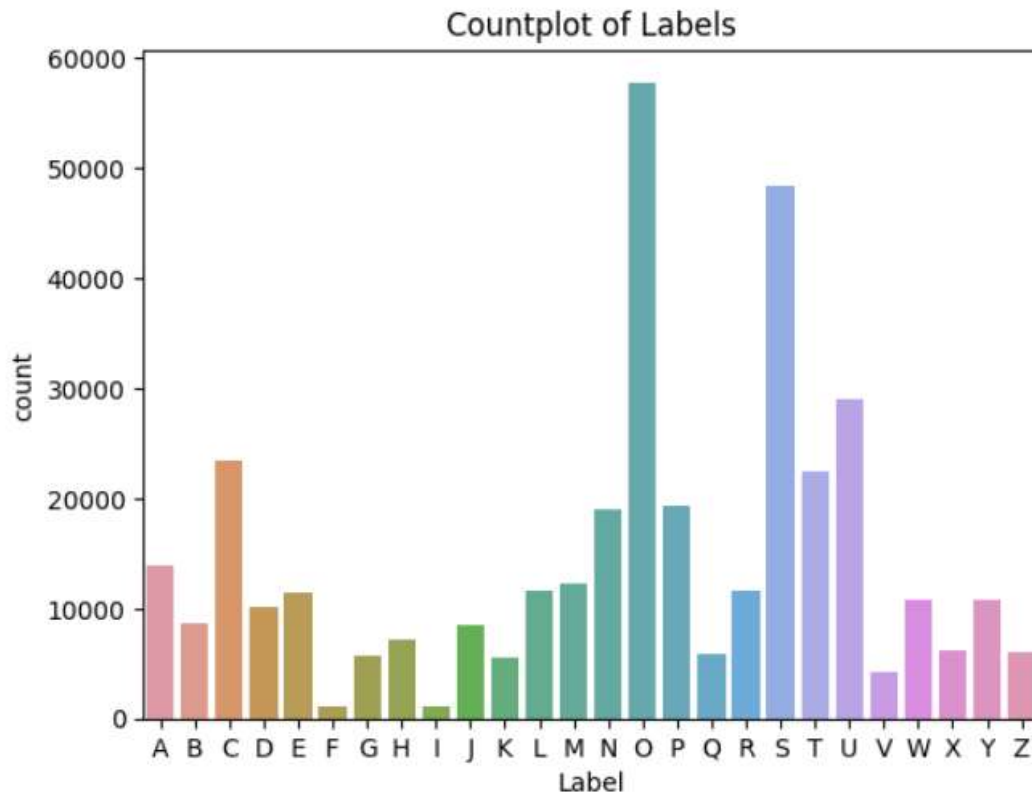
- In [image processing](#), **Linear Normalization** is a process that changes the range of [pixel](#) intensity values.
- The purpose of Normalization is to bring an image to range that is normal to sense.
- **Non-Linear Normalization** used when there is no linear relationship between old image and New\_image. Example Normalization follows a sigmoid function.
- In [Image processing](#), **Greyscale images** are one in which each pixel value represent only amount of light. The color info is removed.
- **Black-White image** is purely made of black(0) and white color(1). The values of pixel in this image either 0 or 1.
- **Greyscale image** is made of **shades of gray**. Shades of gray means values of pixels are in the range from 0 to 1. So 0 represent dark black color, 0.1 represent less dark than 0(dark black) .... and 1 represent white color.

# Image Preprocessing

- Image preprocessing is a crucial step in machine learning, where the raw image data is transformed and prepared for analysis by algorithms.
- Preprocessing helps enhance data quality, handle noise, and standardize the input, leading to improved model performance.
- Flattening is a fundamental preprocessing technique for image data, especially when using certain machine learning algorithms.
- Images are typically represented as 2d arrays (height x width) of pixel values, with each pixel corresponding to a specific location in the image.
- Flattening converts this 2D array into a 1D array by arranging the pixel values sequentially.
- Numpy `ravel()` is used for the flatten technique which takes a multi-dimensional array as input and returns a 1D array.



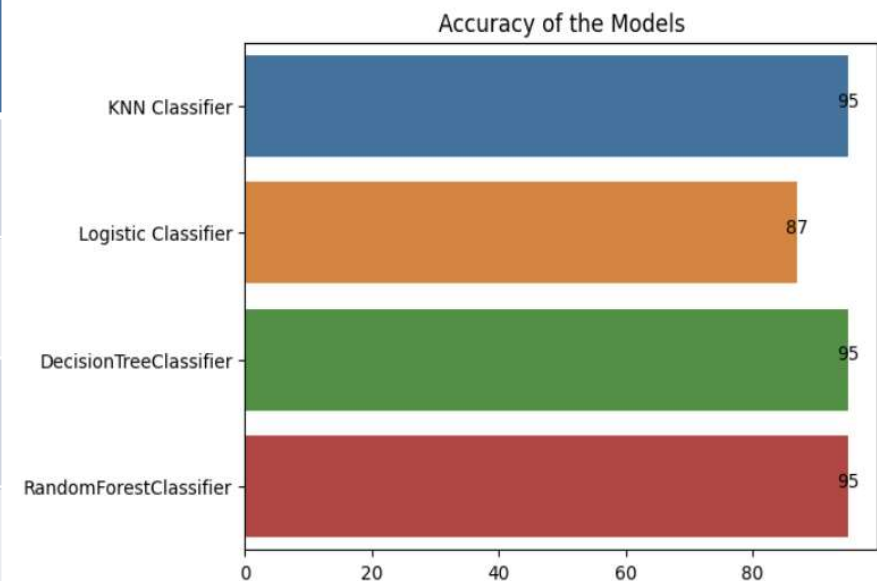
# Analysis



- we can observe that Alphabet 'O' has more than 55,000 handwritten images.
- Alphabet 'S' has more than 45,000 Hand written images. These two alphabets have more images than the all other images.
- 'F' and 'I' alphabets have around 1150 handwritten images.
- These alphabet images are less in count.

# Comparison of Algorithm

Machine Learning Algorithm	Accuracy Score
Logistic Regression	87
KNN Classifier	95
Decision Tree Classifier(CART)	95
Random Forest Classifier	95



- We can observe that KNN, Decision Tree and Random Forest algorithms are giving more accuracy than Logistic Regression.



## Model Size

- **Comparative all Models, logistic\_classifier is the lightest model.**
- **But it is giving less accuracy than the three models. If we want go with light weigh and high accuracy, dt\_classifier is the best model.**

Machine Learning Algorithm	Model Name	Size
Logistic Regression	logistic_classifier	170kb
Decision Tree Classifier(CART)	knn_classifier	8,677kb
KNN Classifier	dt_classifier	11,17,737kb
Random Forest Classifier	rf_classifier	17,12,047kb



# Model Production Time

- Comparative all Models, **logistic\_classifier** has less latency to predict but at the same time accuracy is low.
- **knn\_classifier** is taking much prediction time comparative all the three models even though the accuracy is good.
- **dt\_classifier** has less latency with high accuracy.
- **rf\_classifier** also has less latency with high accuracy. But not less than **dt\_classifier**.

Machine Learning Algorithm	Model Name	Prediction Time
Logistic Regression	<b>logistic_classifier</b>	Less than a second
Decision Tree(CART)	<b>knn_classifier</b>	Less than a second
KNN	<b>dt_classifier</b>	Average time is 10 seconds
Random Forest	<b>rf_classifier</b>	Less than a second

# Streamlit Web Page

This interface gives a user an option to select handwritten alphabet by clicking “Browse files” button.

## Welcome to Handwritten Alphabet Image Recognition

Upload an alphabet image and see the prediction!

Choose an image...



Drag and drop file here  
Limit 200MB per file • PNG,  
JPG, JPEG

Browse  
files

# Logistic Regression Model Prediction

- When a user selects an alphabet by default Logistic Regression model will be selected and gives it's prediction.
- As We already discussed , that though logistic regression model has less latency it's accuracy it gives less accuracy than the other three models.



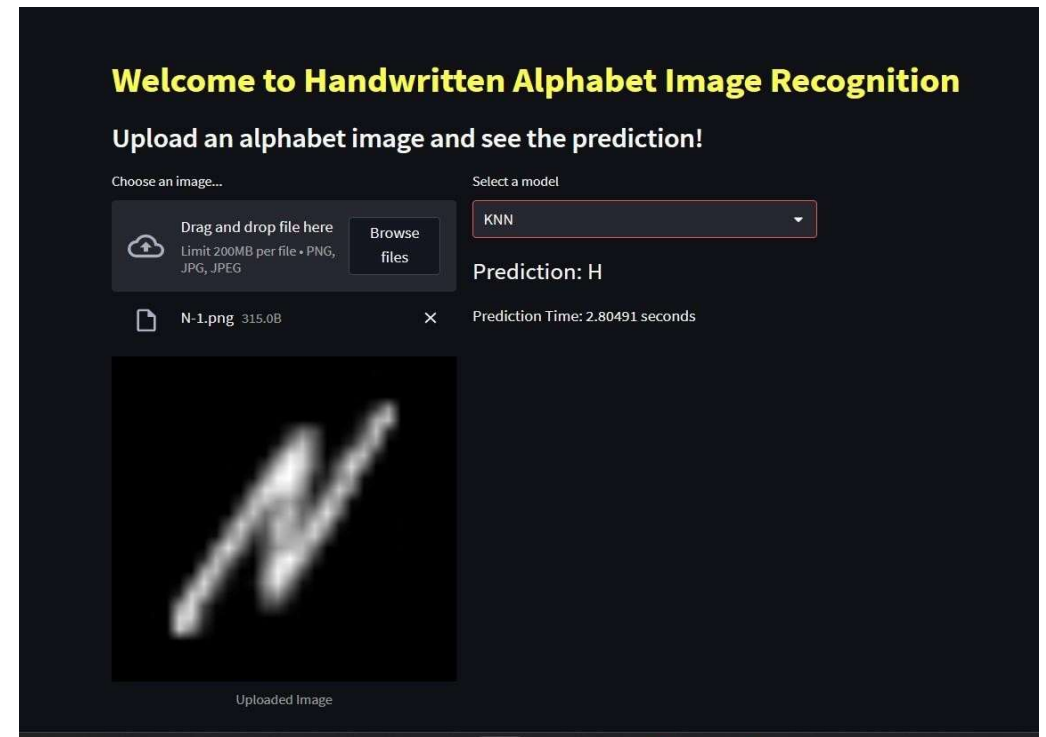
# Decision Tree Model Prediction

- When user selects Decision Tree from dropdown , It's prediction will be displayed on the screen for same alphabet.
- Though Logistic Regression gives wrong prediction, Decision tree gives correct prediction for “J” and “N” as it has higher accuracy than that.



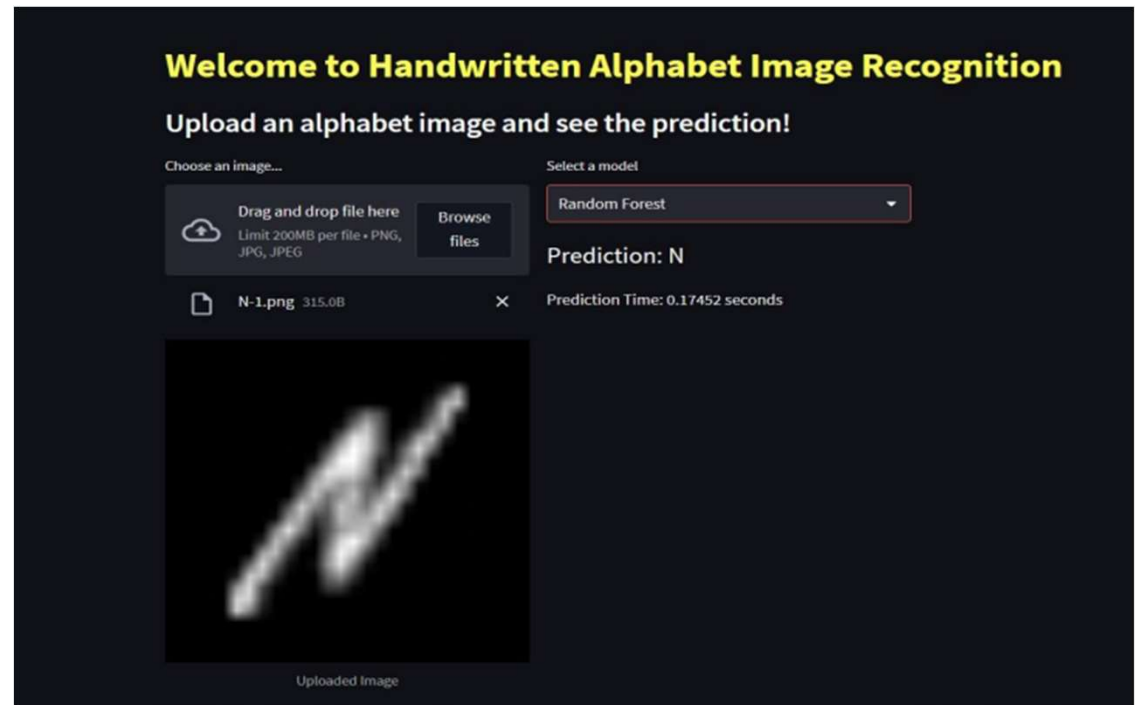
# KNN Model Prediction

- When a user selects KNN model from the drop down it 's prediction will be displayed on the screen for the same alphabet.
- Though KNN model has 95% accuracy it gives wrong prediction for letter "N".



# Random Forest Model Prediction

- When user selects Random Forest from dropdown , It's prediction will be displayed on the screen for same alphabet.
- Though Random forest model has little latency in prediction,it gives correct prediction for “J” and “N” as it has higher accuracy than that.



# Conclusion

- **Logistic classifier is lighter model than remaining three model but it has less accuracy than the three.**
- **Knn classifier is not lighter and also it's prediction time is also higher than remaining all.**
- **rf\_classifier is not lighter but it's prediction is correct.**
- **Comparing All models I will conclude that dt\_classifier is the best model with higher accuracy and light also comparative random forest.**





