

This project applies KNN, SVM and Random Forest on MNIST dataset. Feature Engineering phase is first applied to the MNIST dataset by applying the HOG to the features. The following are the results of each Model after changing the hyperparameter of the model.

- Experiment 1,2,3 are all about tweaking the pixels\_per\_cell hyperparameter in the HOG.
- KNN Experiment is about tweaking the K hyperparameter in the KNN Model
- SVM Experiment is about tweaking the C hyperparameter in the SVM with LinearSVC model
- Random Forest Experiment is about tweaking the N\_estimators and max\_depth hyperparameters in the Random Forest Model

From all the experiments, we see that the SVM Model is the best classifier on our MNIST dataset.

## Experiment 1:

- HOG pixels\_per\_cell = (2, 2):

KNN

- $k = 5$
- accuracy = 96.56 %

SVM

- $c = 0.1$
- accuracy = 98.009 %

Random forest

- $N_{\text{estimators}}=500$
- $\text{max\_depth} = 21$
- $\text{accuracy} = 97.18 \%$

## Experiment 2:

- HOG  $\text{pixels\_per\_cell} = (4, 4)$ :

KNN

- $k = 5$
- $\text{accuracy} = 97.49 \%$

SVM

- $c = 0.1$
- $\text{accuracy} = 98.27 \%$

Random forest

- $N_{\text{estimators}}=500$
- $\text{max\_depth} = 21$
- $\text{accuracy} = 97.61 \%$

## Experiment 3:

- HOG pixels\_per\_cell = (8, 8):

KNN

- $k = 5$
- accuracy = 94.84 %

SVM

- $c = 0.1$
- accuracy = 94.1 %

Random forest

- N\_estimators=500
- max\_depth = 21
- accuracy = 97.19 %

## KNN Experiments:

- HOG pixels\_per\_cell = (4, 4)

KNN

- $k = 3$
- accuracy = 97.28%

- $k = 7$
- accuracy = 97.45%
- $k = 9$
- accuracy = 97.26 %
- $k = 11$
- accuracy = 97.24 %

## **SVM Experiments:**

- HOG pixels\_per\_cell = (4, 4)

### **SVM**

- $c = 0.01$
- accuracy = 97.79 %
- $c = 1$
- accuracy = 97.79 %
- $c = 2$
- accuracy = 98.31 %
- $c = 5$
- accuracy = 98.16 %

## Random Forest Experiments:

- HOG pixels\_per\_cell = (4, 4)

### Random Forest

- N\_estimators=100
- max\_depth = 15
- accuracy = 97.17 %
  
- N\_estimators=200
- max\_depth = 18
- accuracy = 97.61 %
  
- N\_estimators=500
- max\_depth = 22
- accuracy = 97.78 %
  
- N\_estimators=500
- max\_depth = 5
- accuracy = 93.12 %

## Best case for KNN:

- HOG pixels\_per\_cell = (4, 4)
- K=7
- accuracy = 97.45%

## **Best case for SVM:**

- HOG pixels\_per\_cell = (4, 4)
- C = 2
- accuracy = 98.2%

## **Best case for Random forest:**

- HOG pixels\_per\_cell = (4, 4)
- N\_estimators=500
- max\_depth = 22
- accuracy = 97.78 %