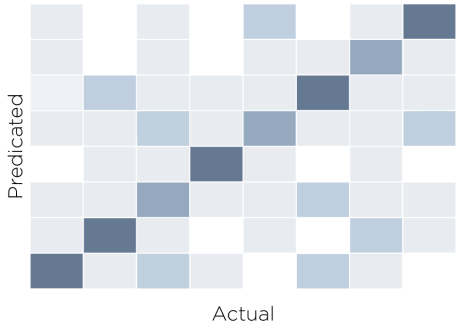
Digital detection



What is our GOAL for this MODULE?

The goal of this module is to explore the image processing techniques to detect the numbers from the images.

What did we ACHIEVE in the class TODAY?

- We wrote a prediction algorithm which would detect the numbers from the given images.

Which CONCEPTS/CODING BLOCKS did we cover today?

- Using data from ML library
- Logistic regression
- Confusion matrix

How did we DO the activities?

1. We imported all the necessary libraries.

```
import cv2
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.datasets import fetch_openml
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
```

2. We fetched the data from the open ml library.

```
X, y = fetch_openml('mnist_784', version=1, return_X_y=True)
print(pd.Series(y).value_counts())
classes = ['0', '1', '2','3', '4','5', '6', '7', '8', '9']
nclasses = len(classes)
```

```
1    7877
7    7293
3    7141
2    6990
9    6958
0    6903
6    6876
8    6825
4    6824
5    6313
dtype: int64
```

3. We printed the data to see what the images looked like.

```
samples_per_class = 5
figure = plt.figure(figsize=(nclasses*2,(1+samples_per_class*2)))

idx_cls = 0
for cls in classes:
  idxs = np.flatnonzero(y == cls)
  idxs = np.random.choice(idxs, samples_per_class, replace=False)
  i = 0
  for idx in idxs:
    plt_idx = i * nclasses + idx_cls + 1
    p = plt.subplot(samples_per_class, nclasses, plt_idx);
    p = sns.heatmap(np.reshape(X[idx], (28,28)), cmap=plt.cm.gray,
            xticklabels=False, yticklabels=False, cbar=False);
    p = plt.axis('off');
    i += 1
  idx_cls += 1
```

4. To printed the number of images and the number of pixels

```
print(len(X))
print(len(X[0]))
```

```
70000
784
```

5. We also checked the array of the particular image.

```
print(X[0])
print(y[0])
```

```
[   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   3.  18.
   18.  18. 126. 136. 175.  26. 166. 255. 247. 127.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.  30.  36.  94. 154. 170. 253.
  253. 253. 253. 253. 225. 172. 253. 242. 195.  64.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.  49. 238. 253. 253. 253. 253. 253.
  253. 253. 253. 251.  93.  82.  82.  56.  39.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.  18. 219. 253. 253. 253. 253. 253.
  198. 182. 247. 241.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.  80. 156. 107. 253. 253. 205.
   11.   0.  43. 154.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.  14.   1. 154. 253.  90.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0. 139. 253. 190.
    2.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  11. 190. 253.
   70.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  35. 241.
  225. 160. 108.   1.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  81.
  240. 253. 253. 119.  25.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   45. 186. 253. 253. 150.  27.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.  16.  93. 252. 253. 187.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0. 249. 253. 249.  64.   0.   0.   0.   0.   0.   0.   0.
    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
```

6. Then we split the data to train and test the model.

```
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=9, train_size=7500, test_size=2500)

#scaling the features
X_train_scaled = X_train/255.0
X_test_scaled = X_test/255.0
```

7. We fit the test data to the model.

```
clf = LogisticRegression(solver='saga', multi_class='multinomial').fit(X_train_scaled, y_train)
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/linear_model/_sag.py:330: ConvergenceWarning: The max_iter was reached which means the coef_ did not converge
  "the coef_ did not converge", ConvergenceWarning)
```

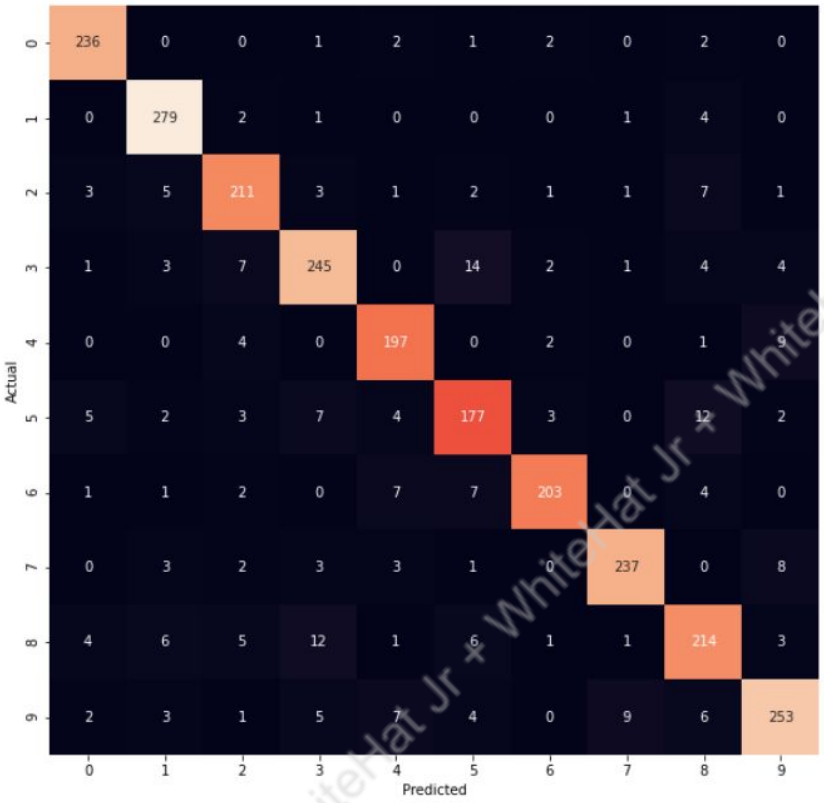
8. We made a prediction and checked the accuracy of the model.

```
y_pred = clf.predict(X_test_scaled)

accuracy = accuracy_score(y_test, y_pred)
print(accuracy)
```

```
0.9008
```

9. We also created the confusion matrix.

```
cm = pd.crosstab(y_test, y_pred, rownames=['Actual'], colnames=['Predicted'])

p = plt.figure(figsize=(10,10));
p = sns.heatmap(cm, annot=True, fmt="d", cbar=False)
```



What's NEXT?

In the next class, we will continue working on the image detection algorithm.

EXTEND YOUR KNOWLEDGE:

Explore more data sets and the usage of fetch_openml
https://scikit-learn.org/stable/modules/generated/sklearn.datasets.fetch_openml.html