Handwritten Signature Verifier
using
Image Processing

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Problem definition

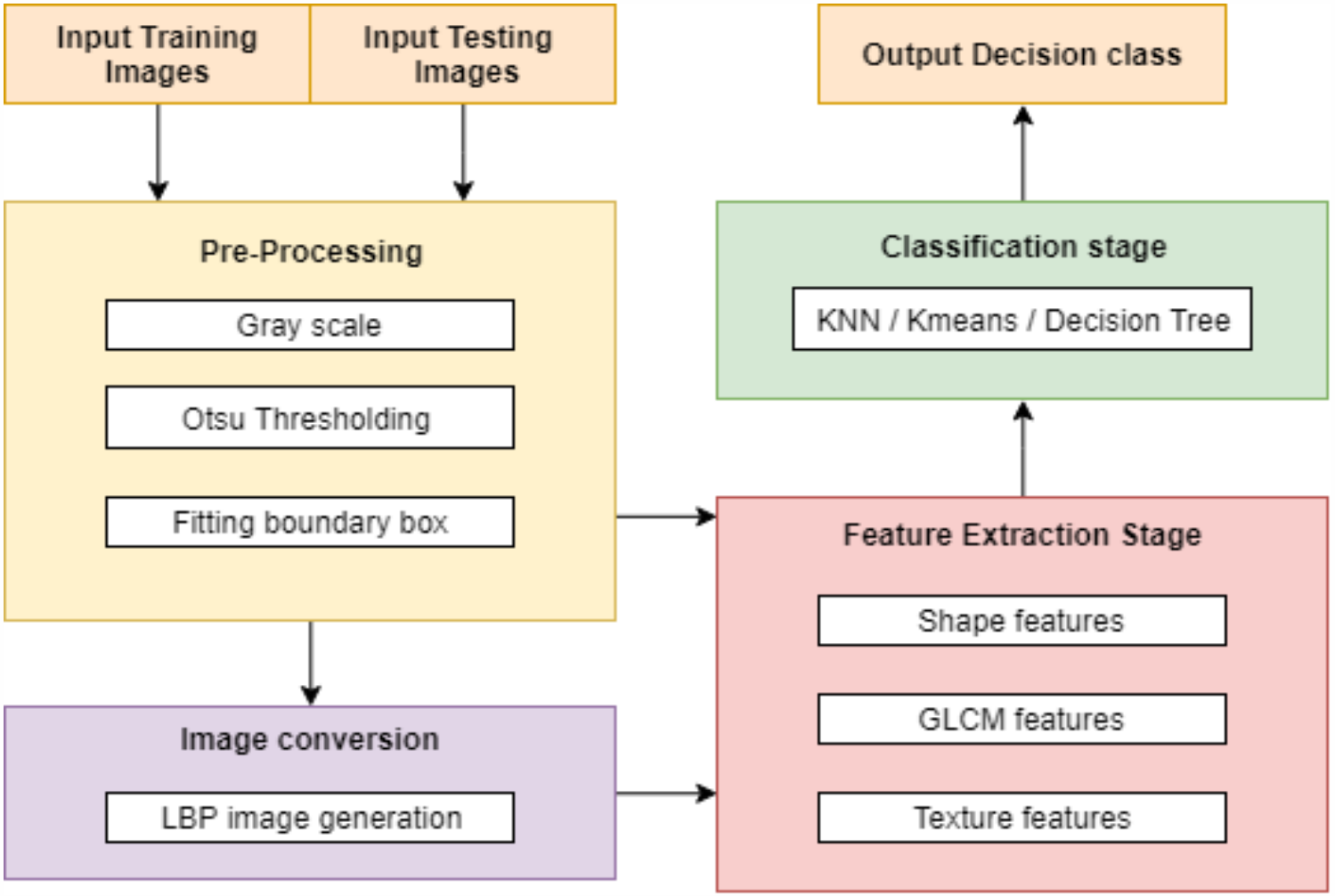
- Signature Verification is the procedure of determining to whom a particular signature belongs to.

- System would take as input signature images and tell us
  - To whom the signature belongs to (Author Identification)
  - If the signature is forged or genuine (Signature Verification)

Literature Review

- An excel sheet of all the Literature Review has been prepared and is been attached with this slide.
- The literature review contains total of 40 research papers based on the topic Signature Recognition
- Most of the papers make use of 3 stages:
  - Preprocessing stage
  - Feature extraction stage
  - Classification stage

Proposed Work



Proposed Work

- Local Binary Pattern

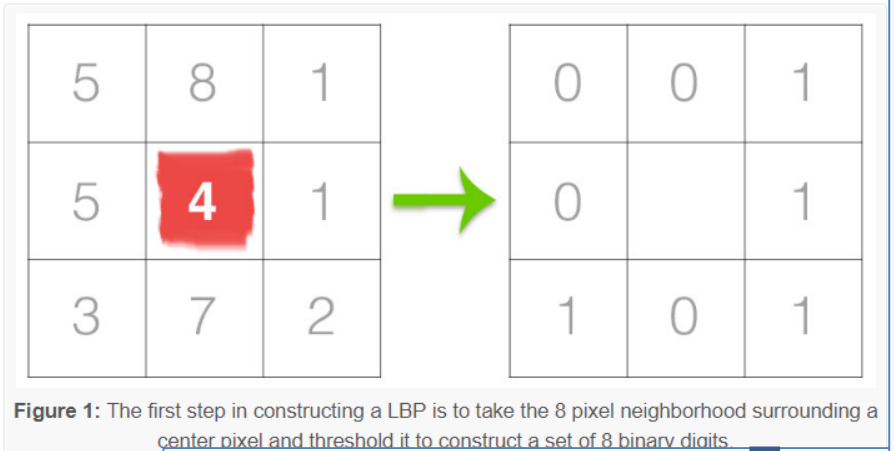


Figure 1: The first step in constructing a LBP is to take the 8 pixel neighborhood surrounding a center pixel and threshold it to construct a set of 8 binary digits.

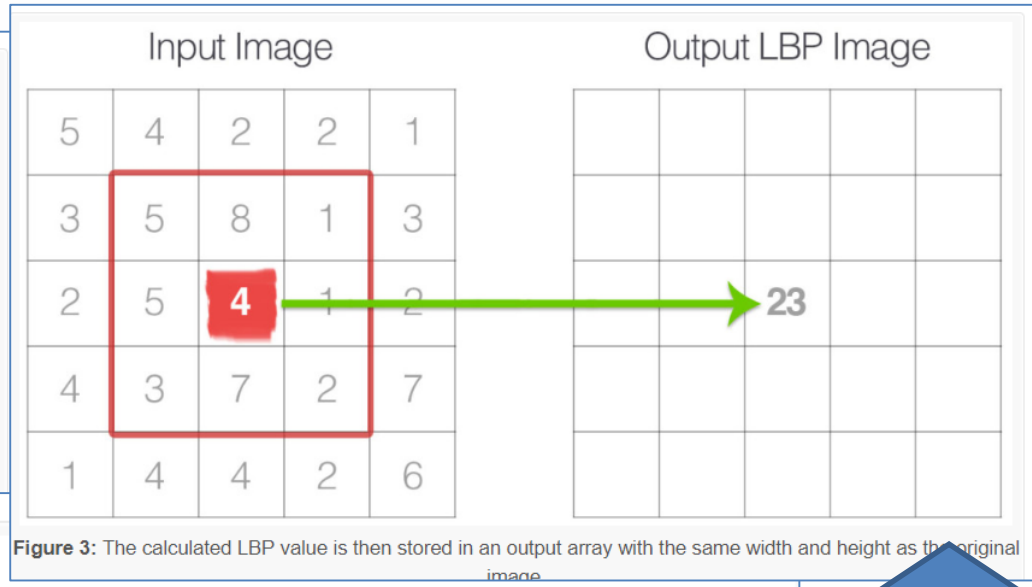


Figure 3: The calculated LBP value is then stored in an output array with the same width and height as the original image.

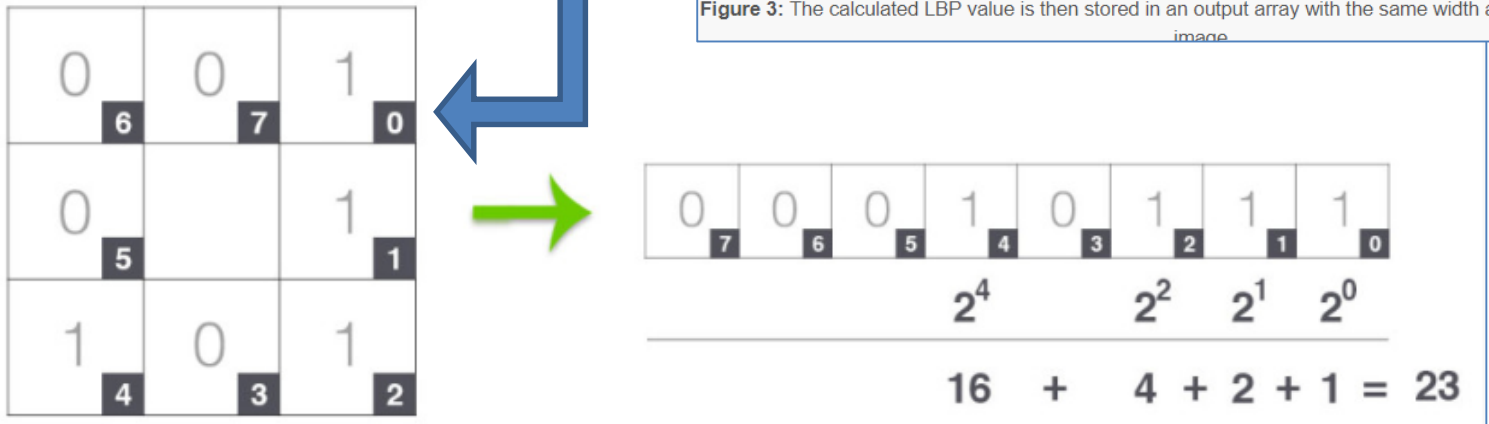


Figure 2: Taking the 8-bit binary neighborhood of the center pixel and converting it into a decimal representation.
(Thanks to Bikramjot of Hanzra Tech for the inspiration on this visualization!)

Implementation tool & setup

❑ Python using PyCharm

- Python is a popular programming language used in web & software development, mathematics, system scripting
- PyCharm is a python editor and compiler allows intelligent code completion, on-the-fly error checking and quick-fixes, easy project navigation, and much more.

❑ SQL using MySQL

- SQL is a standard language for storing, manipulating and retrieving data in databases.
- MySQL is an open source relational database management system, very easy to establish, use and manage

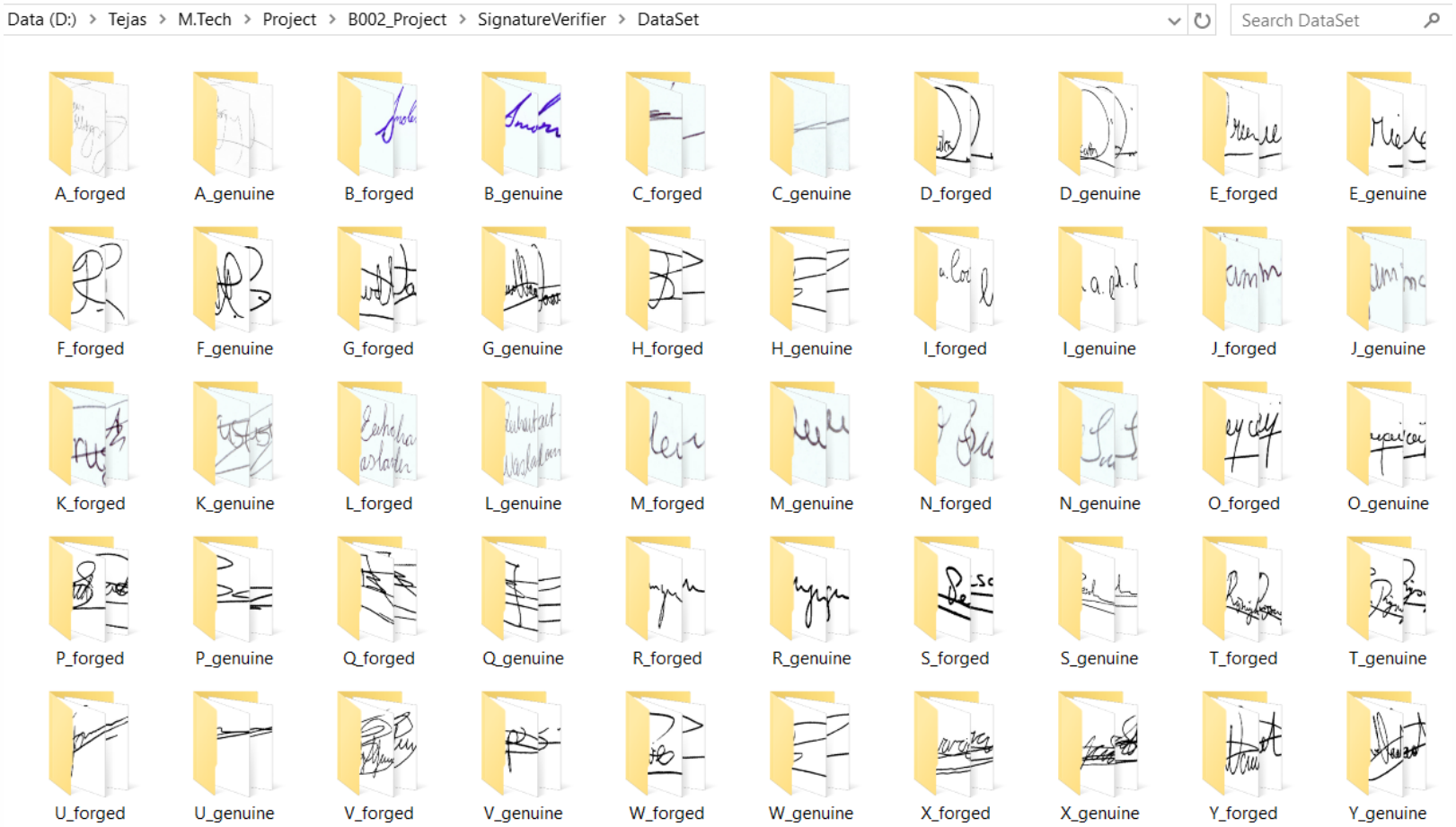
Implementation tool & setup

❑ Python libraries

- Using number of libraries, which are easy to install & import..
  - OpenCV : *Computer vision and machine learning software library.*
  - NumPy : *Scientific computing & array-processing*
  - Imutils : *Functions to make basic image processing functions easier*
  - Math : *Provides access to the mathematical functions*
  - MatplotLib : *Python 2D plotting library*
  - Pymysql : A simple database interface for Python
  - OS : allows easy file handling
  - Scipy : Provides many user-friendly and efficient numerical routines

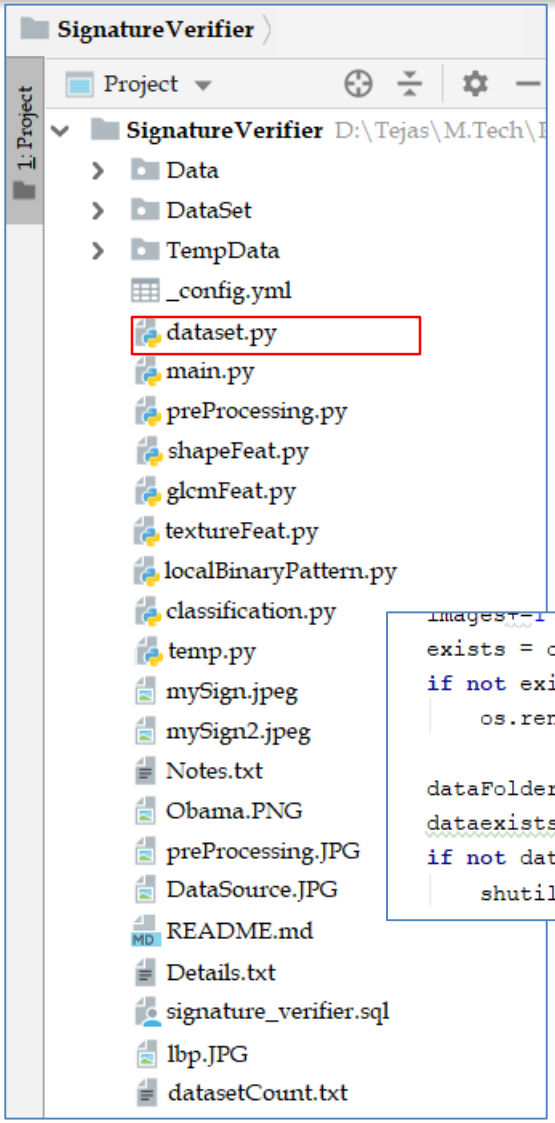
Dataset

25 Authors, 50 Classes, **826 Images**
637 Training images (77.12%)
189 Testing images (22.88%)



Implementation Work done

Implementation

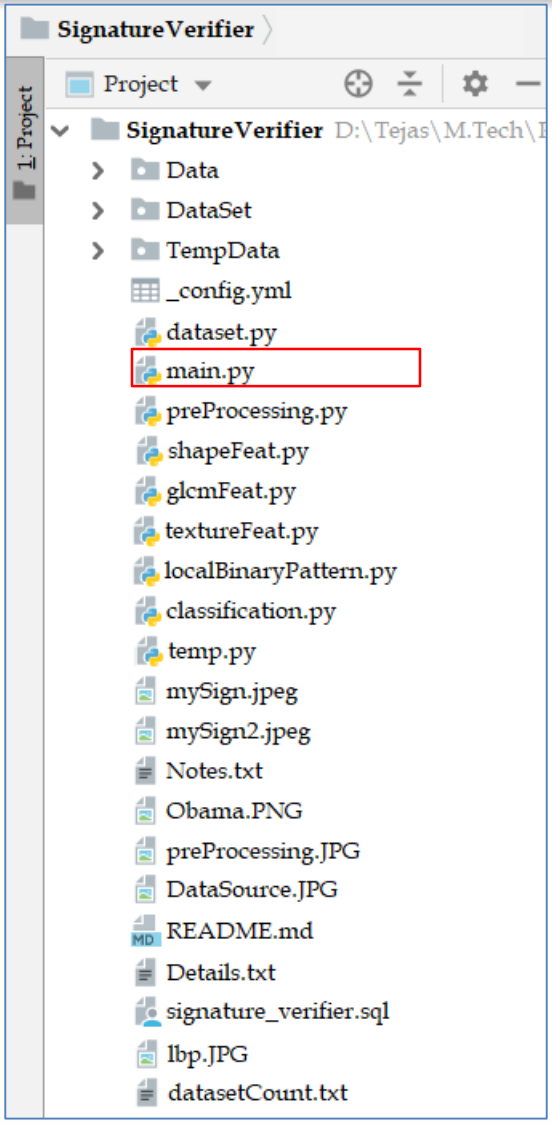


❑ Dataset.py

- Our dataset is read, renamed, copied and organized in the correct naming convention to a different folder, from where our system will use
- xyz.png → A_genuine_7.png
- Also gives an analysis of the count of dataset

```
images+=1
exists = os.path.isfile("DataSet/"+folder+"/"+folder+"_"+str(j)+".png")
if not exists:
    os.rename("DataSet/" + folder + "/" + file, "DataSet/" + folder + "/" + folder + "_" + str(j) + ".png")

dataFolder = training_folder if (j < (4*total/5)) else testing_folder
dataexists = os.path.isfile(dataFolder + "/" + folder + "_" + str(j) + ".png")
if not dataexists:
    shutil.copy("DataSet/" + folder + "/" + folder + "_" + str(j) + ".png", dataFolder)
```

Implementation

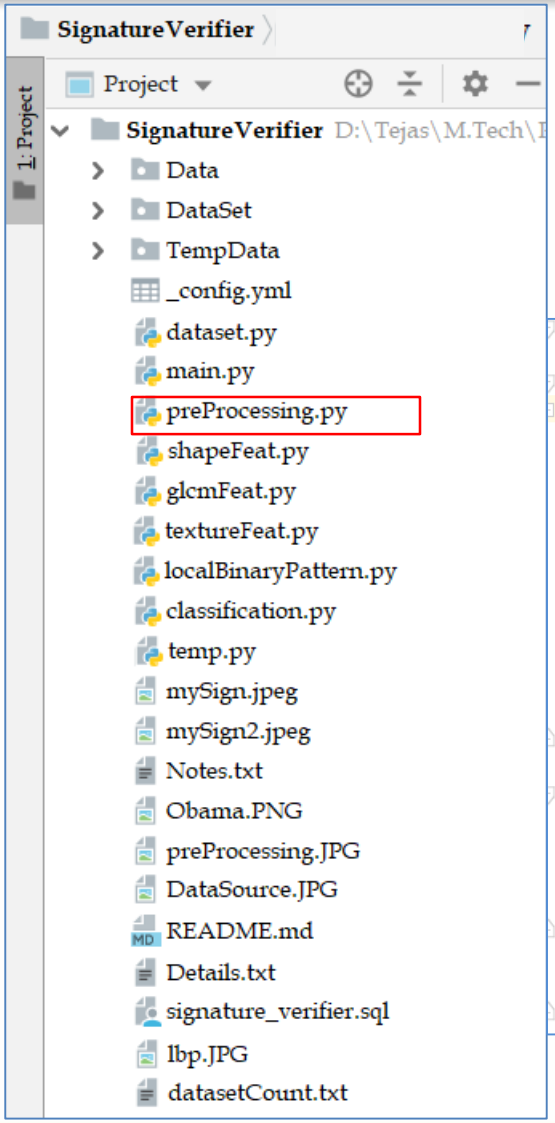


❑ Main.py

- This is the main python file where the system working starts, calls the other functions, gives the appropriate results and ends.

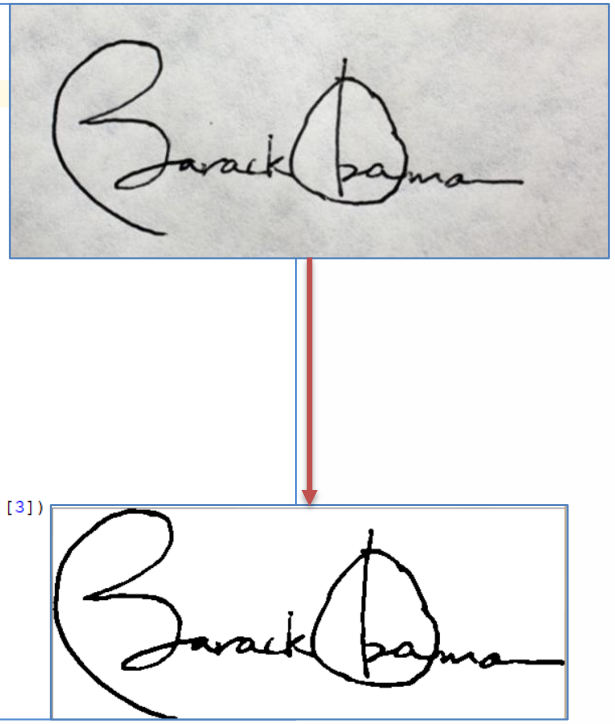
```
for filename in os.listdir(testing_folder):
    img = cv.imread(os.path.join(testing_folder, filename), 0)
    if img is not None:
        isLBP = False
        f = open("Data/" + datafile, "a")
        print("\n~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~")
        f.write("\n~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~\n")
        print("Image file : ", filename)
        f.write("\nImage file : "+ str(filename) +"\n")
        f.close()
        orgImg = img
        # cv.imshow(filename, img)
        proImg = pr.preprocess(orgImg, datafile)
        # cv.imshow(filename, myImg)

        sf.shapeFeat(proImg, testingFeatures, isLBP, datafile, filename)
        gf.glcm(proImg, testingFeatures, datafile)
        tf.textFeat(proImg, testingFeatures, datafile)

        isLBP = True
        lbpImg = lbp.lbp(orgImg, datafile)
        sf.shapeFeat(lbpImg, testingFeatures, isLBP, datafile, filename)
        gf.glcm(lbpImg, testingFeatures, datafile)
        tf.textFeat(lbpImg, testingFeatures, datafile)
        cl.actualclass(filename, testingClasses, datafile)

        cl.knn(trainingFeatures,testingFeatures,trainingClasses,decisionClasses, datafile)
```

Implementation

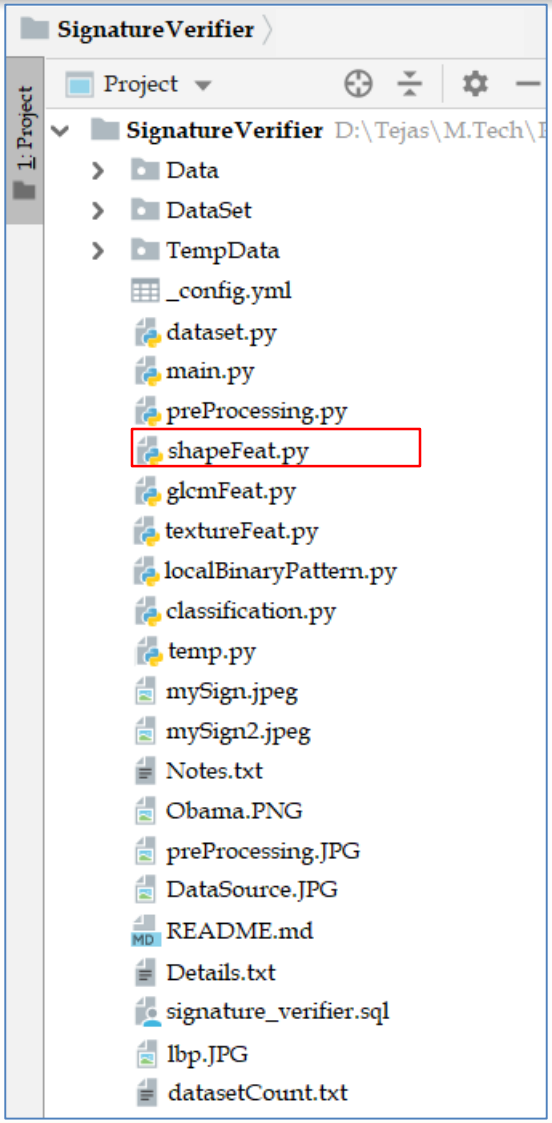


- **Preprocessing.py**
  - This function takes the image in the raw format and converts into a pre-processed format.
  - Resize, RGB to Grey , Otsu thresholding, boundary Box cropping

```
def preprocess(img, datafile):

    try:
        """..."""

        print()
        if(len(img.shape)>2):
            img = cv.cvtColor(img, cv.COLOR_RGB2GRAY)

        img = imutils.resize(img, 720)

        # ~~ Otsu's thresholding after Gaussian filtering ~~
        blur = cv.GaussianBlur(img,(3,3),0)
        ret, img = cv.threshold(blur,0,255,cv.THRESH_OTSU)

        img = boundaryBox(img, datafile)

    except Exception as error:
        print("An exception was thrown in " + inspect.stack()[0][3])
        f = open("Data/"+datafile, "a")
        print("Error: "+ str(error))
        f.write("\nError: "+ str(error))
        f.close()

    finally:
        return img
```



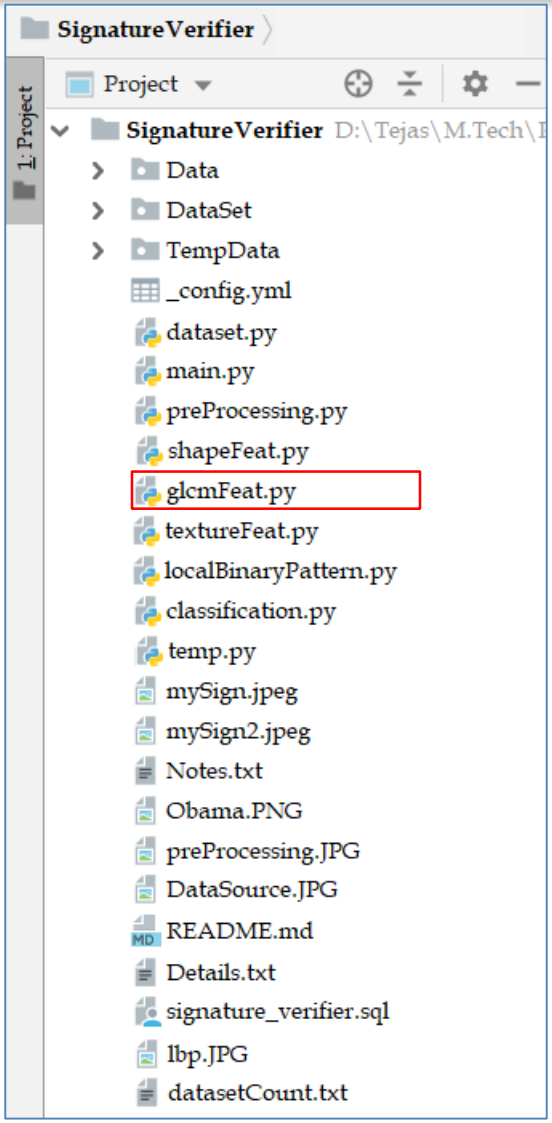
Implementation



- **shapeFeat.py**
  - This function extracts shape based features of the signature from the images.
  - These includes:
    - Aspect Ratio
    - Center of Gravity
    - Normalized Area
    - Baseline Shift
    - Eccentricity
    - HuMoments
    - No of Corners

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Image file :  Y_genuine_12.png

     ~~~ Shape features ~~~
Aspect Ratio :  1.8882175226586102
X_COG: 314.35614528971786
Y_COG: 160.09018323098957
Normalized area:  0.8808652567975831
Baseline shift:  5.49301214401541
Eccentricity:  0.844747849543066
HuMoments:  13.06358045823279
Corners:  317
```

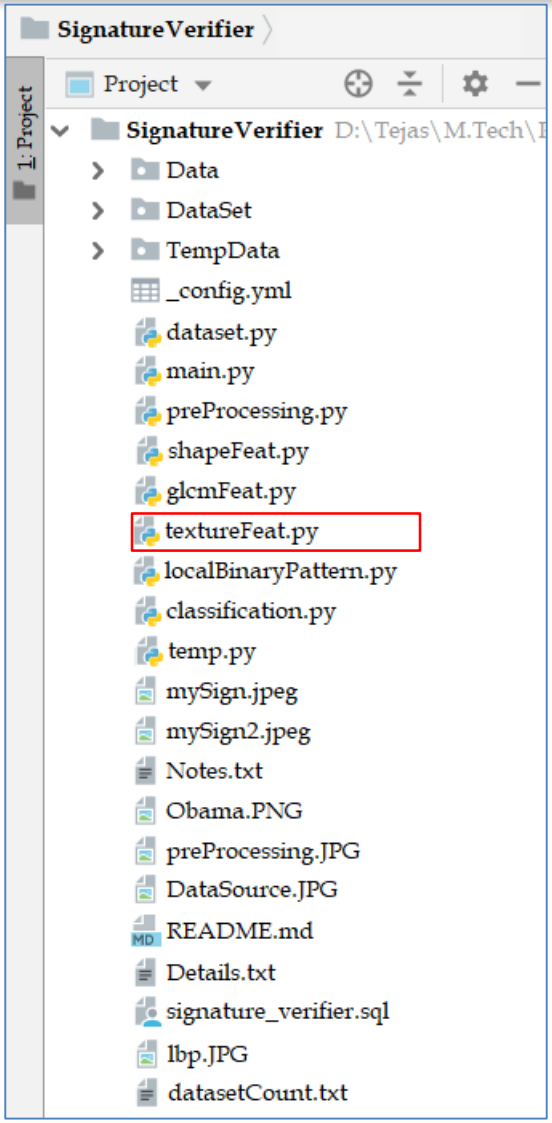
Implementation



- **glcmFeat.py**
  - This function extracts glcm based features of the signature from the images.
  - Gray Level Coherence Matrix
  - These includes:
    - Contrast
    - Dissimilarity
    - Homogeneity
    - Energy
    - Correlation
    - ASM

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Image file :  Y_genuine_12.png

     ~~~ GLCM features ~~~
Contrast:  1619.1396264234256
Dissimilarity:  6.3495671624448065
Homogeneity:  0.9751001195456674
Energy:  0.8751210985740953
Correlation:  0.8813611181808606
ASM:  0.7658369371695313
```

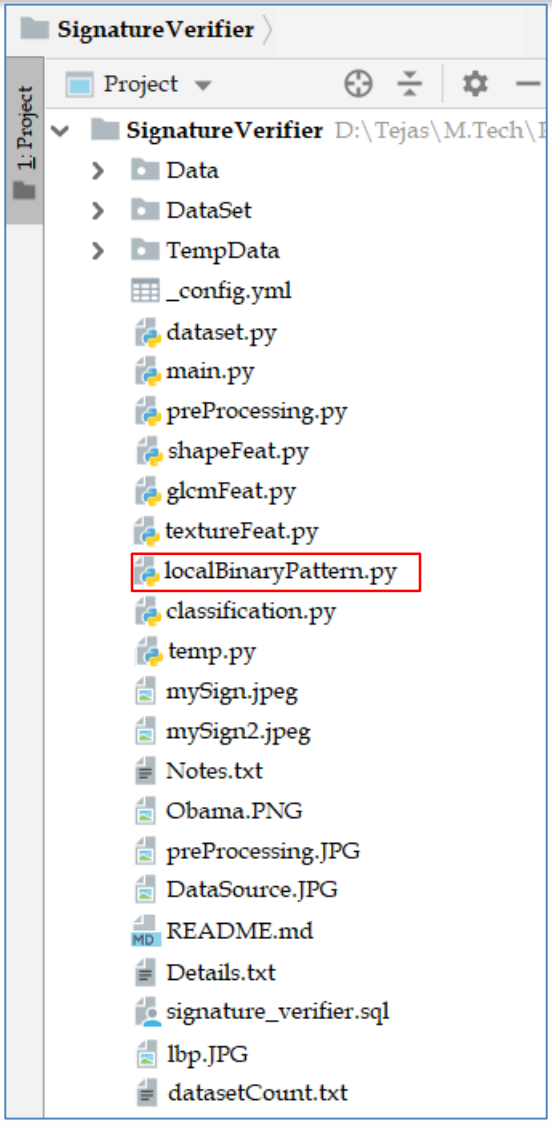
Implementation



- **textureFeat.py**
  - This function extracts texture based features of the signature from the images.
  - These includes:
    - Mean
    - Variance
    - Skewness
    - Kurtosis
    - Energy
    - Haralick

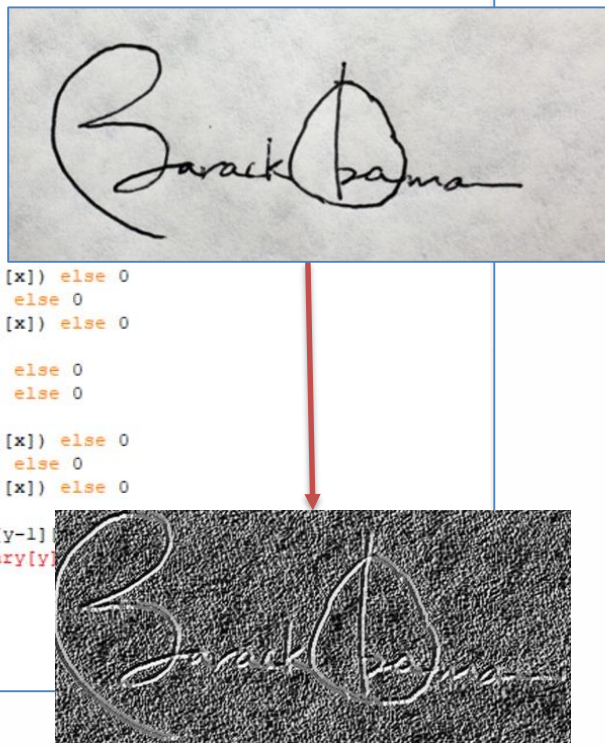
```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Image file :  Y_genuine_12.png

      ~~~ Texture features ~~~
 Mean:  224.62064048338368
 Variance:  132.49999999976717
 Skewness:  -2.67989282143756
 Kurtosis:  6.181647412206975
 Entropy:  5.672146449324859
 Haralick:  2663.808568037615
```

Implementation

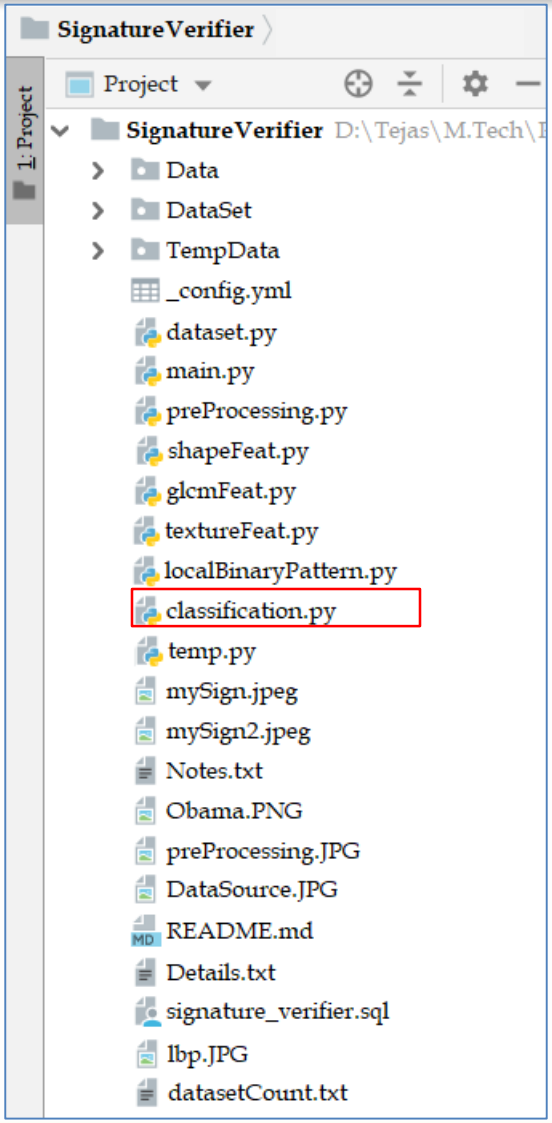


- **localBinaryPattern.py**
  - This python file contains function that converts the image to an LBP image.
  - Local Binary Pattern

```
def lbp(img):
    if(len(img.shape)>2):
        img = cv.cvtColor(img, cv.COLOR_RGB2GRAY)

    binary = img.copy()
    lbpImg = img.copy()
    height = img.shape[0]
    width = img.shape[1]

    y=1
    while(y<height-1):
        x=1
        while(x < width-1):
            binary[y-1][x-1] = 1 if(img[y-1][x-1] < img[y][x]) else 0
            binary[y-1][x] = 1 if(img[y-1][x] < img[y][x]) else 0
            binary[y-1][x+1] = 1 if(img[y-1][x+1] < img[y][x]) else 0

            binary[y][x-1] = 1 if(img[y][x-1] < img[y][x]) else 0
            binary[y][x+1] = 1 if(img[y][x+1] < img[y][x]) else 0

            binary[y+1][x-1] = 1 if(img[y+1][x-1] < img[y][x]) else 0
            binary[y+1][x] = 1 if(img[y+1][x] < img[y][x]) else 0
            binary[y+1][x+1] = 1 if(img[y+1][x+1] < img[y][x]) else 0

            lbpImg[y][x] = (binary[y][x-1]*128) + (binary[y-1]
            #lbpImg[y][x] = (binary[y-1][x+1]*128) + (binary[y
            x+=1
        y+=1

    return lbpImg
```



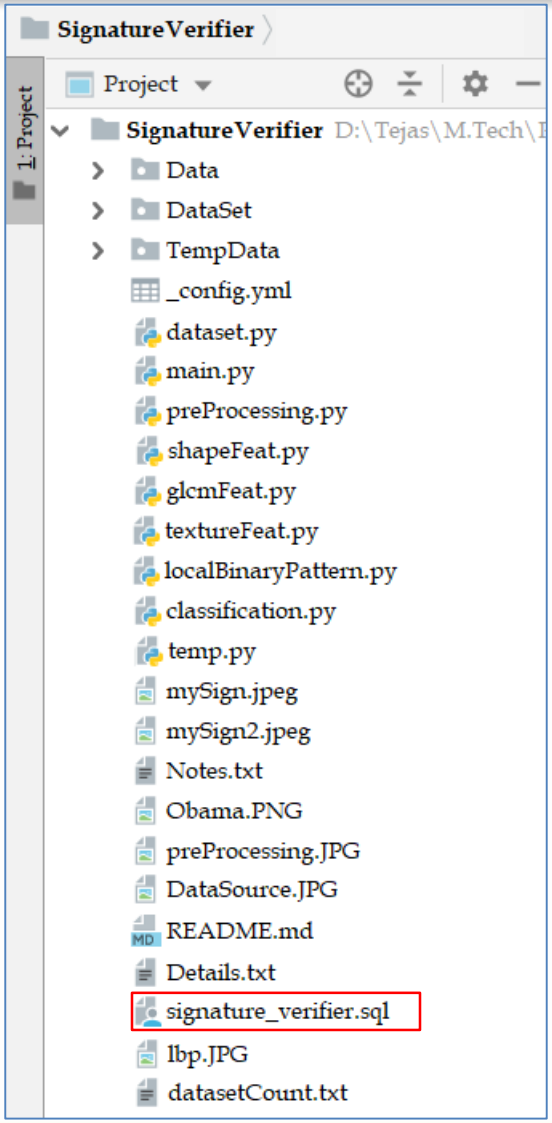
Implementation



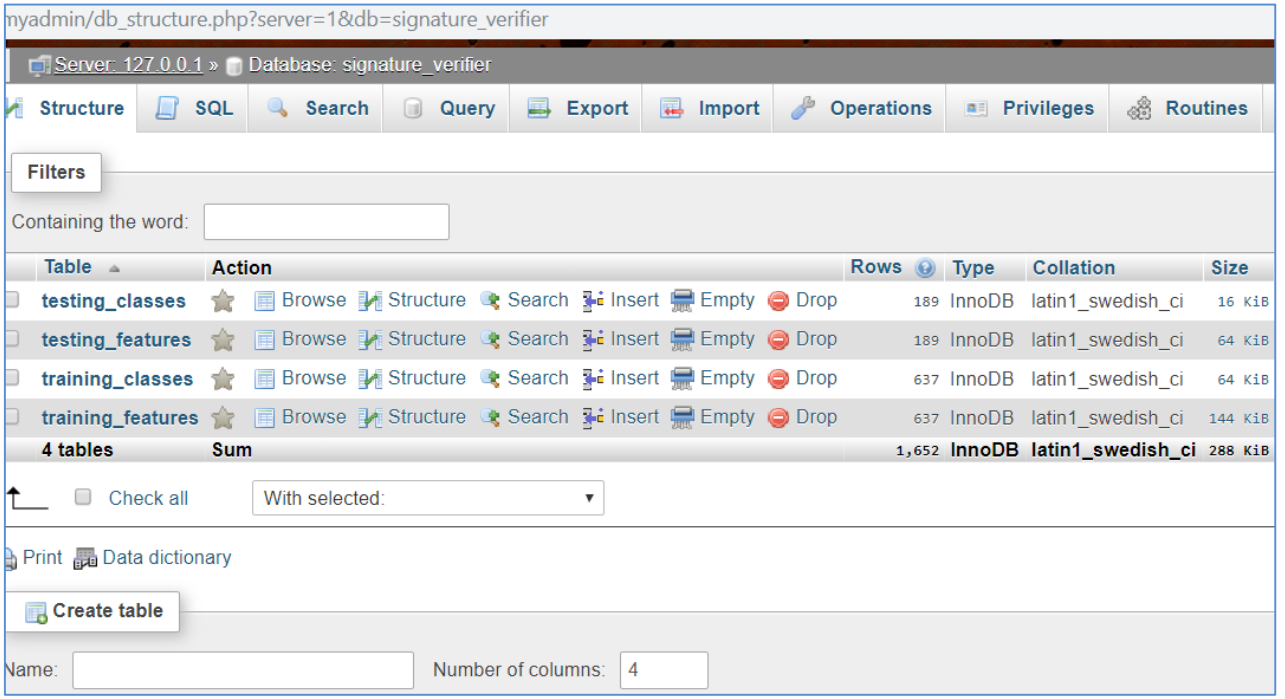
- **classification.py**
  - This python file contains KNN classification function which classifies the given test data to a particular class.
  - There are two functions one that gets the actual class of the function by merely the name of the file and other is the KNN classifier.

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Image file :  A_forged_21.png
                    ■
                    ■
                    ■

Actual Class:  A_forged
Decision:  A_forged
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

Implementation

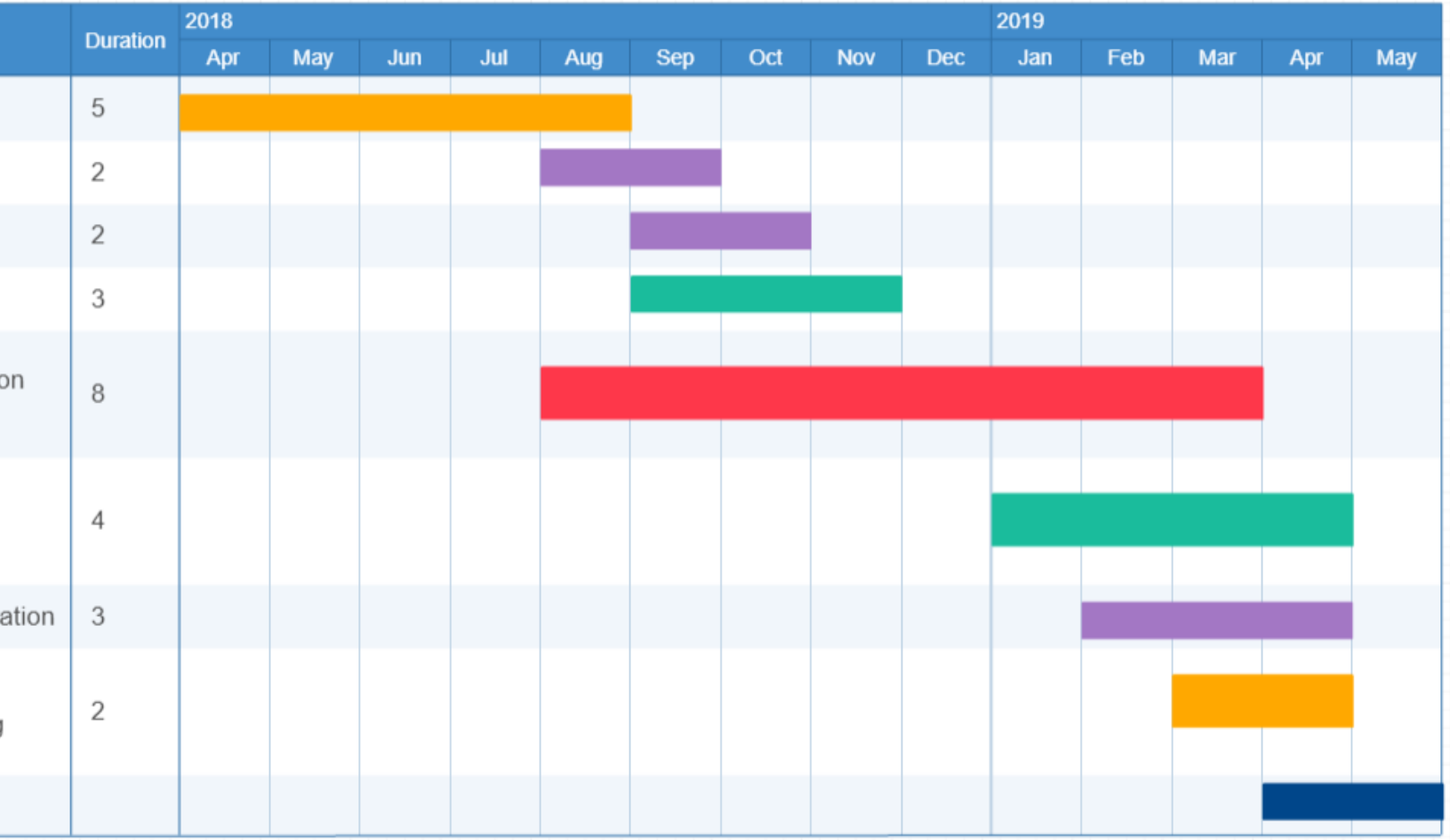


- **signature_verifier.sql**
  - This has SQL queries for creating database, creating tables, inserting entries into the tables.
  - Main.py also inserts and reads data into the database one row at a time



Gantt Chart

ID	Task Name	Duration
1	Research	5
2	Planning	2
3	Analysis	2
4	Design	3
5	Implementation and Support	8
7	Testing and Evaluation	4
8	Report generation	3
9	Technical Paper Writing	2
9	Future Work	



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[41] Python : https://www.python.org/

[42] Dataset source :- http://www.iapr-tc11.org/mediawiki/index.php?title=Datasets_List#Handwritten%20Documents

Thank You ☺

Any Questions?