DAI_ASSIGNMENT_1_Q1.ipynb

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Q1. Analysis of Machine Learning model for bias. [50 Marks] ● Use the SVM model. (You can use sklearn library) ● Train the model on Bollywood celebrity dataset [Download Here: https://www.kaggle.com/havingfun/100-bollywood-celebrity-faces/download] ● Choose any 10 classes from the dataset of your choice ● Report/ Show ○ Class-wise accuracy [10 Marks] ○ Overall accuracy [10 Marks] ○ Training loss vs Testing loss curve wrt epochs.[10 Marks] ○ Check if your model is biased or not by using at-least 2 metrics ex. Confusion Matrix [15 Marks] ○ What type of bias you see(if any), explain. [5 Marks]

```
[1] # ref: https://medium.com/analytics-vidhya/how-to-fetch-kaggle-datasets-into-google-colab-ea682569851a
    from google.colab import drive
    drive.mount('/content/gdrive')

    Mounted at /content/gdrive

[2] import os
    os.environ['KAGGLE_CONFIG_DIR'] = "/content/gdrive/My Drive/Kaggle"

[3] %cd /content/gdrive/My Drive/Kaggle

    /content/gdrive/My Drive/Kaggle

[4] !kaggle datasets download -d havingfun/100-bollywood-celebrity-faces

    100-bollywood-celebrity-faces.zip: Skipping, found more recently modified local copy (use --force to force download)

[5] !ls

    100-bollywood-celebrity-faces.zip  bollywood_celeb_faces2
    bollywood_celeb_faces_0            kaggle.json
    bollywood_celeb_faces_1            question_one_dataset

[6] !unzip \*.zip

    Archive:  100-bollywood-celebrity-faces.zip
    replace bollywood_celeb_faces2/Randeep_Hooda/1.jpg? [y]es, [n]o, [A]ll, [N]one, [r]ename: N

[7] !ls

    100-bollywood-celebrity-faces.zip  bollywood_celeb_faces2
    bollywood_celeb_faces_0            kaggle.json
    bollywood_celeb_faces_1            question_one_dataset

[8] !pwd

    /content/gdrive/My Drive/Kaggle

[9] !ls

    100-bollywood-celebrity-faces.zip  bollywood_celeb_faces2
    bollywood_celeb_faces_0            kaggle.json
    bollywood_celeb_faces_1            question_one_dataset

[10] # Selecting any 10 classes: Shraddha_Kapoor, Shahid_Kapoor, Richa_Chadda, Randeep_Hooda, Tapsee_Pannu, Suniel_Shetty, Shruti_Haasan, Sidharth_Malhotra, Disha_

[11] !pwd

    /content/gdrive/My Drive/Kaggle

[12] #Folders
    Shraddha_Kapoor  = '/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Shraddha_Kapoor'
    Shahid_Kapoor = '/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Shahid_Kapoor'
    Richa_Chadda= '/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Richa_Chadda'
    Randeep_Hooda= '/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Randeep_Hood'
    Tapsee_Pannu='/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Tapsee_Pannu'
    Suniel_Shetty= '/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Suniel_Shetty'
    Shruti_Haasan='/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Shruti_Haasan'
    Sidharth_Malhotra='/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Sidharth_Malhotra'
    Disha_Patani='/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces_0/Disha_Patani'
    Arjun_Rampal='/content/gdrive/My Drive/Kaggle/bollywood_celeb_faces_0/Arjun_Rampal'

[13] !ls

    100-bollywood-celebrity-faces.zip  bollywood_celeb_faces2
    bollywood_celeb_faces_0            kaggle.json
    bollywood_celeb_faces_1            question_one_dataset

[14] %cd /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces_0

    /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces_0

[15] !ls

    Aamir_Khan         Ameesha_Patel      Arshad_Warsi        Esha_Gupta
    Abhay_Deol         Amitabh_Bachchan   Asin                Farhan_Akhtar
    Abhishek_Bachchan  Amrita_Rao         Ayushmann_Khurrana  Govinda
    Aftab_Shivdasani   Amy_Jackson        Bhumi_Pednekar      Hrithik_Roshan
    Aishwarya_Rai      Anil_Kapoor        Bipasha_Basu        Huma_Qureshi
    Ajay_Devgn         Anushka_Sharma     Bobby_Deol          Ileana_D╫У├З├ЦCruz
    Akshaye_Khanna     Anushka_Shetty     Deepika_Padukone
    Akshay_Kumar       Arjun_Kapoor       Disha_Patani
    Alia_Bhatt         Arjun_Rampal       Emraan_Hashmi

[16] %cd /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces_1

    /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces_1

[17] !ls

    Irrfan_Khan          Kartik_Aaryan     Mrunal_Thakur      Prachi_Desai
    Jacqueline_Fernandez Katrina_Kaif      Nana_Patekar       Preity_Zinta
    John_Abraham         Kiara_Advani      Nargis_Fakhri      Priyanka_Chopra
    Juhi_Chawla          Kriti_Kharbanda   Naseeruddin_Shah   Rajkummar_Rao
    Kajal_Aggarwal       Kriti_Sanon       Nushrat_Bharucha   Ranbir_Kapoor
    Kajol                Kunal_Khemu       Paresh_Rawal       R_Madhavan
    Kangana_Ranaut       Lara_Dutta        Parineeti_Chopra
    Kareena_Kapoor       Madhuri_Dixit     Pooja_Hegde
    Karisma_Kapoor       Manoj_Bajpayee    Prabhas

[18] %cd /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2

    /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2

[19] !ls

    Randeep_Hooda     Shahid_Kapoor      Suniel_Shetty         Vaani_Kapoor
    Rani_Mukerji      Shah_Rukh_Khan     Sunny_Deol            Varun_Dhawan
    Ranveer_Singh     Shilpa_Shetty      Sushant_Singh_Rajput  Vicky_Kaushal
    Richa_Chadda      Shraddha_Kapoor    Taapsee_Pannu         Vidya_Balan
    Riteish_Deshmukh  Shreyas_Talpade    Tabu                  Vivek_Oberoi
    Saif_Ali_Khan     Shruti_Haasan      Tamannaah_Bhatia      Yami_Gautam
    Salman_Khan       Sidharth_Malhotra  Tiger_Shroff          Zareen_Khan
    Sanjay_Dutt       Sonakshi_Sinha     Tusshar_Kapoor
    Sara_Ali_Khan     Sonam_Kapoor       Uday_Chopra

[20] %cd /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Shraddha_Kapoor

    /content/gdrive/My Drive/Kaggle/bollywood_celeb_faces2/Shraddha_Kapoor

[21] !ls | wc -l # Number of images in Shraddha_Kapoor Dataset

    121

[22] %cd /content/gdrive/My Drive/Kaggle/question_one_dataset

    /content/gdrive/My Drive/Kaggle/question_one_dataset

[23] !pwd

    /content/gdrive/My Drive/Kaggle/question_one_dataset
```

Run the program from here

Overall accuracy: 0.35833333333333334

```
[24] import os
    import cv2
    import numpy as np
    import matplotlib.pyplot as plt
    dir = "/content/gdrive/My Drive/Kaggle/question_one_dataset"

[25] classes = [   'Shraddha_Kapoor',#0
                   'Shahid_Kapoor',#1
                   'Richa_Chadda',#2
                   'Randeep_Hooda',#3
                   'Taapsee_Pannu',#4
                   'Suniel_Shetty',#5
                   'Shruti_Haasan',#6
                   'Sidharth_Malhotra',#7
                   'Disha_Patani',#8
                   'Arjun_Rampal'#9
                   ]

[26] from google.colab.patches import cv2_imshow

    # cv2_imshow(cv2.imread("/content/gdrive/My Drive/Kaggle/question_one_dataset/Shraddha_Kapoor/1.jpg")) # Worked!!!!

    # This implies the data is fetched from the google drive. Now we just have to do the learning.

[27] data = []
    for clas in classes:
      path = os.path.join(dir, clas)
      label = classes.index(clas)
      print(label)
      for img in os.listdir(path): # Gets the list of all files in the directory
        imagepath = os.path.join(path,img)
        # print(str(imagepath))
        star_image = cv2.imread(imagepath, 0)
        try:
          star_image = cv2.resize(star_image,(250,250))
          image_array = np.array(star_image).flatten()
          data.append([image_array, label])
        except Exception as e:
          pass

    print(len(data))

    0
    1
    2
    3
    4
    5
    6
    7
    8
    9
    1198

[28] import random
    random.shuffle(data)
    X_features = []
    Y_labels = []

    for x,y in data:
      X_features.append(x)
      Y_labels.append(y)

[29] from sklearn.model_selection import train_test_split
    X_train,X_test, Y_train, Y_test = train_test_split(X_features, Y_labels, test_size=0.1)

[30] print("Sizes of X_train, Y_train, X_test, Y_test")
    print(len(X_train))
    print(len(X_test))
    print(len(Y_train))
    print(len(Y_test))

    Sizes of X_train, Y_train, X_test, Y_test
    1078
    120
    1078
    120

[31] from sklearn.svm import SVC

[74] model = SVC(decision_function_shape='ovo', kernel='rbf')
    model.fit(X_train, Y_train)
    prediction_test = model.predict(X_test)
    accu = model.score(X_test, Y_test)

    print("Testing accuracy:",accu)

    Testing accuracy: 0.3333333333333333

[75] model = SVC(decision_function_shape='ovo', kernel='rbf')
    model.fit(X_train, Y_train)
    prediction_train = model.predict(X_train)
    train_accu = model.score(X_train, Y_train)

    print("Training accuracy:",train_accu)

    Training accuracy: 0.7597402597402597

[76] # Testing Metrics
    from sklearn.metrics import classification_report
    print(classification_report(Y_test, prediction_test,
                                target_names=classes))

                       precision    recall  f1-score   support

      Shraddha_Kapoor       0.42      0.33      0.37        15
        Shahid_Kapoor       0.24      0.44      0.31         9
         Richa_Chadda       0.20      0.22      0.21         9
        Randeep_Hooda       0.12      0.22      0.16         9
        Taapsee_Pannu       0.44      0.24      0.31        17
        Suniel_Shetty       0.00      0.00      0.00         6
        Shruti_Haasan       0.57      0.67      0.62        18
    Sidharth_Malhotra       0.00      0.00      0.00         9
         Disha_Patani       0.32      0.62      0.42        13
         Arjun_Rampal       0.43      0.20      0.27        15

             accuracy                           0.33       120
            macro avg       0.27      0.29      0.27       120
         weighted avg       0.33      0.33      0.31       120

    /usr/local/lib/python3.6/dist-packages/sklearn/metrics/_classification.py:1272: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to
      _warn_prf(average, modifier, msg_start, len(result))

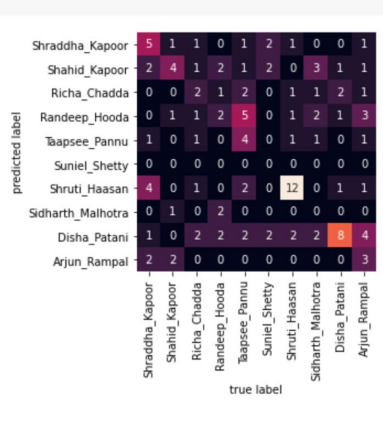
[77] # Training Metrics
    from sklearn.metrics import classification_report
    print(classification_report(Y_train, prediction_train,
                                target_names=classes))

                       precision    recall  f1-score   support

      Shraddha_Kapoor       0.93      0.75      0.83       104
        Shahid_Kapoor       0.75      0.84      0.79       136
         Richa_Chadda       0.92      0.71      0.80       109
        Randeep_Hooda       0.71      0.75      0.73       106
        Taapsee_Pannu       0.83      0.78      0.80       128
        Suniel_Shetty       1.00      0.38      0.55        66
        Shruti_Haasan       0.78      0.90      0.84       112
    Sidharth_Malhotra       0.91      0.69      0.79        91
         Disha_Patani       0.53      0.91      0.67       139
         Arjun_Rampal       0.89      0.63      0.74        87

             accuracy                           0.76      1078
            macro avg       0.82      0.73      0.75      1078
         weighted avg       0.80      0.76      0.76      1078

[80] import seaborn as sns
    from sklearn.metrics import confusion_matrix
    matrix = confusion_matrix(Y_test, prediction_test)
    sns.heatmap(matrix.T, square=True, annot=True, fmt='d', cbar=False,
                xticklabels=classes,
                yticklabels=classes)
    plt.xlabel('true label')
    plt.ylabel('predicted label');
```




```
[45] test_error = []
    training_error = []
    loss_train=0
    loss_test=0
    for item in range(len(Y_train)):
      if(model.predict(X_train[item].reshape(1,-1))[0] == Y_train[item]):
        l=0
      else:
        loss_train = loss_train+1
        training_error.append(loss_train)

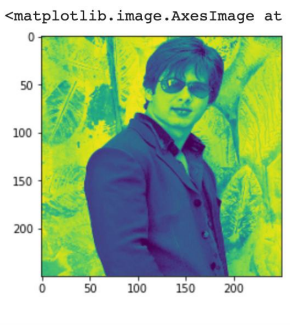

    for item in range(len(Y_test)):
      if(model.predict(X_test[item].reshape(1,-1))[0] == Y_test[item]):
        l=0
      else:
        loss_test = loss_test + 1
        test_error.append(loss_test)

[62]

[63]

[37] plt.imshow(X_test[9].reshape(250,250))

    <matplotlib.image.AxesImage at 0x7fdcd339eac8>
```



```
[38] Y_test[9]

    1

[39] a = model.predict(X_test[9].reshape(1,-1))[0]

[40] print(classes[a])

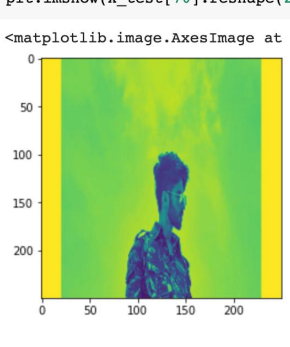
    Shahid_Kapoor

[41] print (a)

    1

[ ] plt.imshow(X_test[70].reshape(250,250))

    <matplotlib.image.AxesImage at 0x7f941af7f940>
```



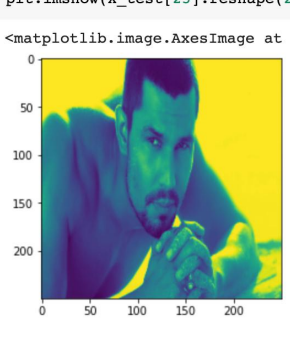
```
[ ] b = model.predict(X_test[9].reshape(1,-1))[0]

[ ] print(classes[b])

    Shahid_Kapoor

[ ] plt.imshow(X_test[25].reshape(250,250))

    <matplotlib.image.AxesImage at 0x7f941aed6ba8>
```



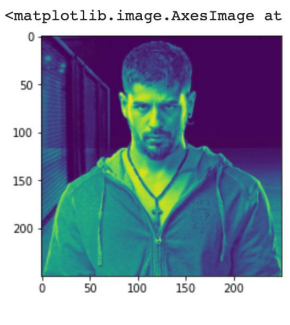
```
[ ] c = model.predict(X_test[9].reshape(1,-1))[0]

[ ] print(classes[c])

    Shahid_Kapoor

[ ] plt.imshow(X_train[400].reshape(250,250))

    <matplotlib.image.AxesImage at 0x7f941aebc080>
```



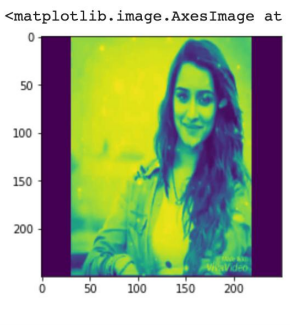
```
[ ] d = model.predict(X_train[400].reshape(1,-1))[0]

[ ] print(classes[d])

    Disha_Patani

[ ] plt.imshow(X_train[363].reshape(250,250))

    <matplotlib.image.AxesImage at 0x7f941ae12390>
```



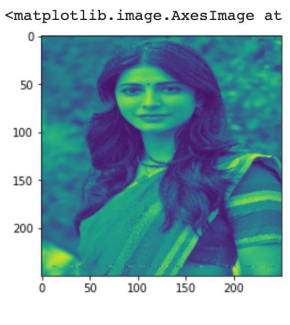
```
[ ] e = model.predict(X_train[363].reshape(1,-1))[0]
    print(classes[e])

    Shraddha_Kapoor

[ ] # so on the training dataset it is performing very well

[ ] plt.imshow(X_test[51].reshape(250,250))

    <matplotlib.image.AxesImage at 0x7f941adea668>
```

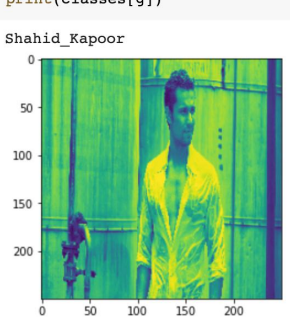


```
[ ] f = model.predict(X_test[51].reshape(1,-1))[0]
    print(classes[f])

    Shruti_Haasan

[ ] plt.imshow(X_test[67].reshape(250,250))
    g = model.predict(X_test[67].reshape(1,-1))[0]
    print(classes[g])

    Shahid_Kapoor
```



```
[ ]
```

Training Loss vs Testing Loss Curve

```
[ ]
```

Class Wise

Lets perform class wise classification and check accuracy. We need to take 2 classes for each training. Here below, classwise accuracy is checked between Shraddha_Kapoor and Taapsee_Pannu, accuracy: 0.6666666666666666

```
[ ]
    import os
    import cv2
    import numpy as np
    import matplotlib.pyplot as plt
    dir = "/content/gdrive/My Drive/Kaggle/question_one_dataset"

    classes = [   'Shraddha_Kapoor',#0
                  'Taapsee_Pannu',#1

                  ]
    data_0 = []
    for clas in classes:
      path = os.path.join(dir, clas)
      label = classes.index(clas)
      print(label)
      for img in os.listdir(path): # Gets the list of all files in the directory
        imagepath = os.path.join(path,img)
        # print(str(imagepath))
        star_image = cv2.imread(imagepath, 0)
        try:
          star_image = cv2.resize(star_image,(250,250))
          image_array = np.array(star_image).flatten()
          data_0.append([image_array, label])
        except Exception as e:
          pass

    print(len(data_0))

    0
    1
    264

[ ] import random
    random.shuffle(data_0)
    X_features = []
    Y_labels = []

    for x,y in data_0:
      X_features.append(x)
      Y_labels.append(y)

[ ] from sklearn.model_selection import train_test_split
    X_train,X_test, Y_train, Y_test = train_test_split(X_features, Y_labels, test_size=0.1)

[ ] print("Sizes of X_train, Y_train, X_test, Y_test")
    print(len(X_train))
    print(len(X_test))
    print(len(Y_train))
    print(len(Y_test))

    Sizes of X_train, Y_train, X_test, Y_test
    237
    27
    237
    27

[ ] from sklearn.svm import SVC
    model = SVC(C=0.1, kernel='linear')
    model.fit(X_train, Y_train)
    prediction = model.predict(X_test)
    accu = model.score(X_test, Y_test)

    print("accuracy:",accu)

    accuracy: 0.6666666666666666

[ ]
```

But what we envision is the accuracies of each of the actor's image should be compared with other. making total of 10 X 10 runs of the training and accuracies.

```
[ ] array1 = [   'Shraddha_Kapoor',#0
                 'Shahid_Kapoor',#1
                 'Richa_Chadda',#2
                 'Randeep_Hooda',#3
                 'Taapsee_Pannu',#4
                 'Suniel_Shetty',#5
                 'Shruti_Haasan',#6
                 'Sidharth_Malhotra',#7
                 'Disha_Patani',#8
                 'Arjun_Rampal'#9
                 ]

    array2 = [   'Shraddha_Kapoor',#0
                 'Shahid_Kapoor',#1
                 'Richa_Chadda',#2
                 'Randeep_Hooda',#3
                 'Taapsee_Pannu',#4
                 'Suniel_Shetty',#5
                 'Shruti_Haasan',#6
                 'Sidharth_Malhotra',#7
                 'Disha_Patani',#8
                 'Arjun_Rampal'#9
                 ]


    def important_function(actor1, actor2):
      print("-----------------------------------------------")
      print("-----------Doing for ---------")
      print(str(actor1)+" and "+str(actor2))
      print("-----------------------------------------------")

      classes = [   str(actor1),#0
                    str(actor2),#1

                    ]
      data_0 = []
      for clas in classes:
        path = os.path.join(dir, clas)
        label = classes.index(clas)
        print(label)
        for img in os.listdir(path): # Gets the list of all files in the directory
          imagepath = os.path.join(path,img)
          # print(str(imagepath))
          star_image = cv2.imread(imagepath, 0)
          try:
            star_image = cv2.resize(star_image,(250,250))
            image_array = np.array(star_image).flatten()
            data_0.append([image_array, label])
          except Exception as e:
            pass

      print(len(data_0))
      random.shuffle(data_0)
      X_features = []
      Y_labels = []

      for x,y in data_0:
        X_features.append(x)
        Y_labels.append(y)
      from sklearn.model_selection import train_test_split
      X_train,X_test, Y_train, Y_test = train_test_split(X_features, Y_labels, test_size=0.1)
      print("Sizes of X_train, Y_train, X_test, Y_test")
      print(len(X_train))
      print(len(X_test))
      print(len(Y_train))
      print(len(Y_test))
      from sklearn.svm import SVC
      model = SVC(C=0.1, kernel='linear')
      model.fit(X_train, Y_train)
      prediction = model.predict(X_test)
      accu = model.score(X_test, Y_test)

      print("accuracy:",accu)





    for element1 in array1:
      for element2 in array2:
        if(str(element1)==str(element2)):
          pass
        else:
          important_function(element1, element2)
    Shahid_Kapoor and Suniel_Shetty
    -----------------------------------------------
    0
    1
    217
    Sizes of X_train, Y_train, X_test, Y_test
    195
    22
    195
    22
    accuracy: 0.4090909090909091
    -----------------------------------------------
    -----------Doing for ---------
    Shahid_Kapoor and Shruti_Haasan
    -----------------------------------------------
    0
    1
    275
```

```
Sizes of X_train, Y_train, X_test, Y_test
247
28
247
28
accuracy: 0.75
------------------------------------------------
-----------Doing for ---------
Shahid_Kapoor and Sidharth_Malhotra
------------------------------------------------
0
1
245
Sizes of X_train, Y_train, X_test, Y_test
220
25
220
25
accuracy: 0.56
------------------------------------------------
-----------Doing for ---------
Shahid_Kapoor and Disha_Patani
------------------------------------------------
0
1
297
Sizes of X_train, Y_train, X_test, Y_test
267
30
267
30
accuracy: 0.7
------------------------------------------------
-----------Doing for ---------
Shahid_Kapoor and Arjun_Rampal
------------------------------------------------
0
1
247
Sizes of X_train, Y_train, X_test, Y_test
222
25
```

```
[ ]
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