Facial Recognition

Results Document

Version 1.0

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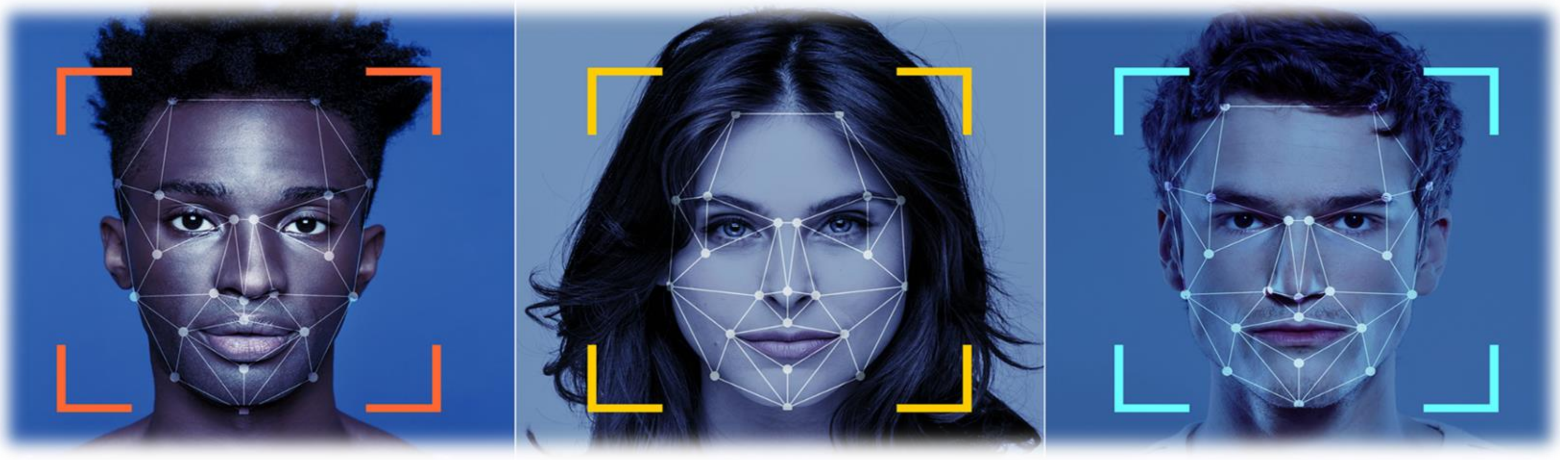

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Introduction

The technology of facial recognition is being used in our day to day lives from unlocking our mobile devices to tagging our friends in a Facebook posts. While it was first observed in the sci-fi staples such as the Star Trek, facial recognition has gained enough recognition in the field of Artificial Intelligence and is being worked on to providing an authentic and accurate result. This result document illustrates the research and steps taken to understand the Olivetti Faces dataset to undertake facial recognition. This challenge was taken by hand to comprehend the "Prediction" phase of the AI methodology.

Project Background

This document contains the implementation of Support Vector Machine (SVM) classifier which is a supervised machine learning algorithm to recognize faces and if an individual is wearing glasses or not. In addition, we have also used cross validation method to better understand our formed model's performance and its various parameters.

Problem Methodology

Algorithm Used

The dataset used is the Olivetti Faces dataset from the scikit-learn library in Python. The use of Support Vector Machine (SVM) which is also known as the discriminative classifier has been done to test, train and predict the accuracy of classifying images of people wearing glasses or not. The main goal of the algorithm is to choose the hyperplane which provides the maximum margin between support vectors in a given dataset.

SVM offers very high accuracy compared to other classifiers such as logistic regression, and decision trees. It is known for its kernel trick to handle nonlinear input spaces. It is used in a variety of applications such as face detection, intrusion detection, classification of emails, news articles and web pages, classification of genes, and handwriting recognition.

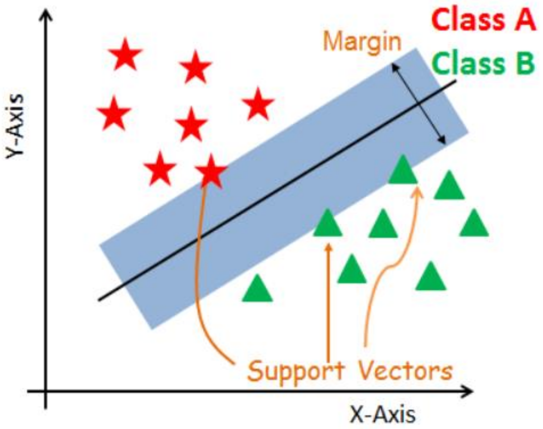


Figure 01: Support Vector Machine Model

Support Vectors Machine Kernels

The SVM algorithm is implemented in practice using a kernel. A kernel transforms an input data space into the required form. In our model, we have first calculated the different accuracy score of various kernels, Linear, Polynomial, RBF and Sigmoid out of which Linear resulted in the highest accuracy score.

Cross Validation

Cross-validation is a technique that avoids a particular train-test split and produces a more realistic overall model score. The advantages of using this technique are that it's a more efficient indication of model's accuracy on unseen data and more effective use of data, since every sample will be used for training and testing. In our model, we have used the Kfold, LeaveOneOut and StratifiedKFold cross validation techniques.

Project Results

Exploratory Data Analysis

After importing the dataset in our Jupyter notebook, we started our exploratory data analysis which included looking at the first 20 images in the dataset. The results are shown below with the ID indicating the unique number of each instance. Additionally, we investigated our dataset more to look at the 40 different individuals present. These images are our training

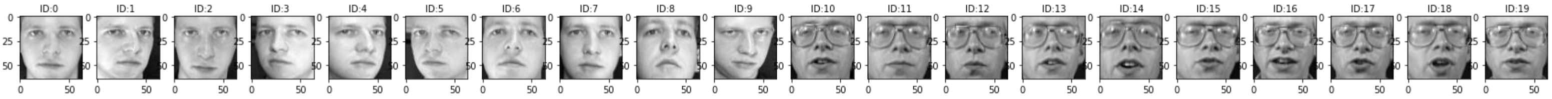


Figure 03: First 20 images in our dataset

Figure 04: 40 individuals in our dataset

Analysis with SVM

For implementing SVM on our model, we first compared the different kernel scores on our model which can be seen in Fig. 05. From our results, we can see that linear kernel achieved the highest accuracy score with 96% with polynomial giving the second highest, 95%. Therefore, we chose linear kernel to conduct our further analysis.

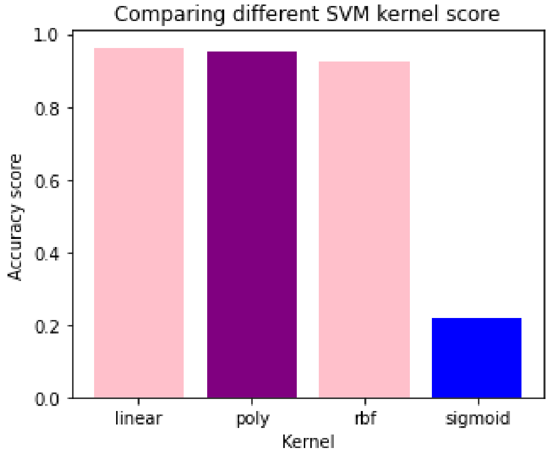


Figure 05: Comparing SVM Kernel Score

Training the model on SVM gave us an accuracy score of 97.5% which is a very strong value and to test it, we constructed our heatmap to see the number of misclassified images from our model.

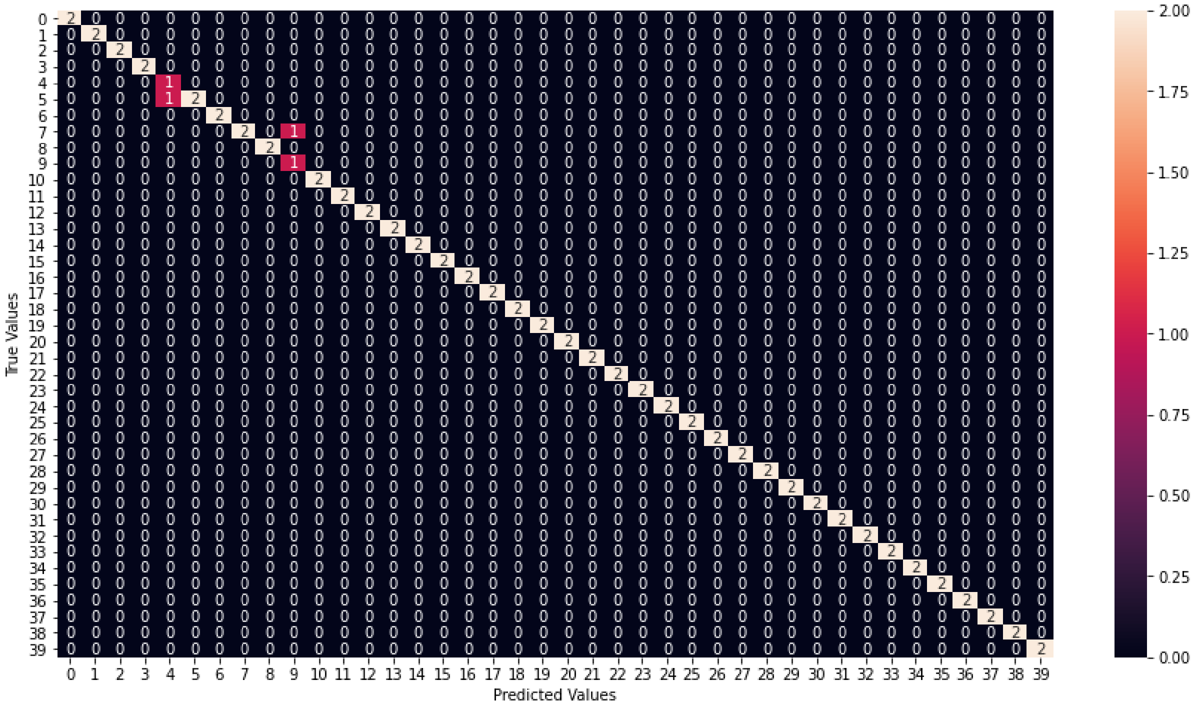


Figure 06: Heatmap of our confusion matrix

From our confusion matrix, we can see our model misclassified only 2 images mainly image 9 and 4.

Cross Validation Techniques

We used Kfold, StratifiedKFold and LeaveOneOut techniques on our model and their respective accuracy scores are mentioned in the table below:

By applying different cross validation techniques, we can see that StratifiedKFold produced the highest accuracy with approximately 96 % indicating that the data points in

Cross Validation Technique	Accuracy Score
Kfold	~ 94%
StratifiedKFold	~ 96%
LeaveOneOut	~ 69%

Figure 07: CV Accuracy Scores

Achieving an accuracy score of 1.0 on training set and 0.975 on testing helps in confirming that SVM is a powerful algorithm. As from our heatmap, only 2 images were misclassified, therefore it could lead to the issue of overfitting but while using cross validation techniques, we can reduce that issue.

Classifying Individuals wearing glasses

We started by plotting the support vector plot on our target values of individuals wearing (1, orange points) and not wearing glasses(0, blue points) with the dataset's initial data column with the highest margin which can seen as follows:

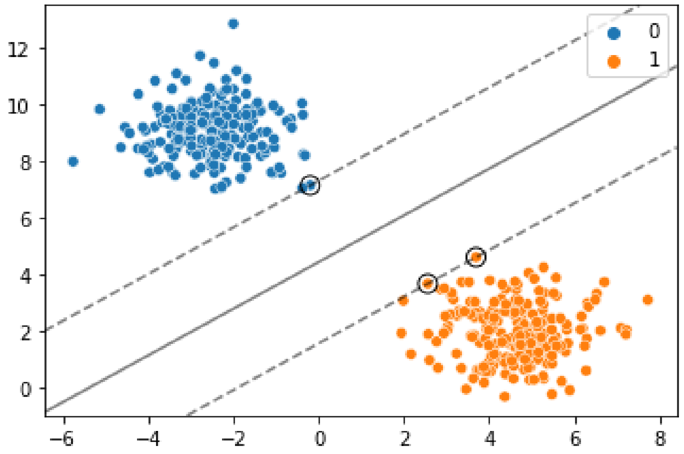


Figure 08: SVM Scatterplot

We were provided with an array with contained all the indices of the people wearing glasses and we formed separate training and testing set with implying our linear SVC classifier. After splitting the data into 80% training and 20% testing, we achieved a score of 97.5%. Furthermore, we formed a confusion matrix to understand which images were misclassified as not wearing glasses as mentioned below. We can agree with the fact that 59 images were correctly classified as not wearing glasses while 19 images were correctly classified as wearing glasses but 2 were misclassified out of 21 images wearing glasses in total.

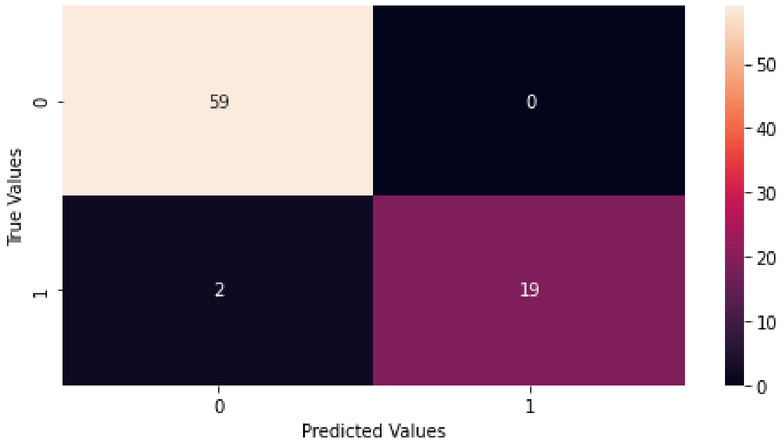
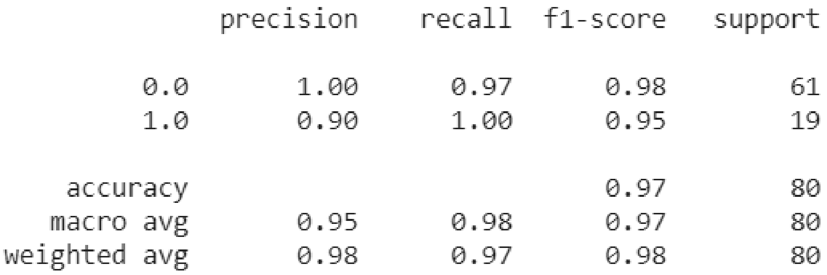


Figure 09: Confusion Matrix of wearing glasses

Moreover, the classification report was also formed which shows the precision, recall and the f-1 score of our two target variables 0 indicating person not wearing glasses and 1 indicating person with glasses. While f-1 score being higher for class 0, we can determine that the model performed slightly better for this class.



```
              precision    recall  f1-score   support

         0.0       1.00      0.97      0.98        61
         1.0       0.90      1.00      0.95        19

    accuracy                           0.97        80
   macro avg       0.95      0.98      0.97        80
weighted avg       0.98      0.97      0.98        80
```

Figure 10: Classification Report of wearing glasses

To test if the StratifiedKFold will perform better on this sample as well, we implemented it. As from our results we can see that the model gave an accuracy of 97.5% with the train test split while with StratifiedKFold, it was 97.8% which when compared don't have a high difference but it helps in understanding the cv method.

Classifying glassed from one individual

We chose indexed 30 to 39 for testing and training the model on 390 instances. Where we got the confusion matrix illustrating misclassifying one image out off 10 wrongly.

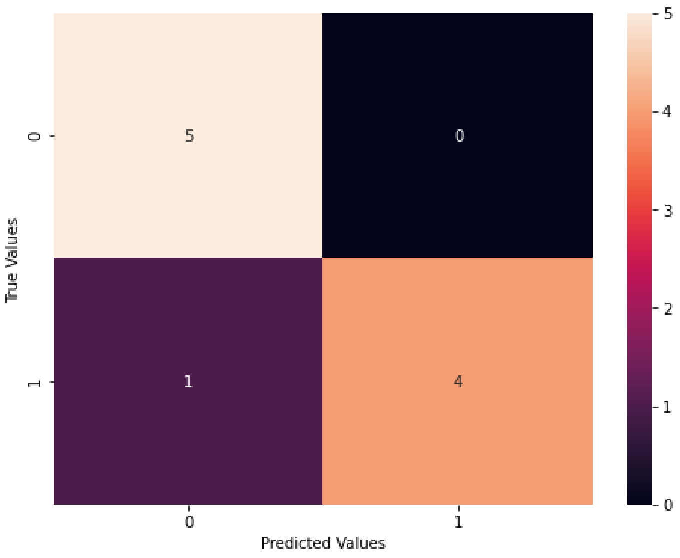


Figure 11: Confusion Matrix of 10 people

Furtherly, visualizing those 10 images for one person, as we can see when counting from 0, we can see the image 8 has been classified as not wearing glasses (0) while it has actually wearing glasses (1).

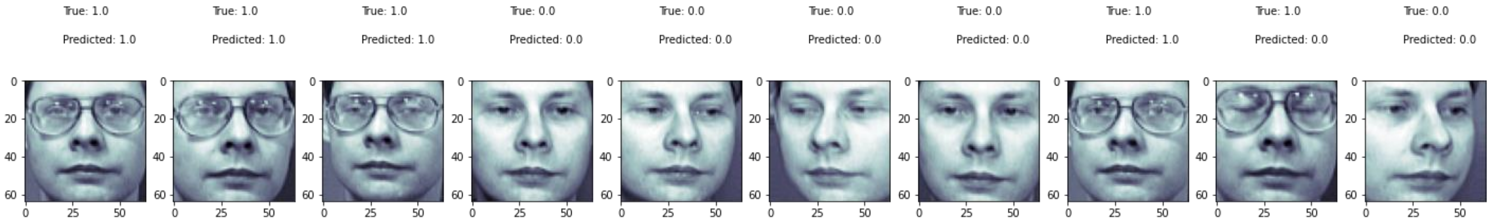


Figure 12: Working of SVM on predicting 10 images

Conclusions

From our analysis done in the Jupyter notebook, we can summarize while keeping in mind the model's accuracy of 97.5% that support vector machine algorithm is a powerful algorithm which with the help of its kernel functionality produces high accuracy rates. It gave an outcome of misclassifying only 1 image from the total 10 images of an individual when it was trained on all the remaining instances in the dataset proves the power of our machine learning model.