Fashion MNIST Image Classification

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Abstract

The E-commerce industry is in a bloom and customers look for more easier and convenient ways to shop. Every day the virtual shopping experience strives to improvise and suit the user demands. In this project I have presented a feature using machine learning for the easy classification and search on items that one may specifically want or buy. This project uses machine learning algorithm with the Fashion MNIST data set to classify and help customers find items, an outfit they are wishing to buy or help searching similar clothing items. The model uses multiclass SVM to train the images and attain a classification accuracy.

1 Introduction

The fashion industry is on a rise and E-commerce has made it easy for one to get their hands on trendy clothing. The online fashion market is blooming, and companies search for ways to improve sales and satisfy customer needs. Technological approach to this problem that may help the consumer shall be of great benefit. The idea is to classify clothing to help consumers look for exactly what they wish for. One of the most popular applications in computer vision is object recognition which aims to extract features from an image and classify it into classes using classification techniques. The machine learning classification I have presented in this report is Support Vector Machine.

1.1 Related works

There have been various studies on the fashion MNIST Data particularly with CNN models. As it is a multi-class, image classification it poses as an ideal to test CNN models. Therefore, here I have proposed to run the model with supervised learning model which is SVM, deploying machine learning in a computer vision classification.

1.2 Results

On implementing the project, the classifier gives an outcome of more than 90% . Mostly all the fashion items are appropriately recognized and classified into one of the 10 classes. The SVM model works best to give the result upon hyper parameter tuning.

2 Problem Description

The problem addressed with this project is categorizing clothing items given by the user to help them look for the one they want to buy. With image classification, a total of 10 classes of clothing and footwear are recognized. A customer can input their outfit or shoes image to be processed; on processing the request and the customer is suggested similar clothing pieces as they wished for, which therefore eases the virtual shopping experience and also helps customers classify different items.

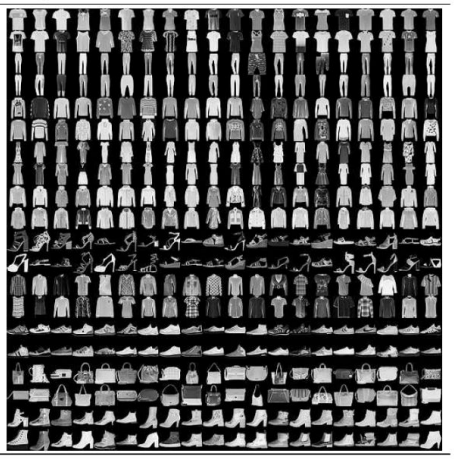
Label	Description	Examples
0	T-Shirt/Top	
1	Trouser	
2	Pullover	
3	Dress	
4	Coat	
5	Sandals	
6	Shirt	
7	Sneaker	
8	Bag	
9	Ankle boots	

Figure 1: Data and its classes

Here for classification multi-class Support Vector Machine is used, a machine learning method that is known to be efficient in classification. The Fashion MNIST dataset developed by Zalando Research as an innovation to the MNIST dataset which was built for digit classification, has about 70,000 apparel items including shirts, pants and shoes. The classes for the Fashion MNIST dataset are as given above.

3 Methodology

3.1 Pre-processing Data

Data normalization is necessary before analyzing the data set. This basically converts the data range which is from 0 to 255 which is used to indicate the pixel intensity of the images to 0 and 1, and then removing the mean from all the data. This is done to decrease noise from the images so that evaluating results is more efficient and misclassification is reduced. While analyzing the data it is also noticed that all the 10 classes in the data set are equally distributed, i.e, the data is well balanced.

3.2 Model Training

Support vector machine is a machine learning algorithm which gives a significant accuracy with less computational power. SVM is highly preferred in pattern recognition methods, showing a good performance in such applications. Also since this is a multi-class problem, an accurate finding is preferred Therefore, I have opted to classify the fashion MNIST data with the use of SVM. The *rbf* kernel is utilized in the classification technique as the radial basis function performs linear manipulations to map points in high dimension spaces that can easily be separated and that works well in our model here.

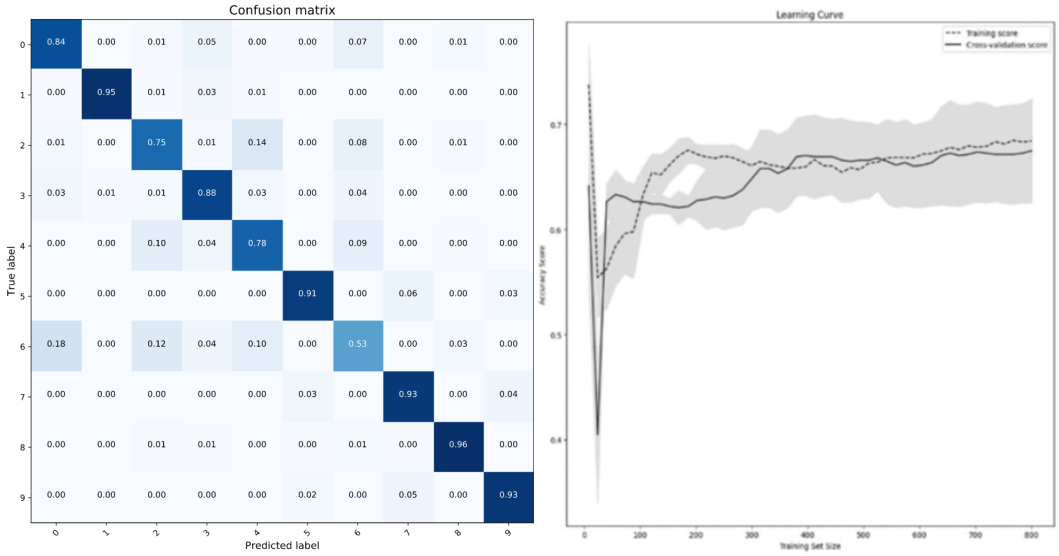
4 Experiment

4.1 Confusion Matrix Learning Curves

As it is a multi-class problem , the accuracy is checked as well as the confusion matrix to see where the model has erroneous predictions.

The resulting confusion matrix shows that classification is misleading for class 6. It predicts the class 6 as class 0, 2 or 4. On the other hand, it performs very well for class 1, 3, 5, 7 and 9 with very small deviations to different classes.

The model accuracy of our SVM algorithm on the training set gives an output of 0.8461 or 84.6



(a) SVM Confusion matrix.

(b) Learning curve

The learning curve depicts that the model is slightly overfitting near the start and does better as we go on.

4.2 Decision Boundaries

Visualizing a decision boundary allows us to present the nature of the classifier. A grid is created with all the data points and on predicting these data points with the trained SVM model, a 2D decision model is projected.

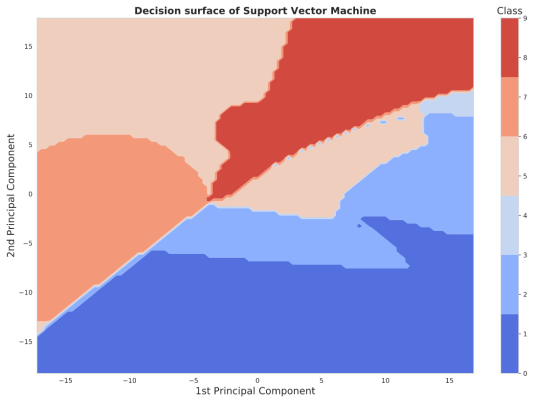


Figure 3: Decision Boundary for SVM

This plotting does not have well defined boundaries and has a few points mixing into the other which shows that some classes are combined into others. Also the boundaries are not linear.

4.3 Hyper Parameter Tuning

Given large data, all data cannot be used to tune hyperparameters; thus, we decide how many data to use. It seems that the accuracy start to saturate around 15000 when 2 splits, so we will only use 14000 data with 2 splits to search parameters. I also fix gamma='scale' because gamma='auto' consistently gave bad accuracies. In this way, the process is sped up.

With SVM, it is less likely that parameters differ with amount of data into this given that its parameter range is narrower and kernel function and C is not affected by amount of data after some points.

Here kernel='rbf' and C='10' produces the smallest log loss. I further narrowed down the value of C.Hence using C=8 as the parameter to train our SVM.

Finally upon training our classifier with inducing hyperparameter tuning and reporting the test accuracy on the train and test data sets, the following accuracies are obtained:

Validation acc for each fold: [0.90065 0.89965 0.8979]

Mean acc: 0.8994

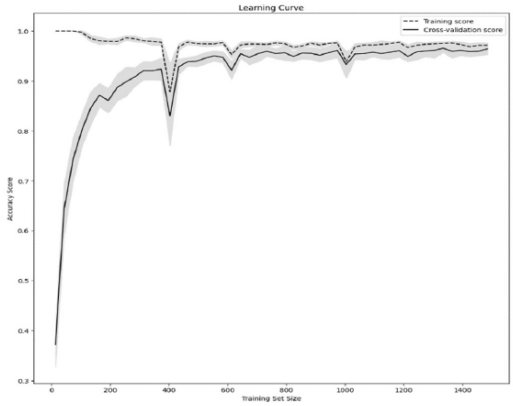


Figure 4: Learning curve after Hyper Parameter Tuning

These clearly indicate that the model performance has improved with the use of an optimal C value.

5 Conclusion

This report shares insights on the classification of fashion items with machine learning. Using the Fashion MNIST data with the SVM classifier, the apparel images are trained and tested to classify any clothing image that shall be inputted to the system. With a high accuracy obtained after tuning the model, with the best paramters, the created model results in about 90% accuracy in classifying the apparel into one of the 10 classes. It can be concluded from this that the machine learning model is of good use to help users find the fashion items they are looking for and get suggestion on similar pieces.

References

[1]https://www.kaggle.com/datasets/zalando-research/fashionmnist

[2] Greeshma, K.V. & Sreekumar, K. (2019) Fashion-MNIST classification based on HOG feature descriptor using SVM*International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-5 March, 2019 System.*

[3] Xiao, H., Rasul, K., Vollgraf, R. (2017). Fashion-mnist: a novel image dataset for benchmarking machine learning algorithms. arXiv preprint arXiv:1708.07747.