Final Report for Machine Learning Project

Izmir Democracy University

Engineering Faculty

Department of Electrical and Electronics Engineering

Project Name:

Multilabel Feature Recommendation Model (Feature Extraction Model)

Group Members:

- ➔ Arjen GÖKDEMİR-2006102031
- ➔ Azad AVŞAR-2006102036
- ➔ Mehmet Umut ASLAN-2106102013

Data Source:

https://www.kaggle.com/datasets/paramaggarwal/fashion-product-images-small

- ➔ **Images** = 44.4k
- ➔ **Styles** = A csv file that contains the labels of images.

Blog Posts:

https://mlp.lptn.name.tr/

Github:

https://github.com/azad35avsar/Fashion-Recommendation-Model

1. Preface

Fashion feature extraction models can be used to extract meaningful information from clothes and accessories. This information can be used to create new designs, improve existing designs and predict fashion trends.

In this report, we present the results of a machine learning project to develop a fashion feature extraction model. The aim of the project was to develop a model to extract features such as color and style from clothes and accessories. The model was trained on a clothing dataset and tested at different parameter settings.

The rest of the report is organized to cover the purpose of the project, literature review, dataset and preprocessing, model design and training, experiments and results, and recommendations.

2. Introduction

2.1 Purpose of This Project:

This project aims to develop a machine learning model to analyze clothes and extract features from clothes. The model will be trained on a CSV dataset containing clothing images and associated labels. These labels will include detailed features for each image, such as color, shape, and even type of clothing. The model will learn to correctly identify and extract these features.

At the end of this learning, our goal is to ensure that the model we have trained can correctly infer the features of the columns of the photographs we have chosen. For example, in response to a blue t-shirt, we expect our model to respond Blue and T-shirt.

It should be noted that our model will extract two features in total from the images. The type of these features will be selected by us in our data processing process and the model will learn accordingly.

Our project had two main focuses. Our first focus was on designing the feature extraction model that we are currently implementing. The second focus was to develop a model that makes recommendations based on these extracted features. However, at this point we have reached, we decided to realize the first focus of the project and present our project in this form.

3. Literature Review:

Our aim in this literature review section will be to read articles about previous studies on the subject we have determined and obtain various information from these articles. This process will both give us experience in the field of reading articles and gain different perspectives by experiencing different initiatives related to our project topic.

3.1 Related Work:

- **Fashion Recommendation Systems: Models and Methods by Zhang et al. (2020**): This paper sheds light on various recommendation systems for fashion, highlighting the importance of features like color, style, and brand preferences. (https://www.researchgate.net/publication/353485380_Fashion_Recommendation_Systems_Models_and_Methods_A_Review)

- **Fashion Recommendation System Using CNN by Xu et al. (2021)**: This research explores the use of Convolutional Neural Networks (CNNs) for extracting features from fashion images, demonstrating their effectiveness in classifying garments and accessories.(https://www.researchgate.net/publication/360087895_Fashion_recommendation_system_using_CNN)

- **An Introduction to Convolutional Neural Networks by Brownlee (2022)**: This resource provides a comprehensive overview of CNNs, explaining their architecture and how they excel at image classification tasks, making them ideal for analyzing fashion images. (https://towardsdatascience.com/an-introduction-to-convolutional-neural-networks-eb0b60b58fd7)

It should be noted that these related works focus more on a fashion recommendation model. Although we carried out a literature review by examining these articles, the part we realized in our project was the fashion feature extraction model, which is the first part of our project goal.

4. Dataset and Preprocessing:

The dataset used in this project consists of a CSV file containing clothing images and their relevant tags. The dataset was used via Kaggle and consists of approximately 44,400 labeled clothing images.

4.1 The dataset contains the following labels:

(Gender,masterCategory,subCategory,articleType,baseColour,season,year,usage,productDisplayName)

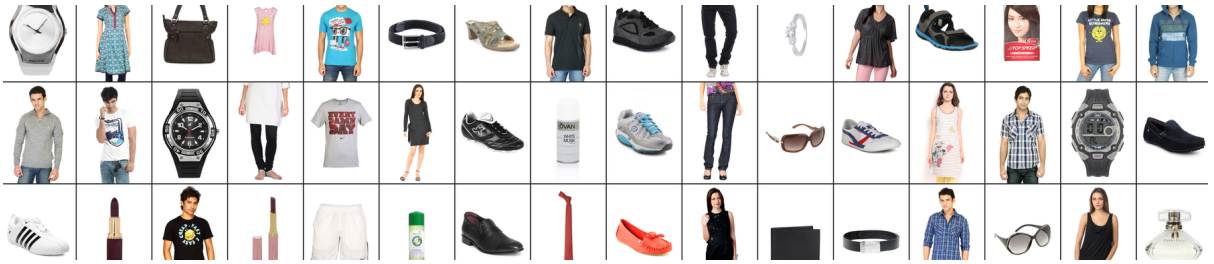
	id	gender	masterCategory	subCategory	articleType	baseColour	season	year	usage	productDisplayName
0	15970	Men	Apparel	Topwear	Shirts	Navy Blue	Fall	2011.0	Casual	Turtle Check Men Navy Blue Shirt
1	39386	Men	Apparel	Bottomwear	Jeans	Blue	Summer	2012.0	Casual	Peter England Men Party Blue Jeans
2	59263	Women	Accessories	Watches	Watches	Silver	Winter	2016.0	Casual	Titan Women Silver Watch
3	21379	Men	Apparel	Bottomwear	Track Pants	Black	Fall	2011.0	Casual	Manchester United Men Solid Black Track Pants
4	53759	Men	Apparel	Topwear	Tshirts	Grey	Summer	2012.0	Casual	Puma Men Grey T-shirt

We stated that we would use two columns in our project definition, so we used the **“articleType”** and **“baseColour”** columns in this model.

articleType: Column that contains types of clothes
baseColour: Column that contains colors of clothes

articleType	baseColour
Shirts	Navy Blue
Jeans	Blue
Watches	Silver
Track Pants	Black
Tshirts	Grey

4.2 Examples of Images

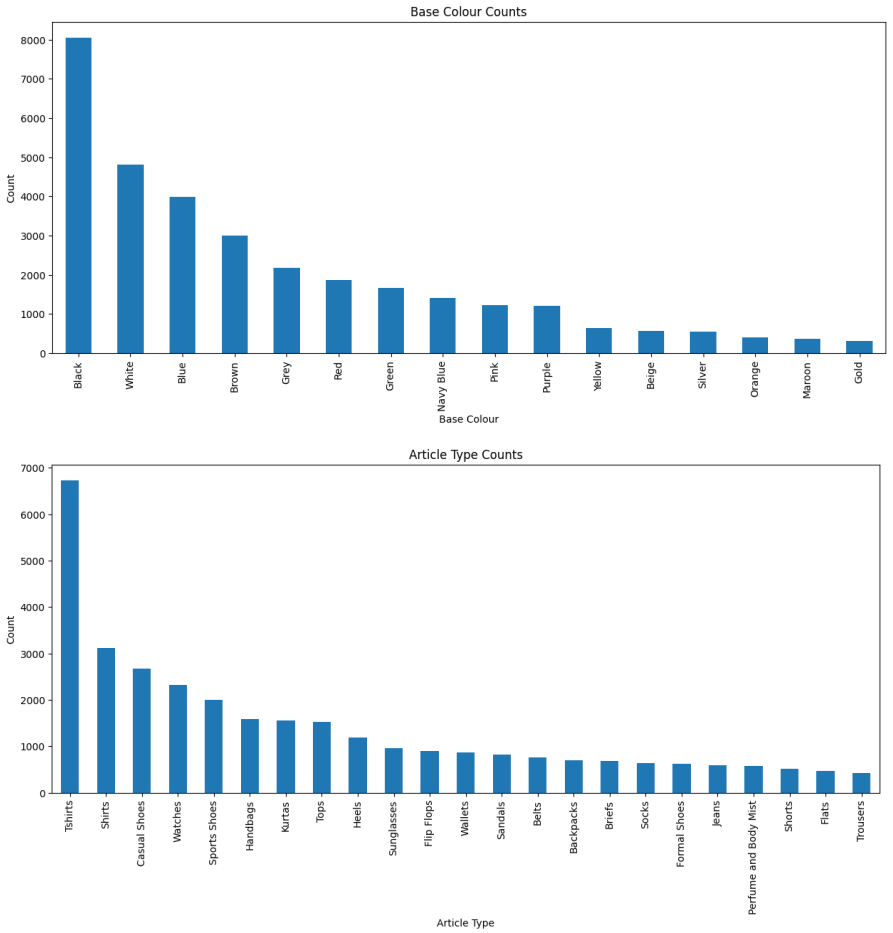


4.2.1 Preprocessing:

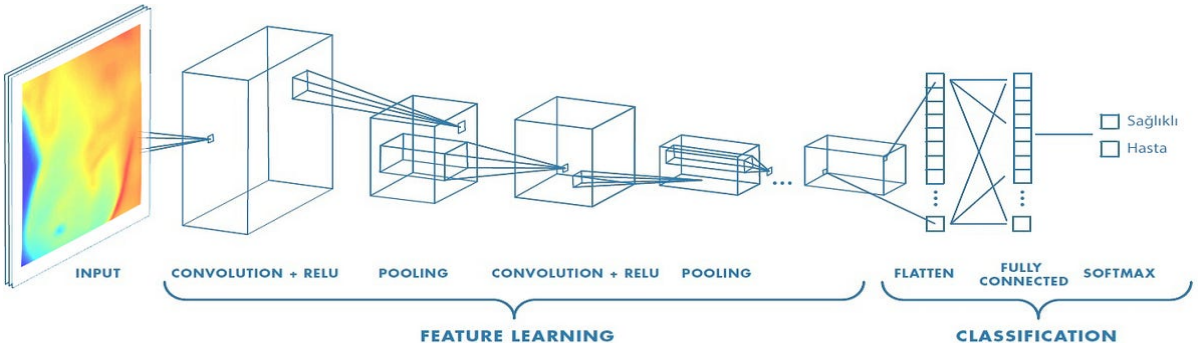
Our aim during the pre-processing process was to make the data as clean as possible and prepare it in the most appropriate way for the model's learning process. The following methods were followed in this process, and sample images after the pre-processing and cleaning process are given below.

- Reading the dataset into a variable.
- Deleting rows containing min values.
- Selecting a certain threshold value (we chose 500) according to the two columns we have chosen (articleType, baseColour) and extracting the parts of the data that are higher than this value.

4.2.2 Preprocessed Columns:



5. CNN, CNN Model Selection



- **Convolutional Layer** — Used to detect features
- **Pooling Layer** — Reduces the number of weights and checks compliance
- **Flattening Layer** — Prepares data for Classic Neural Network
- **Fully-Connected Layer** — Standard Neural Network used in classification

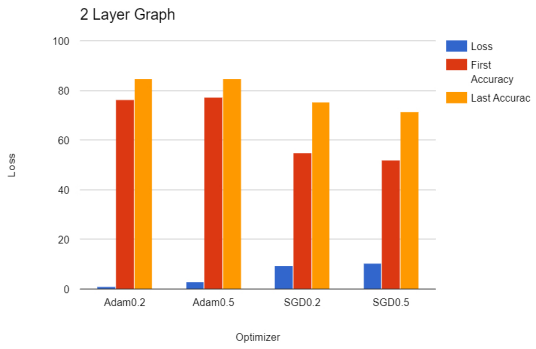
In this machine learning model we developed, we had to use the CNN model because we would design a learning model through images. In the process of determining the structure of this model, we carried out success tests on different models, adhering to a certain rule.

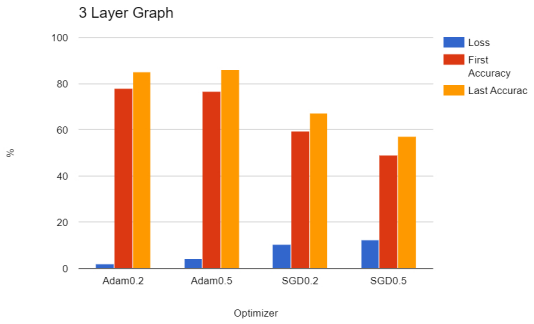
According to the rule we adhered to, we first created CNN models with 2, 3 and 4 layers, and then tried different dropout and optimizer values for each layer.

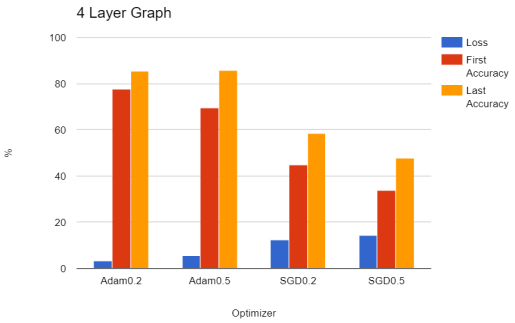
- Dropout: It is a technique of disabling randomly selected neurons with a certain probability while training a neural network, which helps prevent overfitting of the network.

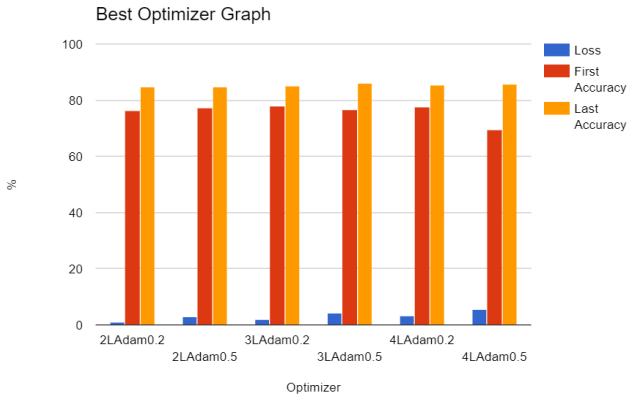
- Optimizer: It is an algorithm used during the training of a deep learning model and tries to minimize the training error by updating the weights.

Results obtained after testing for each different model:









According to these tests, as seen in the table, the CNN model on which our model worked most successfully was the **3-layer** model using the ‘’**adam**”optimizer with a **dropout** value of 0.5.

6. Success of Our Model

After deciding our model, which has the best success for the goal we are trying to achieve, the values obtained after the tests on this model:

Loss Value: 0.0431

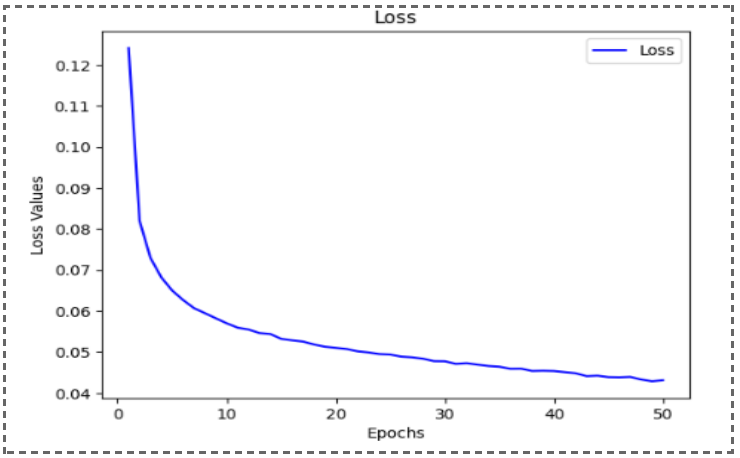
Accuracy: 85.4 %

Before Filtering

```
202/202 [==============================] - 1s 3ms/step
correct:  9923
missing/wrong:  2975
Accuracy:  0.7693440843541635
```

After Filtering

```
correct:  8258
missing/wrong:  1402
Accuracy:  0.8548654244306418
```



7. Additional:

During our presentation, we explained the filtering process we did and why we did this filtering process. However, after this presentation, we mentioned that we found the solution to this problem without the need for filtering.

7.1 Here is the description of the solution to the problem:

In the first version of our code, our model used a threshold value as a basis when generating predictions, returning predictions greater than 0.5 as 1, and predictions smaller than 0. After applying these values to the inverse transform, we got their written form. Meanwhile, sometimes we were getting only 1, sometimes 3 or more written predictions. (Normally, we need to get two predictions.) We solved this problem by completely removing the threshold value and defining the values to be returned as 1 as only the two highest values predicted by the model. In this way, there is no need for any filtering process.

8. Conclusion:

In this project, we successfully developed a multi-label feature extraction model for analyzing clothes and extracting two specific features: "articleType" and "baseColor".

Our model first managed to work with a success rate of 77% and 85%, and finally with a success rate of 81% without the need for a filtering process.

During the process of designing and writing the project, we gained some experiences that will be useful in our future lives. Processes such as being able to prepare a concrete project as a group, presenting the project we prepared, preparing reports and blogs about them, and also doing some literature studies were very useful for us, as engineer candidates.

9. References

- [1] **Zhang, S., Yao, J., & Xie, X. (2020). Fashion recommendation systems: Models and methods. ArXiv preprint arXiv:2006.00051.** (https://www.researchgate.net/publication/353485380_Fashion_Recommendation_Systems_Models_and_Methods_A_Review)
- [2] **Xu, S., Li, M., & He, X. (2021). Fashion Recommendation System Using CNN. International Journal of Electronics and Information Engineering, 14(1), 31-36.** (https://www.researchgate.net/publication/360087895_Fashion_recommendation_system_using_CNN)
- [3] **Brownlee, J. (2022, March 3). An Introduction to Convolutional Neural Networks. Towards Data Science.** (https://medium.com/analytics-vidhya/your-handbook-to-convolutional-neural-networks-628782b68f7e)
- [4] **MLP Araştırma Laboratuvarı. (2023, Nisan 25). Fashion Feature Extraction Model.** (https://goodboychan.github.io/python/deep_learning/tensorflow-keras/2020/09/21/01-Image-Classification-with-Fashion-MNIST.html)
- [5] **Kaggle Dataset: Fashion Product Images (Small).** (https://www.kaggle.com/datasets/paramaggarwal/fashion-product-images-dataset)
- [6] **What is Convolutional Neural Network (ConvNet or CNN) and how does it work?** **(**https://medium.com/@tuncerergin/convolutional-neural-network-convnet-yada-cnn-nedir-nasil-calisir-97a0f5d34cad)
- [7] **What is CNN (Convolutional Neural Networks)?** **(**https://bartubozkurt35.medium.com/cnn-convolutional-neural-networks-nedir-a5bafc4a82a1)