Deep Learning Project 1
MLPs and CNN for Image Classification

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The code can be found here: https://github.com/d-tchmnt/Deep-Learning

1 Introduction

Given an image of a fashion item, build a deep learning model that recognizes the fashion item. You must use at least 2 different architectures, one with MLPs and one with CNNs. Use the Fashion-MNIST dataset to train and evaluate your models. More information about the task and the dataset can be found at https://github.com/zalandoresearch/fashion-mnist. The dataset is also available from Tensorflow and Keras.

2 Data Manipulation

2.1 Dataset

The dataset, after retrieving it from Keras, contains 60,000 28×28 grayscale images of images associated with a label from 10 fashion categories, along with a test set of 10,000 images. Each Label corresponds to the integer of the class to which the item belongs.

2.2 Data split

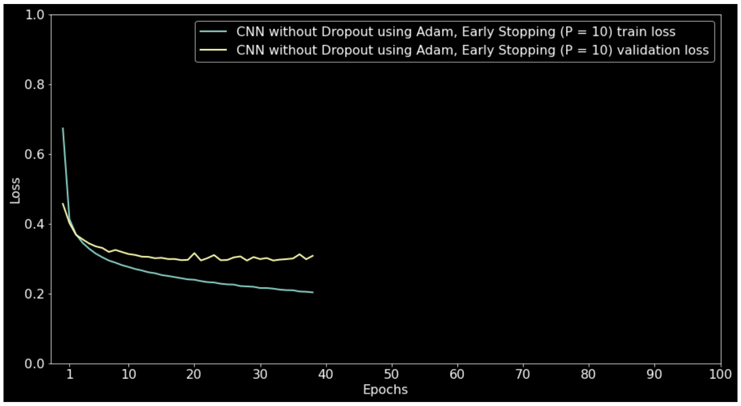
We use the **train_test_split** the dataset into train, and dev train while retrieving the test dataset directly from the keras embedding dataset. We used the **stratified** option, while also making sure **shuffle** is enabled. This way, we shuffle the data before we split them (useful in case data are pre-arranged or sorted) while making sure that the generated subsets of data contain classes with the distribution.

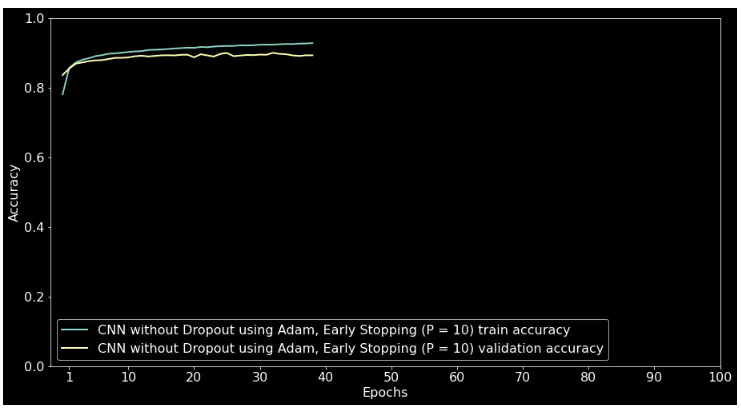
Then we normalize the input pixel values, by dividing each input by 255 (the number of pixels per image) so that every image has embedded range from 0 to 1. This is useful for making faster calculations since Neural networks process inputs using small weight values, and inputs with large integer values can disrupt or slow down the learning process. As such it is good practice to normalize the pixel values so that each pixel value has a value between 0 and 1.

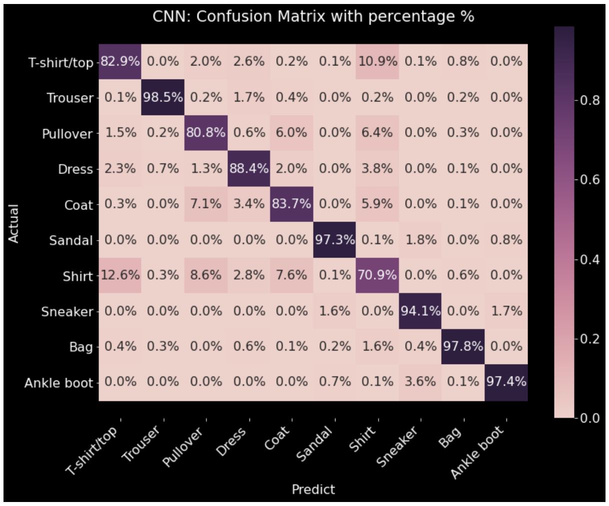
2.3 Data Exploratory Analysis

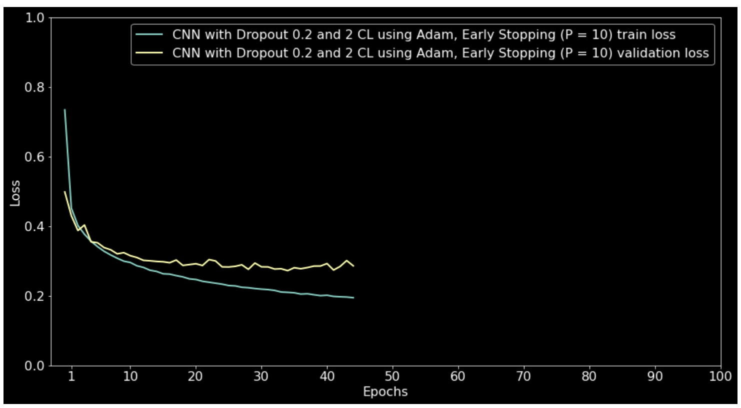
3 MLP Classifier

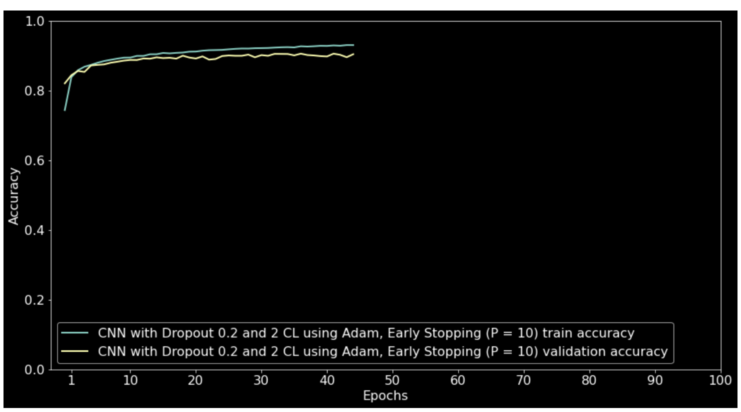
4 CNN Classifier

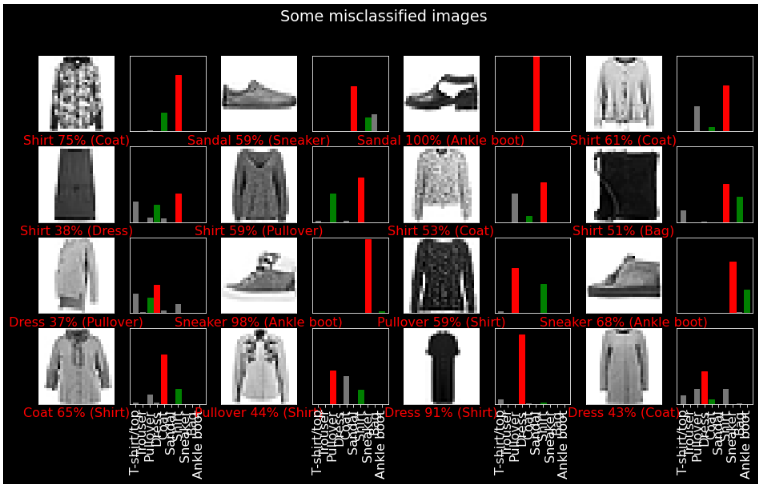


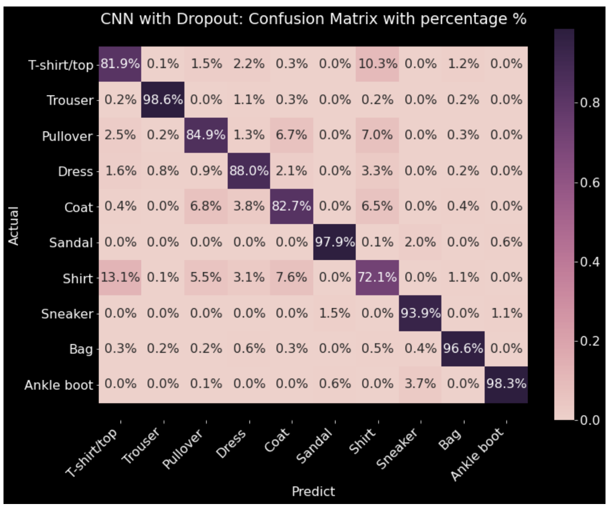



CNN: Confusion Matrix with percentage %
Actual
Predict
T-shirt/top 82.9% 0.0% 2.0% 2.6% 0.2% 0.1% 10.9% 0.1% 0.8% 0.0%
Trouser 0.1% 98.5% 0.2% 1.7% 0.4% 0.0% 0.2% 0.0% 0.2% 0.0%
Pullover 1.5% 0.2% 80.8% 0.6% 6.0% 0.0% 6.4% 0.0% 0.3% 0.0%
Dress 2.3% 0.7% 1.3% 88.4% 2.0% 0.0% 3.8% 0.0% 0.1% 0.0%
Coat 0.3% 0.0% 7.1% 3.4% 83.7% 0.0% 5.9% 0.0% 0.1% 0.0%
Sandal 0.0% 0.0% 0.0% 0.0% 0.0% 97.3% 0.1% 1.8% 0.0% 0.8%
Shirt 12.6% 0.3% 8.6% 2.8% 7.6% 0.1% 70.9% 0.0% 0.6% 0.0%
Sneaker 0.0% 0.0% 0.0% 0.0% 0.0% 1.6% 0.0% 94.1% 0.0% 1.7%
Bag 0.4% 0.3% 0.0% 0.6% 0.1% 0.2% 1.6% 0.4% 97.8% 0.0%
Ankle boot 0.0% 0.0% 0.0% 0.0% 0.0% 0.7% 0.1% 3.6% 0.1% 97.4%
T-shirt/top Trouser Pullover Dress Coat Sandal Shirt Sneaker Bag Ankle boot
0.0 0.2 0.4 0.6 0.8


CNN with Dropout 0.2 and 2 CL using Adam, Early Stopping (P = 10) train loss
CNN with Dropout 0.2 and 2 CL using Adam, Early Stopping (P = 10) validation loss
Loss
Epochs
0.0 0.2 0.4 0.6 0.8 1.0
1 10 20 30 40 50 60 70 80 90 100


CNN with Dropout 0.2 and 2 CL using Adam, Early Stopping (P = 10) train accuracy
CNN with Dropout 0.2 and 2 CL using Adam, Early Stopping (P = 10) validation accuracy
Accuracy
Epochs
0.0 0.2 0.4 0.6 0.8 1.0
1 10 20 30 40 50 60 70 80 90 100






```
Train Loss      : 0.24073
Validation Loss: 0.24195
Test Loss       : 0.24059
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Train Accuracy      : 0.91205
Validation Accuracy: 0.90745
Test Accuracy       : 0.91250
```
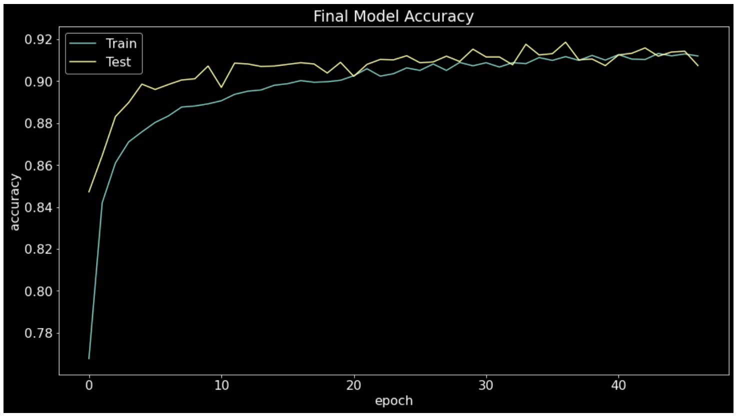
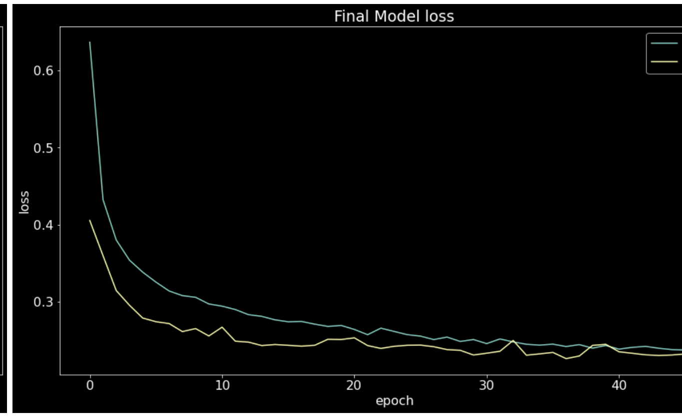
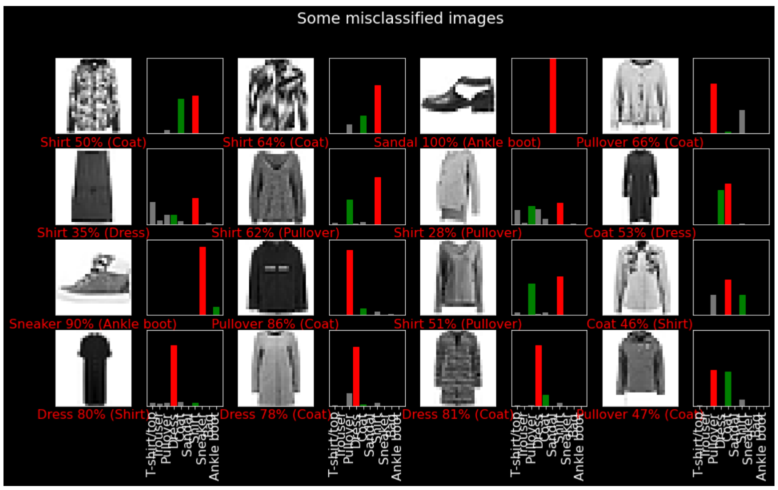
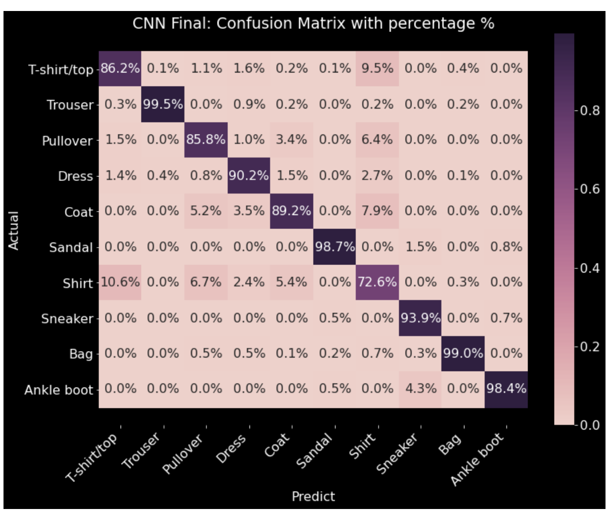


Final Model Accuracy
Train
Test
accuracy
epoch
0.92
0.90
0.88
0.86
0.84
0.82
0.80
0.78
0
10
20
30
40


Final Model loss
loss
epoch
0.6
0.5
0.4
0.3
0
10
20
30
40


Some misclassified images
Shirt 50% (Coat)
Shirt 64% (Coat)
Sandal 100% (Ankle boot)
Pullover 66% (Coat)
Shirt 35% (Dress)
Shirt 62% (Pullover)
Shirt 28% (Pullover)
Coat 53% (Dress)
Sneaker 90% (Ankle boot)
Pullover 86% (Coat)
Shirt 51% (Pullover)
Coat 46% (Shirt)
Dress 80% (Shirt)
Dress 78% (Coat)
Dress 81% (Coat)
Pullover 47% (Coat)
T-shirt/top
Trouser
Pullover
Dress
Coat
Sandal
Shirt
Sneaker
Bag
Ankle boot


CNN Final: Confusion Matrix with percentage %
Actual
Predict
T-shirt/top 86.2% 0.1% 1.1% 1.6% 0.2% 0.1% 9.5% 0.0% 0.4% 0.0%
Trouser 0.3% 99.5% 0.0% 0.9% 0.2% 0.0% 0.2% 0.0% 0.2% 0.0%
Pullover 1.5% 0.0% 85.8% 1.0% 3.4% 0.0% 6.4% 0.0% 0.0% 0.0%
Dress 1.4% 0.4% 0.8% 90.2% 1.5% 0.0% 2.7% 0.0% 0.1% 0.0%
Coat 0.0% 0.0% 5.2% 3.5% 89.2% 0.0% 7.9% 0.0% 0.0% 0.0%
Sandal 0.0% 0.0% 0.0% 0.0% 0.0% 98.7% 0.0% 1.5% 0.0% 0.8%
Shirt 10.6% 0.0% 6.7% 2.4% 5.4% 0.0% 72.6% 0.0% 0.3% 0.0%
Sneaker 0.0% 0.0% 0.0% 0.0% 0.0% 0.5% 0.0% 93.9% 0.0% 0.7%
Bag 0.0% 0.0% 0.5% 0.5% 0.1% 0.2% 0.7% 0.3% 99.0% 0.0%
Ankle boot 0.0% 0.0% 0.0% 0.0% 0.0% 0.5% 0.0% 4.3% 0.0% 98.4%
T-shirt/top
Trouser
Pullover
Dress
Coat
Sandal
Shirt
Sneaker
Bag
Ankle boot
0.8
0.6
0.4
0.2
0.0