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1/31/2018

Springboard Data Science Career Track

Capstone Project 1 – Data Wrangling

The basic data of my project is the fashion.mnist dataset from Kaggle. As an image dataset there is a limited about of data wrangling that can be done to improve the results. The main techniques for image improvement are Normalization and standardization. Normalization spreads the calibration of an image over the range of 0-1, so that the full range of values possible in the image is used. Standardization adjusts the images to fit the statistical model of a bell curve with a range of 0-1. That helps for these images because many of the images are heavily weighed to the low and high sides of the spectrum. Standardization pulls those low points up so they are more visible.

The effect of each technique is different depending on which classification model you are using. For example C-Support Vector Classification (SVC) and Logistic Regression classification models expect normalized images to run the most efficiently.

To get an Idea of how the different preprocessing steps would affect the results I also plotted histograms for each image with a bin size of 10. That showed that most of the images had points on their whole range, but that the low end of the range was more heavily weighted. All the images were normalized to a 0-255 range originally. The classifiers expect the values to be in a 0-1 range, so the normalization and standardization run on the raw data fit it to that range. Standardization should help as well because the images are heavily weighted to the 0 end of the range and it should help to distribute more evenly the low end. Using both techniques at once would mean that one overwrote the other, so comparing each to see which one is the most effective on a representative training set is the best way to see which should be used.

The photo with the maximal absolute difference caused by normalization is image approximately 0 which means the images were already normalized to a range of 0-255, but changing the range to 0-1 improves the classification results.

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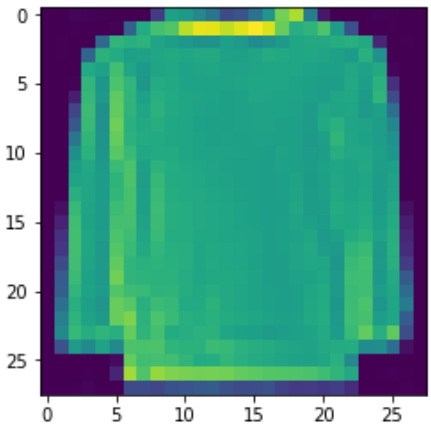
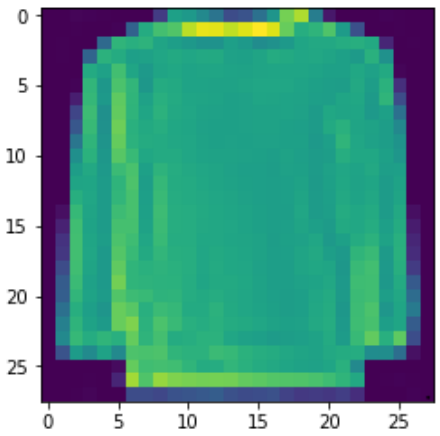


Original Image



Normalized Image

I tested Multi-layer Perceptron (MLP), SVC and Logistic regression to compare the rough results of the classification methods. MLP was the most efficient with Normalization as the image preprocessing. The size of hidden layers on the MLP

MLP (size of hidden layers 784-100-100):

- With no preprocessing(0-255) – 87.65% accuracy
- Normalized(0-1) – 90.37% accuracy
- Standardized(0-1) – 90.09% accuracy

SVC:

- With no preprocessing(0-255) – 70.67% accuracy
- Normalized(0-1) – 85.57% accuracy
- Standardized(0-1) – 81.87%

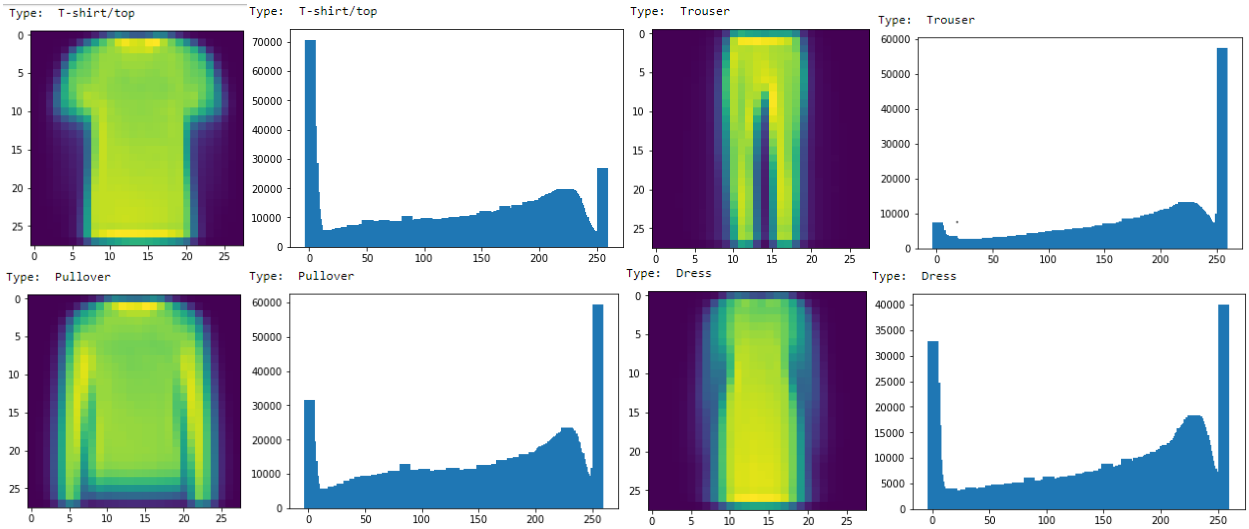
Logistic Regression:

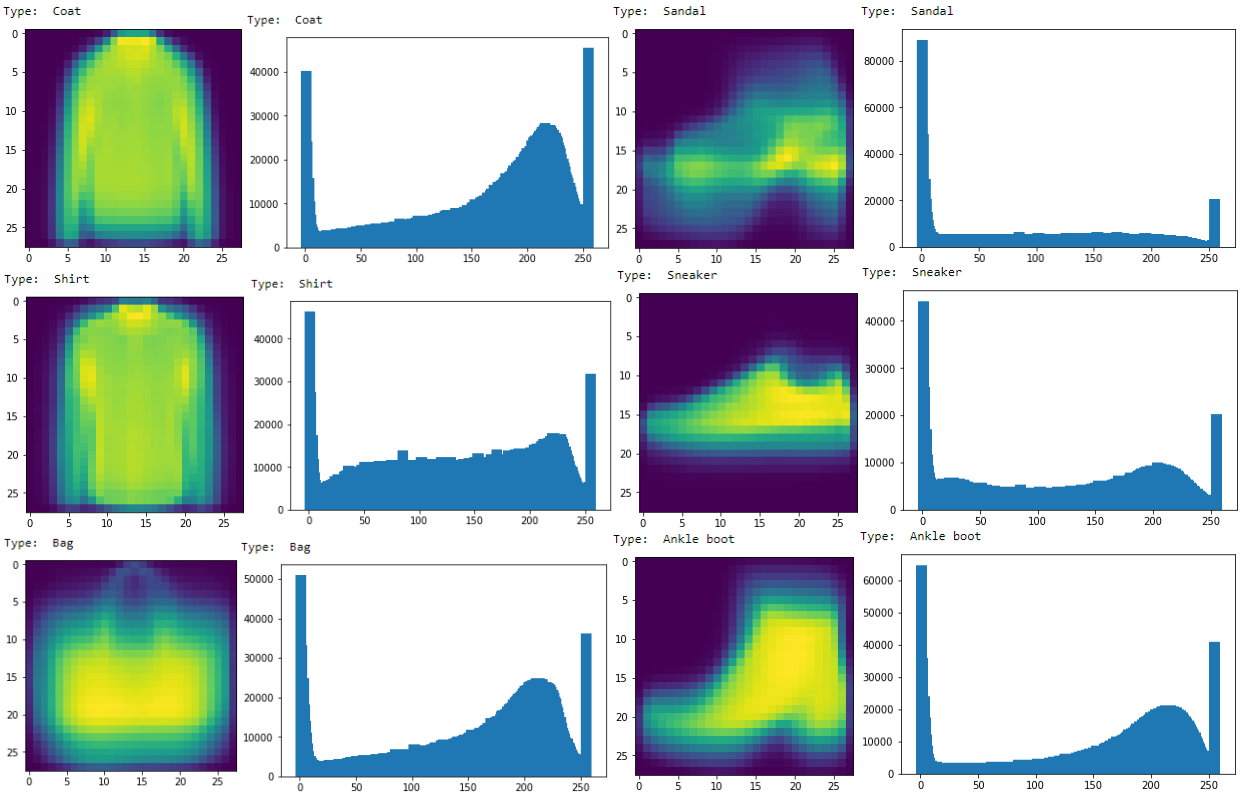
- With no preprocessing(0-255) – supposed to be normalized
- Normalized(0-1) – 84.45% accuracy
- Standardized(0-1) – 85.19% accuracy

CNN:

- Normalized(0-1) – 92.25% accuracy
- Standardized(0-1) – **92.32% accuracy**

From my tests I learned that Normalization and standardization to a range of 0-1 are roughly equivalent, and both improve the results. Given that Normalization to a range of 0-1 is the most effective I will plan to use that. Surprisingly the standardization of the logistic regression model is more effective despite sklearn stating that normalization it important for it (http://scikit-learn.org/stable/auto_examples/preprocessing/plot_scaling_importance.html). As a bonus it looks like MLP is the most effective of the classifiers and I will need to test that against CNNs for the final project. An example of all 10 classes of images are on the following pages, clearly shirt, t-shirt, and pullover categories are a lot more similar than some of the other classes. The Images are averages of all the images of each type, and are meant to be a representation of the types of images that will be feed into the model.




Type: Coat
Type: Coat
Type: Sandal
Type: Sandal
Type: Shirt
Type: Shirt
Type: Sneaker
Type: Sneaker
Type: Bag
Type: Bag
Type: Ankle boot
Type: Ankle boot