Image Classification with Tensorflow

Implementation and Comparison of Deep CNNs for MNIST

Otmane Sabir x Aadil Anil Kumar

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Introduction

01

Brief intro to image classification & (deep) learning

Image Classification

- Process of classifying an image based on visual content
- Began with the use of hand-engineered features
- Pushed forward by the advent of deep learning
- Supervised vs. Unsupervised

Neural Networks

Aims to mimic the functionality of the brain

Stems from the study of Artificial Neural Networks

Feedforward vs. Recurrent

Deep networks add more layers between the input and output layers

Universal Approximation & the Significance of Depth

NNs work to approximate a function

More layers reduce the chance of overfitting

More layers *can* be computationally cheaper

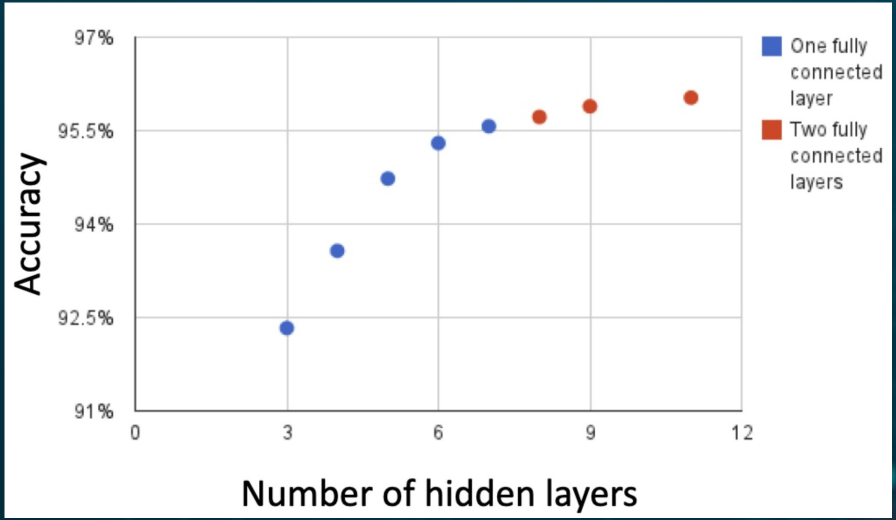
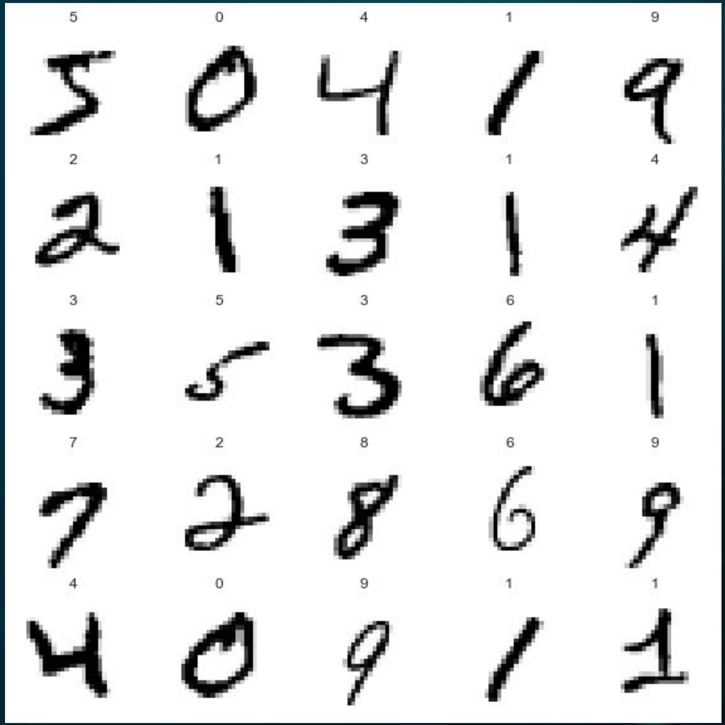


Figure extracted from Goodfellow's 2014 paper "Multi-digit Number Recognition from Street View Imagery using Deep Convolutional Neural Networks"

MNIST Dataset

Labelled Handwritten Digits,
0 - 9
60,000 Training
10,000 Testing
Grayscale, 28x28



Classification 02

Implementing NNs using tensorflow

Layers Used

Matrix vector multiplication

Dense

Introduces non-linearity

Feature dimensionality reducer

Flattening

2d matrix to vector, for input to NN

Sets random input units to 0

Dropout

Prevents overfitting

Extracts features from an image

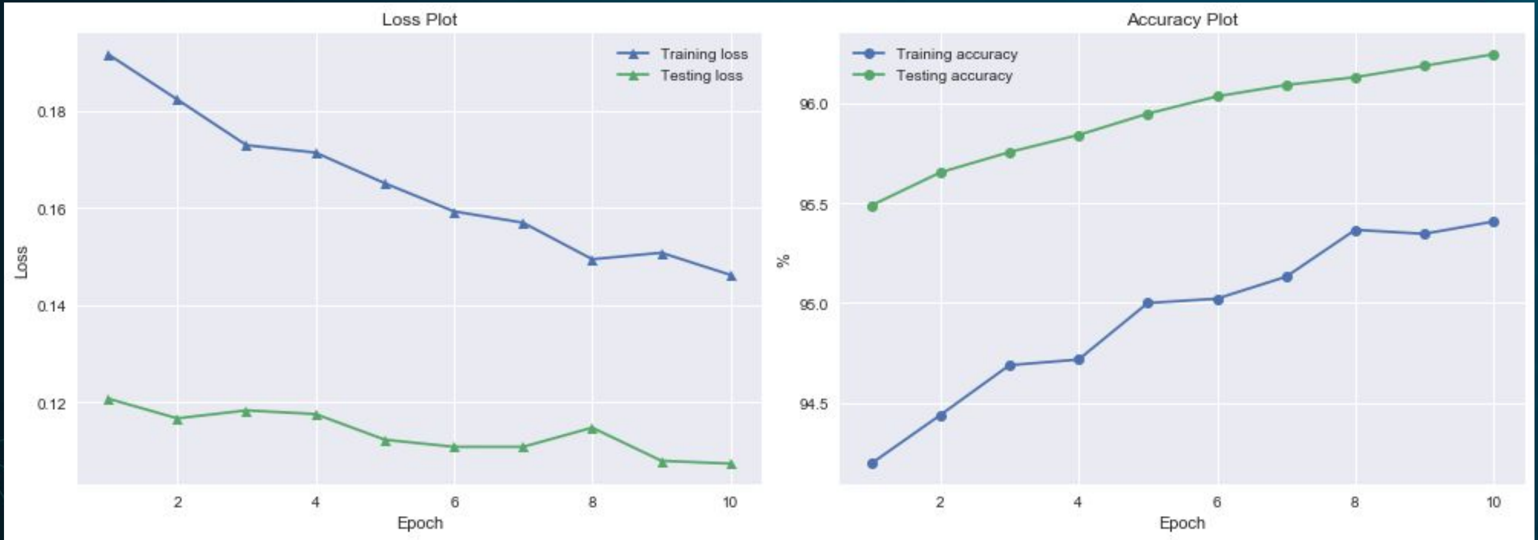
Convolutional

Blurring, sharpening, edge detection, etc...

Baseline - Model 1

- Flattening Layer
- Dense Layer 1   w/ RELU activation
- Dropout Layer 1 w/ 30% dropout rate
- Dense Layer 2   w/ RELU activation

Results - Model 1

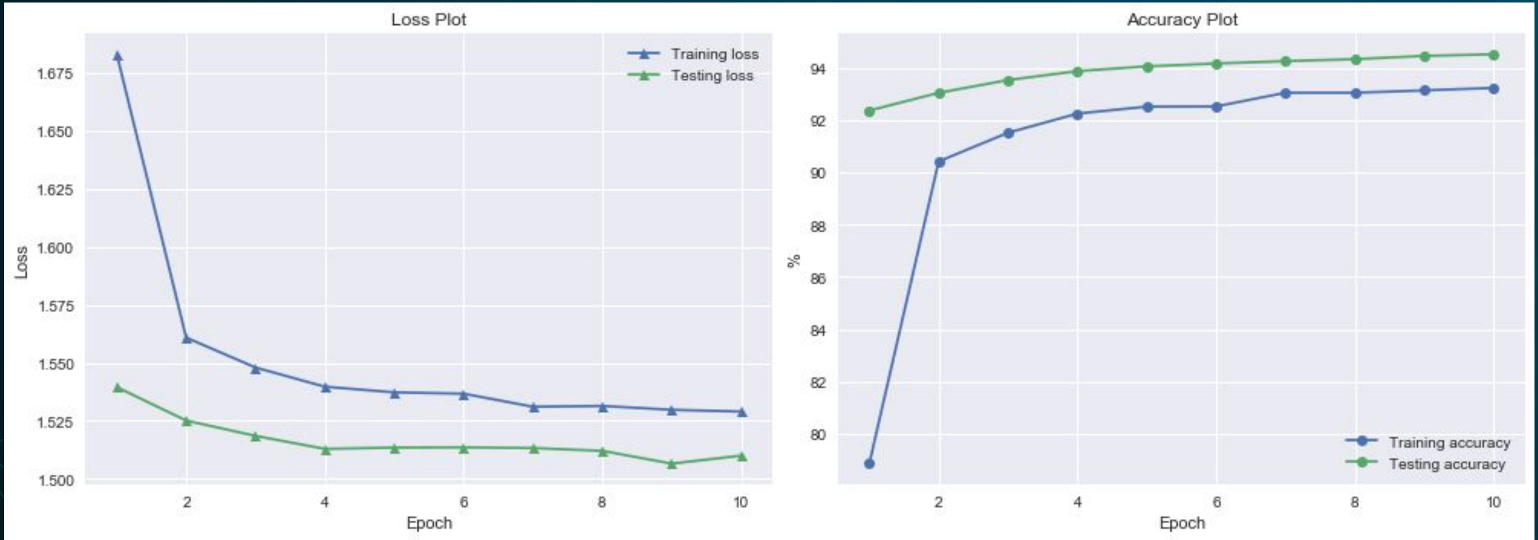


Train Accuracy: 95.4%
Test Accuracy: 96.2%
Trainable Parameters: 36,935

Adding Layers - Model 2

- Flattening Layer
- Dense Layer 1 w/ RELU activation
- Dropout Layer 1 w/ 30% dropout rate
- Dense Layer 2 w/ RELU activation
- Dense Layer 3 w/ RELU activation
- Dense Layer 4 w/ Softmax activation

Results - Model 2



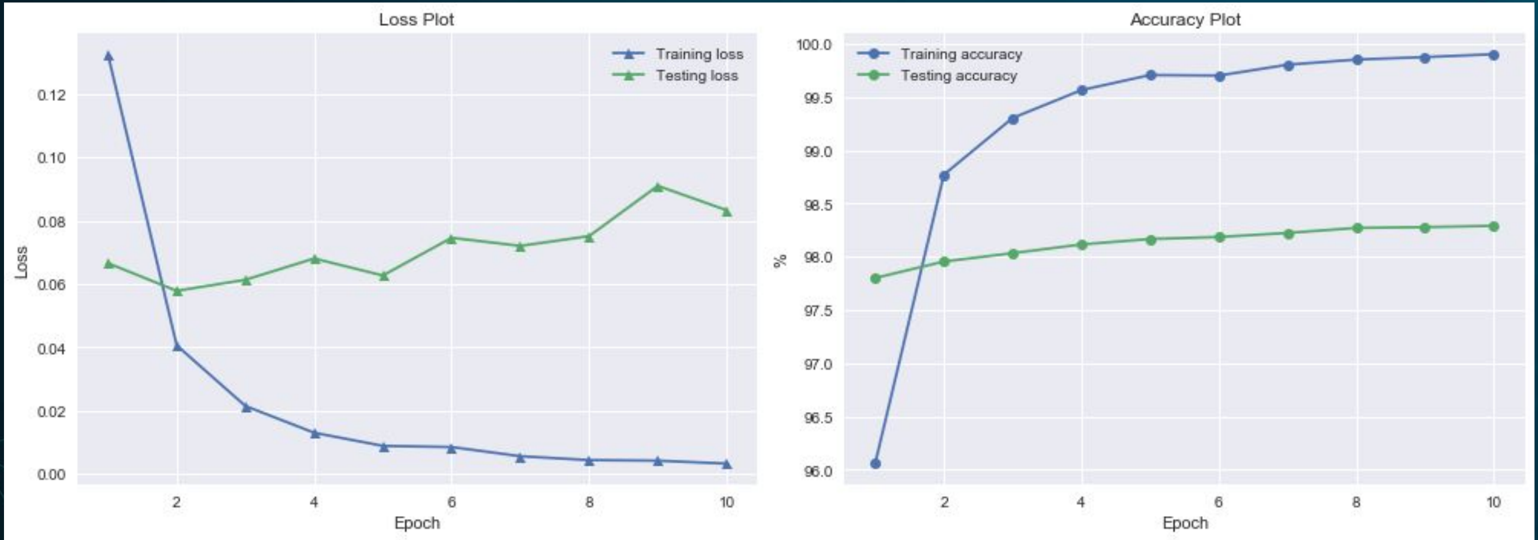
Train Accuracy: 93.2%
Test Accuracy: 94.5%
Trainable Parameters: 38,003

CONVOLUTION

Adding Convolutions - Model 3

- Convolutional Layer w/ RELU activation
- Flattening Layer
- Dense Layer 1 w/ RELU activation
- Dense Layer 2 w/ Linear activation

Results - Model 3

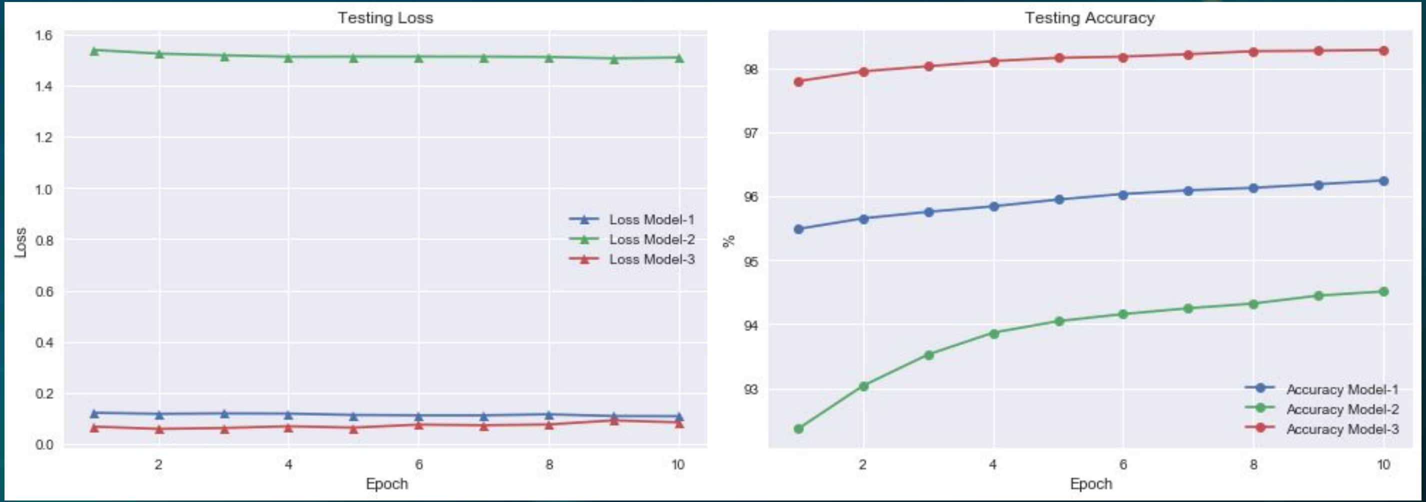


Train Accuracy: 99.9%
Test Accuracy: 98.3%
Trainable Parameters: 2,770,634

Conclusion 03

Comparison of model performances

Model Comparison



Model-1	Model-2	Model-3
Test Accuracy: 96.2%	Test Accuracy: 94.5%	Test Accuracy: 98.3%

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