

## Part 2: notMNIST

### Partial Model

The partial model is a convolution neural network with 8 filter 3\*3 convolution layer, 2x2 pooling layer, another 8 filter 3\*3 convolution layer, another 2x2 pooling layer, and then two fully connected layers before an output layer. It had training/testing accuracy of 94.8% / 95.2%.

### Testing Programs

I modified `predict_test.py`.

First line to load model: `model = tf.keras.models.load_model(sys.argv[2])`

Second line to make prediction: `prediction = model.predict(img)[0]`

Third line to determine predicted label: `predicted_label = np.argmax(prediction)`

### Incorrect Images

The three incorrect images I picked were index 34, 47, and 93 in the testing set.

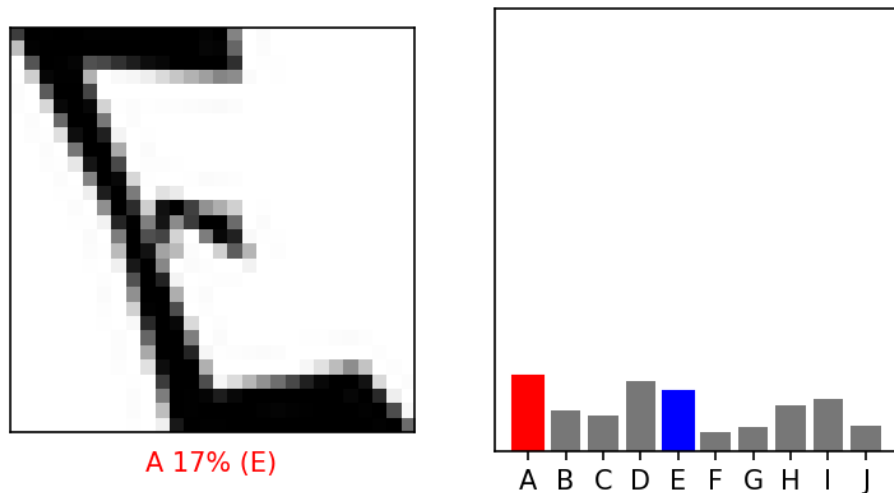


Figure 1: Image 34

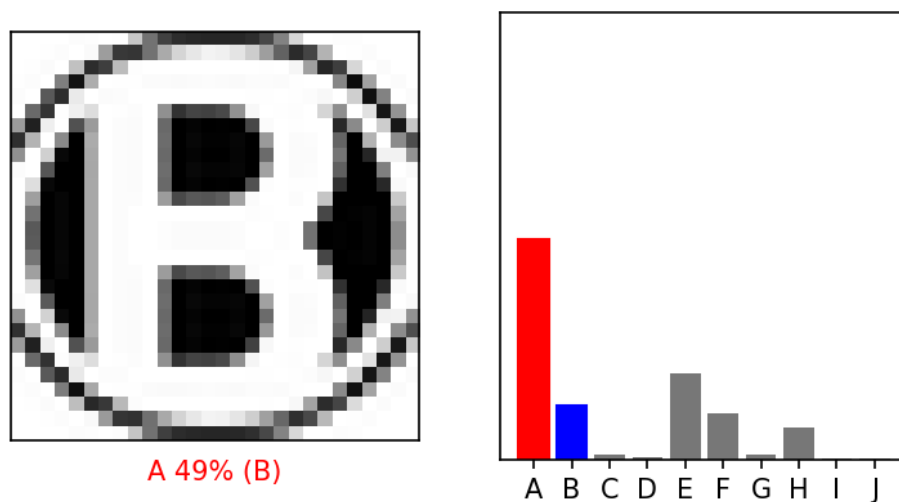


Figure 2: Image 47

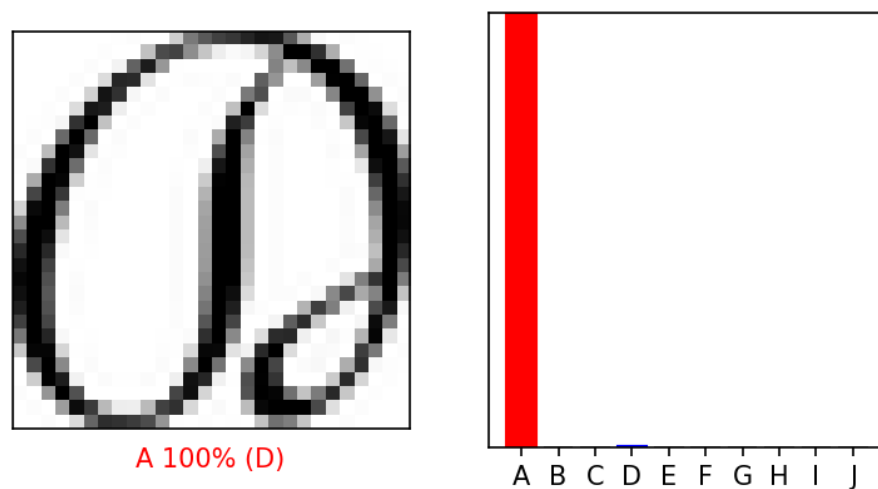


Figure 3: Image 93

Image 34 had the incorrect label of A (E is correct), although we can see that the model was not very confident in any particular answer.

Image 47 had the incorrect label of A (B is correct). I suspect it was due to the circle around it distracting the model.

Image 93 had the incorrect label of A (D is correct). The model was very confident in its incorrect answer. As a human, I can see how it sort of shares the features of a lowercase 'a'.

**Improvements**

Because the model had lower accuracy on the training set than the testing set, I decided that overfitting was not an issue. Therefore I modified the decay rate on the scheduled learning rate from 0.6 to 0.75. This allows the model to fit more closely to the training data.

I also changed the size of the first convolution layer from 3x3 to 5x5 (filter number unchanged). This should allow the model to detect slightly larger features on the original image.

**Results**

The three misidentified images are now identified correctly.

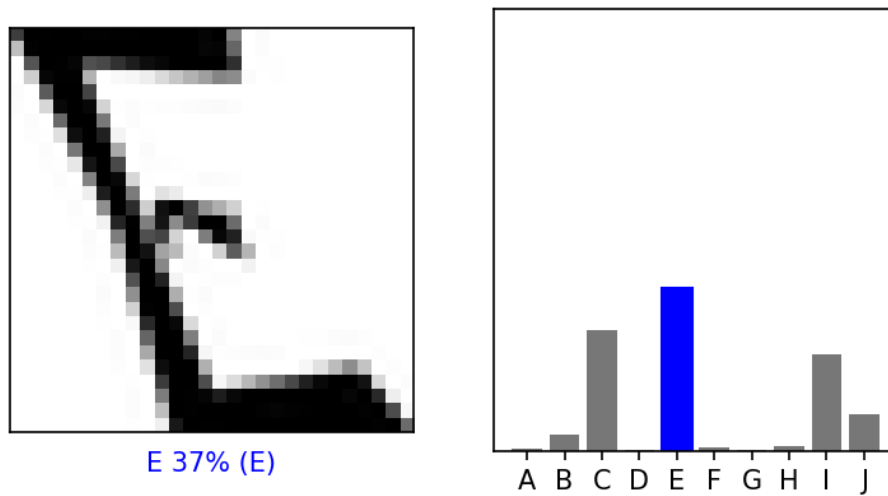


Figure 4: Image 34

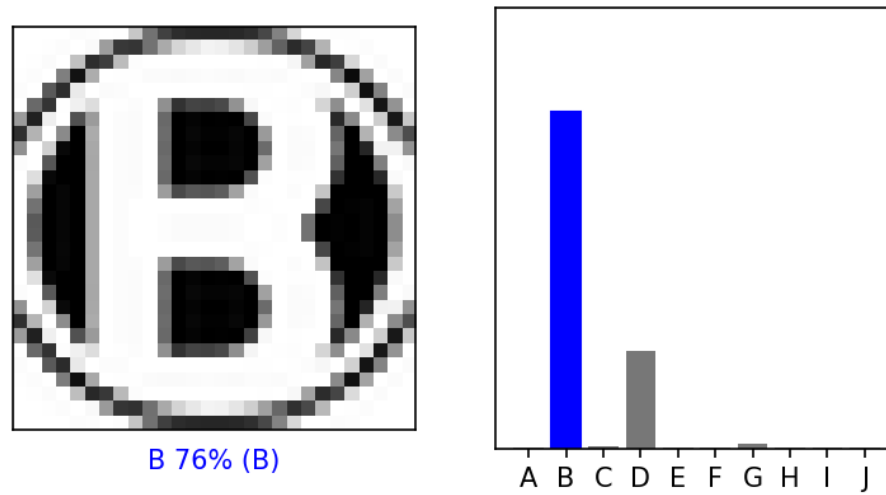


Figure 5: Image 47

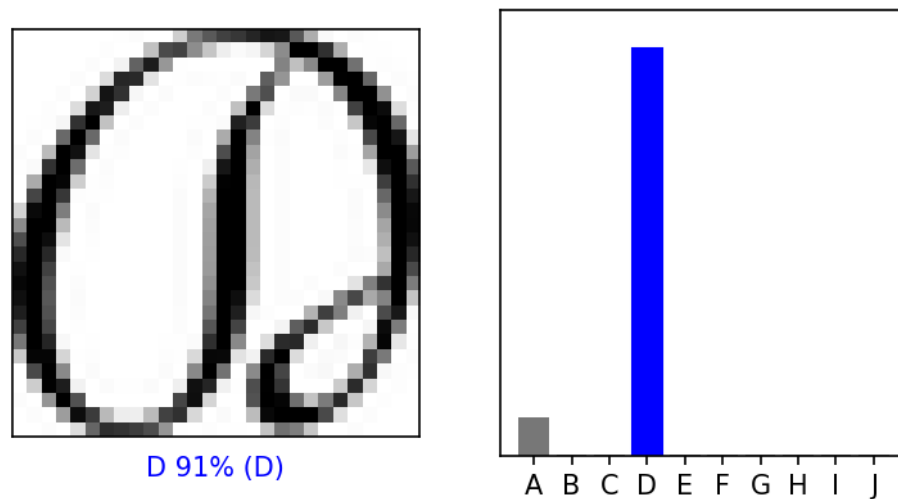


Figure 6: Image 93

The final model has training/testing accuracy of 96.7% / 95.2%. Note that the testing accuracy didn't actually improve compared to the partial model, which means that other images are now being misidentified.