Drexel University

CS499I

Advanced Neural Networks

Facial Recognition With Artificial Neural Networks

Author:
Alexander Marion
Matthew D'Amore

Supervisor:
Dr. Matthew Burlick

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1 Datasets

Yale Faces Database This dataset contains 165 grayscale images in GIF format of 15 individuals with 11 images per person. There is one image per each of the following configurations: center-light, w/glasses, happy, left-light, w/no glasses, normal, right-light, sad, sleepy, surprised, and wink.

2 Testing Parameters

The following variants are tested for accuracy:

1. With and without a bias node at the input layer
2. With and without a bias node at the hidden layer
3. With and without standardizing features
4. With and without applying PCA to reduce the number of features to 95%

Empirical data was generated to optimize the following parameters:

1. Image size
2. Hidden layer size
3. Termination criteria

3 Baseline Accuracy

The baseline accuracy was created using the negative form of all variants with the exception of data standardization. The baseline parameters were as follows: 40 by 40 sized images, a hidden layer size of 20, and 1000 training iterations.

Input layer bias node	N
Hidden layer bias node	N
Standardization of features	Y
PCA applied	N
Testing Accuracy	0.800000

Table 1: Baseline Testing Accuracy

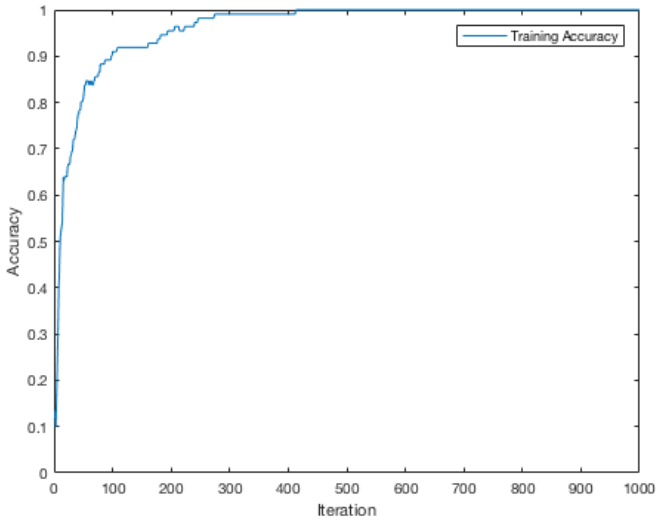

Figure 1: Baseline Training Accuracy

4 Variant Accuracy Testing

All variants were tested using 40 by 40 sized images, a hidden layer size of 20, and 1000 training iterations.

Input layer bias node	N
Hidden layer bias node	N
Standardization of features	N
PCA applied	N
Testing Accuracy	0.1455

Table 2: NNNN Testing Accuracy

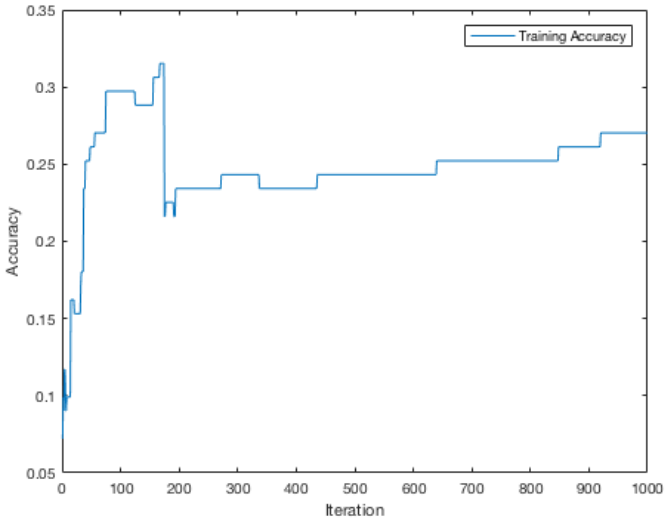

Figure 2: NNNN Training Accuracy

Input layer bias node	Y
Hidden layer bias node	N
Standardization of features	N
PCA applied	N
Testing Accuracy	0.2727

Table 3: YNNN Testing Accuracy

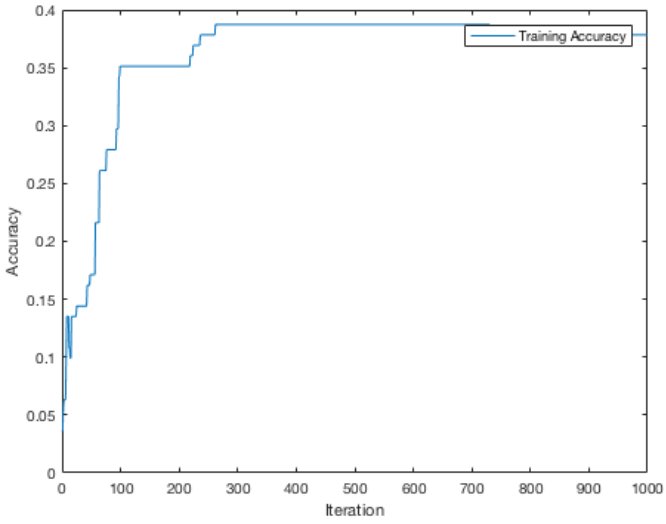

Figure 3: YNNN Training Accuracy

Input layer bias node	N
Hidden layer bias node	Y
Standardization of features	N
PCA applied	N
Testing Accuracy	0.1818

Table 4: NYNN Testing Accuracy

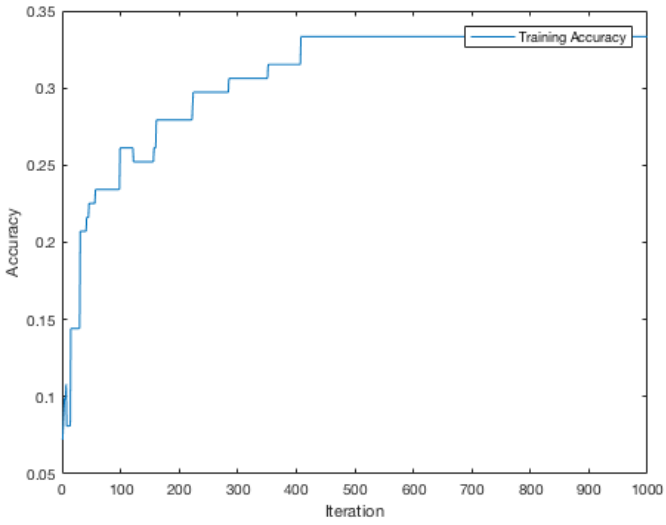

Figure 4: NYNN Training Accuracy

Input layer bias node	N
Hidden layer bias node	N
Standardization of features	N
PCA applied	Y
Testing Accuracy	0.1818

Table 5: NNNY Testing Accuracy

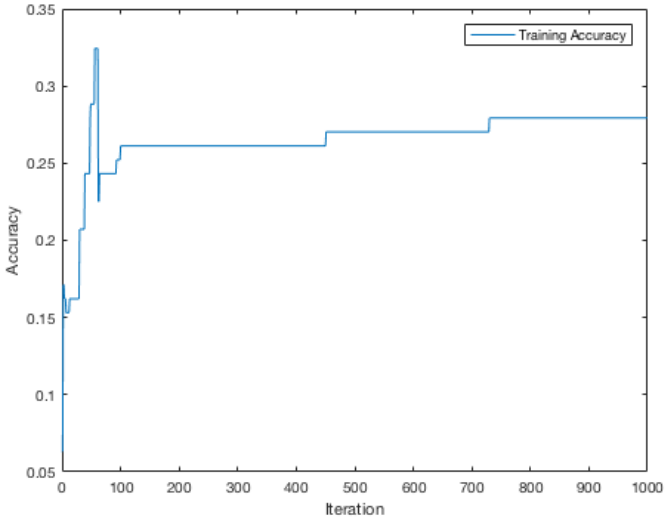

Figure 5: NNNY Training Accuracy

Input layer bias node	Y
Hidden layer bias node	Y
Standardization of features	N
PCA applied	N
Testing Accuracy	0.4000

Table 6: YYNN Testing Accuracy

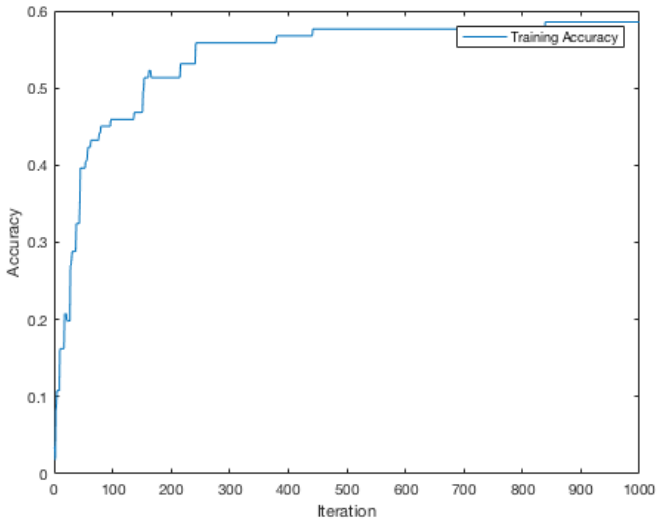

Figure 6: YYNN Training Accuracy

Input layer bias node	Y
Hidden layer bias node	N
Standardization of features	Y
PCA applied	N
Testing Accuracy	0.8182

Table 7: YNYN Testing Accuracy

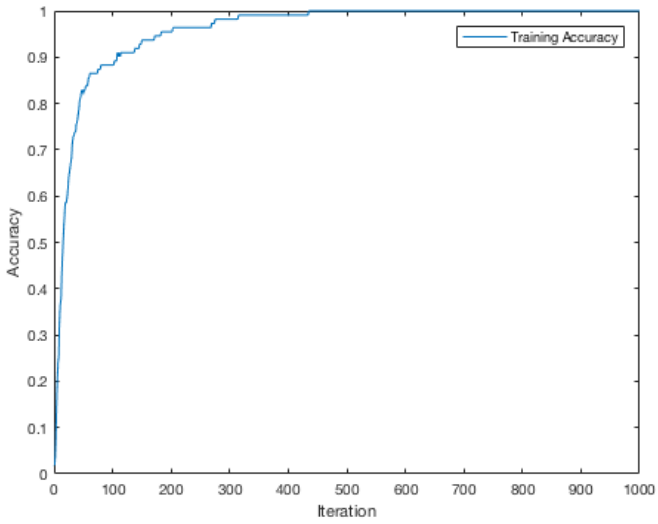

Figure 7: YNYN Training Accuracy

Input layer bias node	Y
Hidden layer bias node	N
Standardization of features	N
PCA applied	Y
Testing Accuracy	0.2364

Table 8: YNNY Testing Accuracy

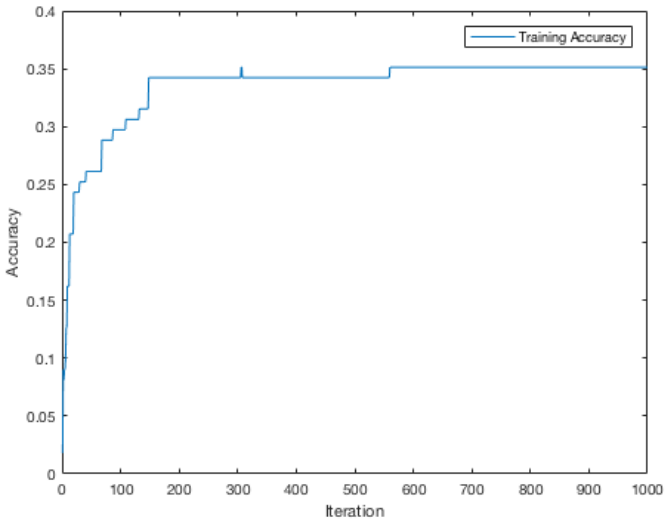

Figure 8: YNNY Training Accuracy

Input layer bias node	N
Hidden layer bias node	Y
Standardization of features	Y
PCA applied	N
Testing Accuracy	0.8182

Table 9: NYYN Testing Accuracy

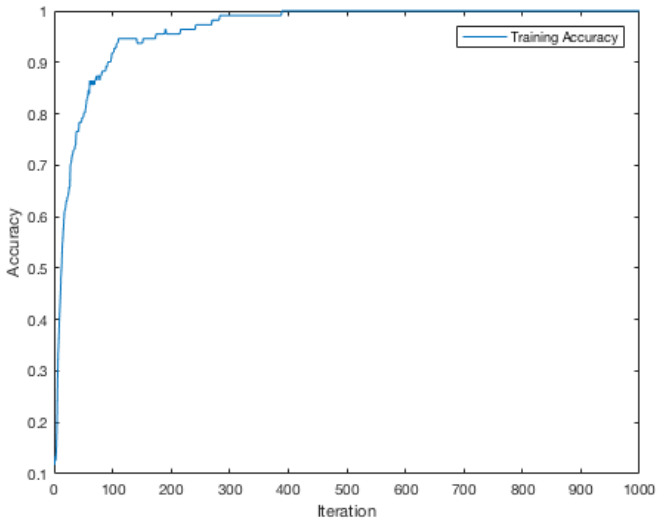

Figure 9: NYYN Training Accuracy

Input layer bias node	N
Hidden layer bias node	Y
Standardization of features	N
PCA applied	Y
Testing Accuracy	0.2364

Table 10: NYNY Testing Accuracy

Figure 10: NYNY Training Accuracy

Input layer bias node	N
Hidden layer bias node	N
Standardization of features	Y
PCA applied	Y
Testing Accuracy	0.8000

Table 11: NNYY Testing Accuracy

Figure 11: NNYY Training Accuracy

Input layer bias node	Y
Hidden layer bias node	Y
Standardization of features	Y
PCA applied	N
Testing Accuracy	0.8000

Table 12: YYYN Testing Accuracy

accuracy_imgs/YYYN_training_accuracy.png

Figure 12: YYYN Training Accuracy

Input layer bias node	Y
Hidden layer bias node	Y
Standardization of features	N
PCA applied	Y
Testing Accuracy	0.2000

Table 13: YYNY Testing Accuracy

accuracy_imgs/YYNY_training_accuracy.png

Figure 13: YYNY Training Accuracy

Input layer bias node	Y
Hidden layer bias node	N
Standardization of features	Y
PCA applied	Y
Testing Accuracy	0.8182

Table 14: YNYY Testing Accuracy

Figure 14: YNYY Training Accuracy

Input layer bias node	N
Hidden layer bias node	Y
Standardization of features	Y
PCA applied	Y
Testing Accuracy	0.8000

Table 15: NYYY Testing Accuracy

Figure 15: NYYY Training Accuracy

Input layer bias node	Y
Hidden layer bias node	Y
Standardization of features	Y
PCA applied	Y
Testing Accuracy	0.8182

Table 16: YYYY Testing Accuracy

Figure 16: YYYY Training Accuracy

5 Empirical Parameter Accuracy Testing

All empirical data was gathered using the following variant which had the highest accuracy from the variant testing:

YNYNN0.8181820.181818YNYNN accuracy and testing

Figure 17: Plot of YNYNN training error

1. Number of Training Iterations The number of training iterations was varied from 0 to 10,000 by 100. The number of hidden nodes was 20 and the image size was 40 by 40. The following is a plot of the accuracy as number of training iterations increases.

Figure 18: Plot of accuracy as number of training iterations increases

2. Number of Hidden Nodes The number of hidden nodes was varied from 0 to 1600 (the number of features) by 20. The number of training iterations was 1000 and the image size was 40 by 40. The following is a plot of the accuracy as number of hidden nodes increases.

Figure 19: Plot of accuracy as number of hidden nodes increases

3. Image Size