

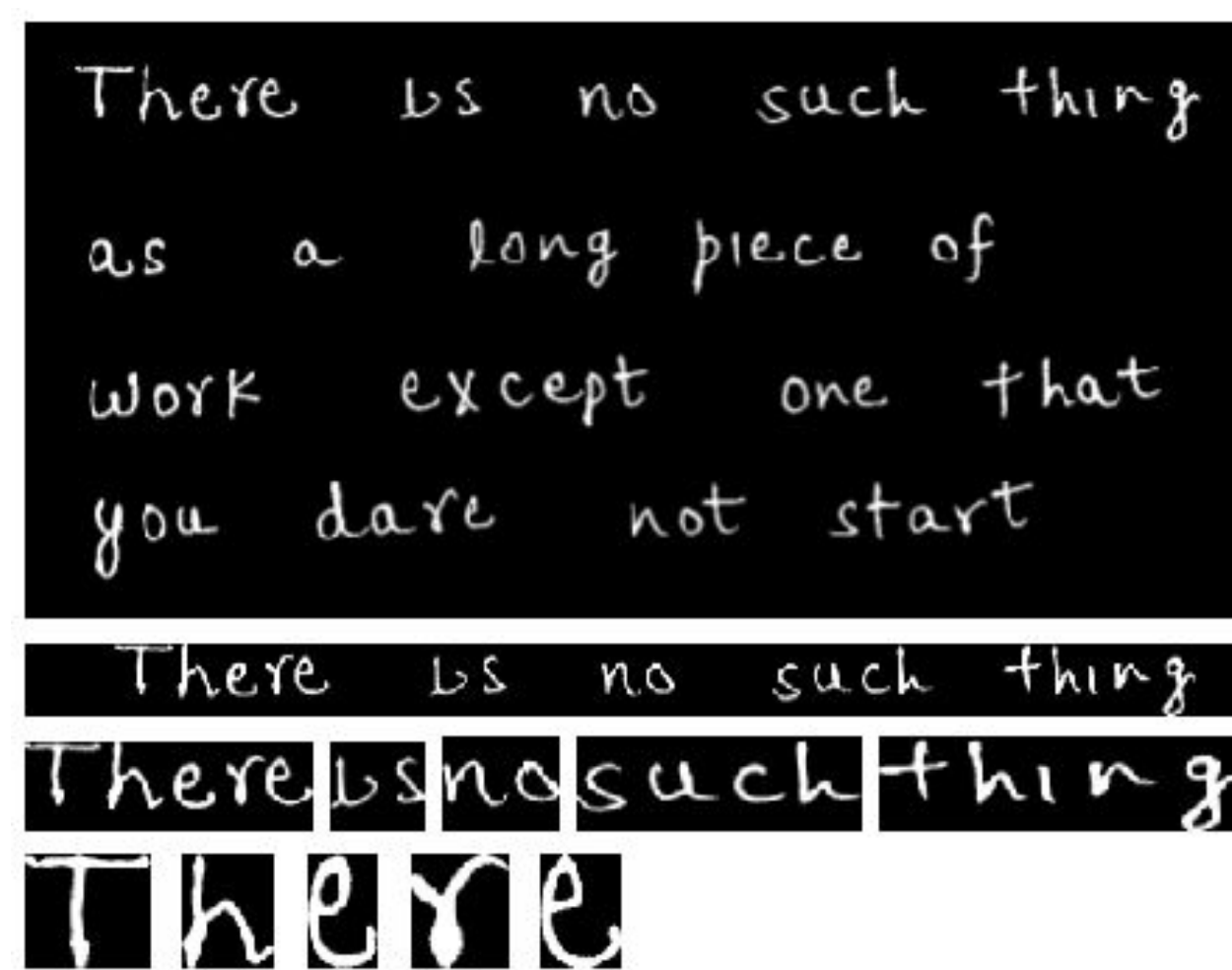


ABSTRACT

The purpose of this project is to use neural networks to identify the writers of handwritten inputs in order to better detect forgery-related issues. By using personalized training data we aim to train neural networks to both classify the character and to identify the writer of the letter.

BACKGROUND

Handwriting analysis relies on the unique features of each writer's characters. However, they are often not trained to recognize deliberate forgery attempts seeking to mimic users' handwriting. In training the neural network toward that purpose, it can more accurately discern minute differences between handwriting samples and increase precision.

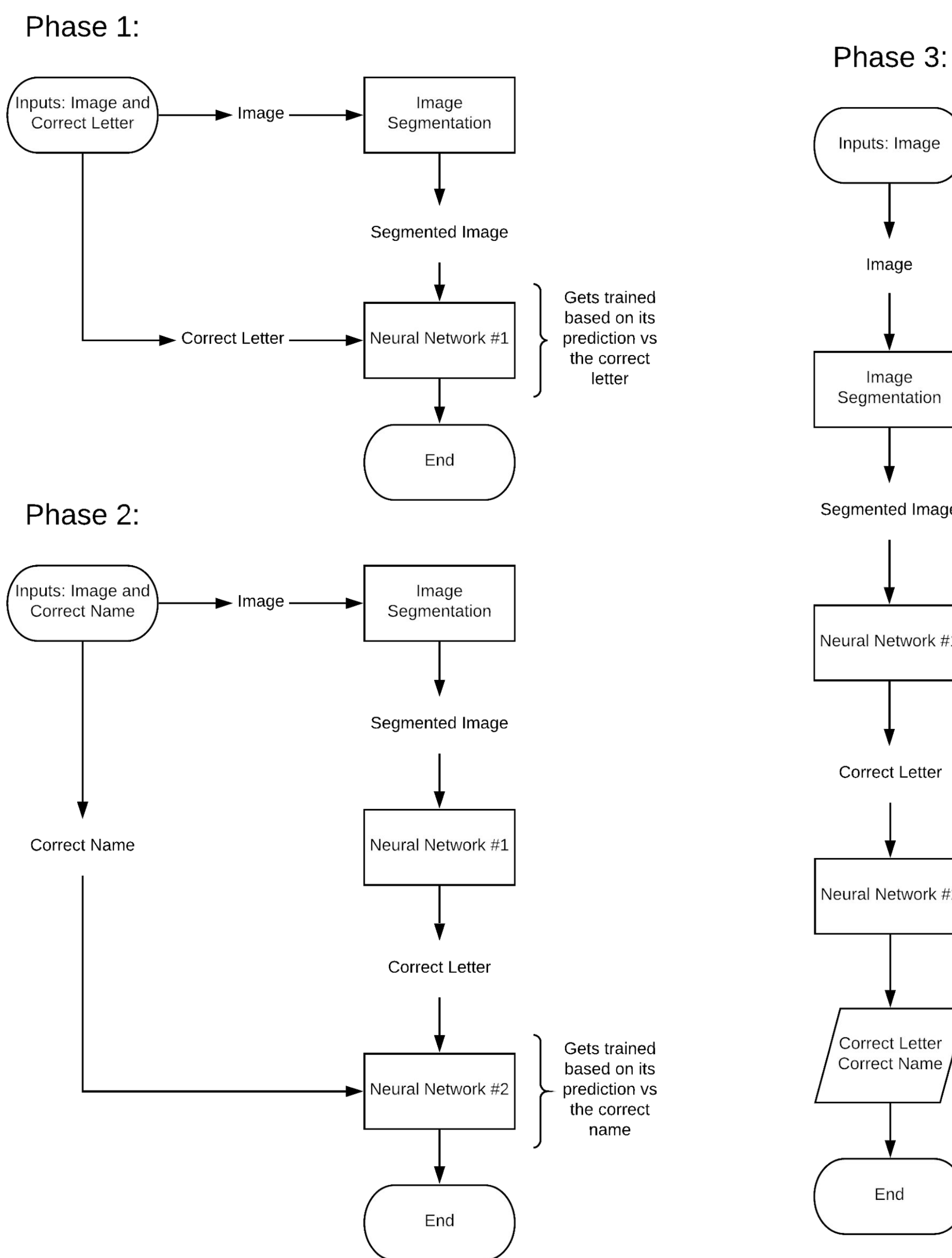


IMAGE

LINE

WORD

CHARACTER



METHOD

- Multiple neural networks
- First neural network trained to classify written characters
- Output from first neural network fed into second neural network
- Uses information as character to process into network and identify writer

TOOLS

- Python Libraries
 - matplotlib – plotting
 - numpy – matrices and vectorization
 - Pillow – image processing
 - pathlib – file path identification
 - scipy – matlab data reading
- Segmentation Library – handwritten word separation
- Tensorflow – accuracy comparison testing
- E-MNIST data set – NN1 training data

Epoch 0: 111 / 122	Epoch 20: 103 / 122
Epoch 1: 111 / 122	Epoch 21: 111 / 122
Epoch 2: 111 / 122	Epoch 22: 117 / 122
Epoch 3: 111 / 122	Epoch 23: 118 / 122
Epoch 4: 111 / 122	Epoch 24: 94 / 122
Epoch 5: 111 / 122	Epoch 25: 119 / 122
Epoch 6: 111 / 122	Epoch 26: 105 / 122
Epoch 7: 111 / 122	Epoch 27: 119 / 122
Epoch 8: 111 / 122	Epoch 28: 119 / 122
Epoch 9: 111 / 122	Epoch 29: 119 / 122
Epoch 10: 111 / 122	Epoch 30: 119 / 122
Epoch 11: 112 / 122	Epoch 31: 120 / 122
Epoch 12: 111 / 122	Epoch 32: 113 / 122
Epoch 13: 111 / 122	Epoch 33: 120 / 122
Epoch 14: 105 / 122	Epoch 34: 121 / 122
Epoch 15: 113 / 122	Epoch 35: 120 / 122
Epoch 16: 115 / 122	Epoch 36: 121 / 122
Epoch 17: 111 / 122	Epoch 37: 121 / 122
Epoch 18: 112 / 122	Epoch 38: 120 / 122
Epoch 19: 112 / 122	Epoch 39: 122 / 122

RESOURCES

- Nielsen, Michael A. "Neural Networks and Deep Learning." *Neural Networks and Deep Learning*, Determination Press, 2 Dec. 2015, neuralnetworksanddeeplearning.com/chap1.html.
- Ujjwal, Ajeet. "Character Segmentation of Handwritten Text." Github Repository, 2016. <https://github.com/ajeet-ujjwal/Character-Segmentation-of-Handwritten-Text>
- "EMNIST: an extension of MNIST to handwritten letters." CoRR, abs/1702.05373, . Cornell University Library, 1 Mar. 2017, <https://arxiv.org/abs/1702.05373v1>. Accessed 14 Aug. 2018.