

Handwriting Recognition System: Comparative Analysis of Artificial Neural Network and Convolutional Neural Network Models



Emily Pfau
Advised By Kowshik Bhowmik

Abstract

Handwriting recognition has been a challenging research area with many functions in everyday life. An application is capable of recognizing letters and digits can convert handwritten text into digital format. This paper took two different neural networks, Artificial neural network and Convolutional neural network, and shows the steps both networks take to recognize English handwritten letters and then transfer it to regular typeface. This is done by the use of the library Pytorch and EMNIST Dataset.

Handwriting Recognition

Handwriting recognition is the ability of a computer to recognise handwritten characters this could be letters or digits, English or another language.

- Characters can be on paper, photograph, touch screen or other devices.
- Characters are scanned and analyzed by a network, the program then returns a predicted character[5].

The English alphabet allows users multiple ways of writing different letters and digits. A handwriting recognition system needs to be trained using datasets to recognize patterns.



Fig. 1: Different ways to draw 'a'

Dataset: EMNIST

The dataset EMNIST is used to train and test both the ANN and CNN.

- The dataset is a collection of pixel images.
- Each image is of a handwritten letter and digit
- The split used was Balanced -
 - 131,600 character
 - 47 balanced classes[1].



Fig. 2: Samples of EMNIST dataset [1]

Neural Network

Neural networks are a type of deep learning algorithm that is based off of the human brain. It copies the idea of neurons in the human mind. These computer networks have nodes that are interconnected to allow the program to learn and adjust when information given to it. There are multiple different types of neural networks such as Artificial neural networks and Convolutional neural networks [4].

Artificial Neural Network

Artificial neural network is the most common neural network used [5].

- A dataset it passed through layers within the network.
- Each layer analyzes the the image for a specific at tribute such as lines or loops
- Final Layer output the predict letter or digit [3].

Figure 3 is a diagram of a artificial neural network.

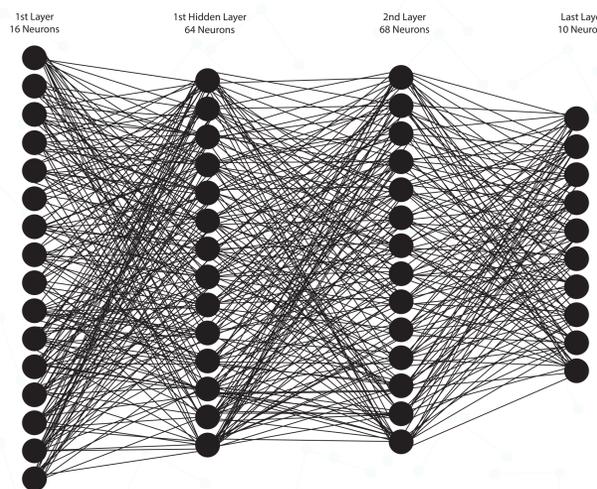


Fig. 3: Diagram of a Artificial Neural Network

Convolutional Neural Network

This Network specializes in image recognition and processing.

- It analyzes the pixels from the image to create feature maps.
- Each layer inspect a different aspect of the image. This could be horizontal lines, vertical lines or circles[2].

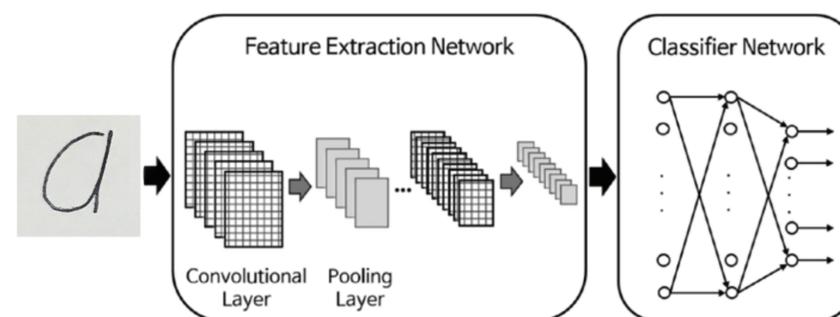


Fig. 4: Diagram of a Convolutional Neural Network

User Interface

The results from the ANN and CNN are then used to create a user interface. The user draws a letter or digits using a mouse, touch screen or tablet.

- User's image is taken and the two neural network predict what the character is.
- Each letter or digit must be draw one at a time could

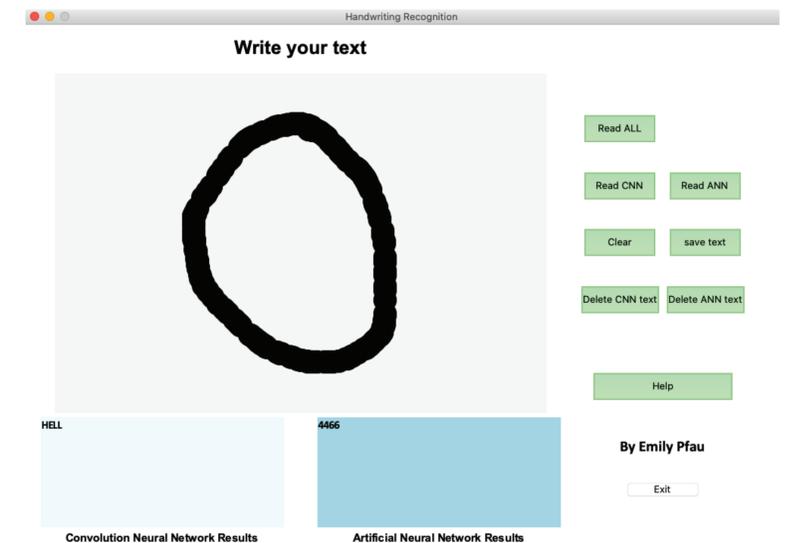


Fig. 5: User Interface

Conclusion

Handwriting recognition software is a newer technology that a lot of research and development has been made in resent years. Neural networks are a break through to this research. These AIs allow the computer to learn itself allowing for fast and better computation period. This project shows that CNN works faster and has a better accuracy then ANN when recognizing handwritten words.

References

- [1] Gregory Cohen et al. "EMNIST: an extension of MNIST to handwritten letters". In: The MARCS Institute for Brain, Behavior and Development (2017).
- [2] Michael Nielsen. "Neural Networks and Deep Learning". In: Detemination Press (Dec. 2017).
- [3] Kulik S.D. "Neural Network Model of Artificial Intelligence for Handwriting Recognition". In: Journal of Theoretical and Applied Information Technology 73.2 (1992-8645 Mar. 2005-2015), pp. 202-211.
- [4] Hyatt Saleh. The Deep Learning with PyTorch Workshop. Packet Publishing, July 2020.
- [5] Vishnu Subramanian. Deep Learning with Pytorch. Packet Publishing, Feb. 2018.