CS4055 - Digital Image Processing

Saleh Ahmad 20i0605, Muhammad Ammar 20i0783, Usman Naveed 20i0826

1 Project Title

Using GANs with Fully Connected Feed Forward Networks and Convolutional Networks to Create Unique Images of CryptoPunks

2 Project Goal

In order to create original images of CryptoPunks, this study used Generative Adversarial Networks (GANs), and it compared the outcomes using two distinct architectures, Fully Connected Feed Forward Networks and Convolutional Networks for the generator and the discriminator.

3 Project Description

The aim of this project is to generate new unique Cryptopunks using Generative Adversarial Networks (GANs) and compare the performance of Fully Connected and Convolutional Neural Network (CNN) architectures in terms of the quality and diversity of the generated images.

Cryptopunks are unique digital characters created using a combination of 8-bit graphics and Blockchain technology. Each CryptoPunk has a unique combination of traits such as hairstyle, accessories, and facial features. As Cryptopunks have become increasingly popular, there has been a growing interest in creating new unique Cryptopunks using AI and machine learning techniques.

For this project, we use a dataset of existing Cryptopunks to train our GAN. The GAN architecture consists of two main components, the generator, and the discriminator. The generator generates new images that mimic the distribution of the training data given some random noise, while the discriminator distinguishes between real and generated images. The two components are trained simultaneously in an adversarial manner until the generator is able to produce high-quality images that fool the discriminator.

We have use both Fully Connected and Convolutional architectures to build our GAN models. The Fully Connected architecture consists of multiple fully connected layers, while the CNN architecture consists of multiple convolutional layers.

Once the models are trained, we evaluate their performance based on the quality and diversity of the generated images. We have used custom metrics like real and fake scores to evaluate the model.

The project concludes with a comparison of the performance of Fully Connected and CNN architectures, and a discussion of the strengths and weaknesses of each approach. The results of this project will provide insights into the use of GANs for generating unique CryptoPunks and will help in determining the best architecture for generating high-quality and diverse images.

4 Methodology

For this project, we utilize Python, Numpy, PyTorch, and Pandas. We load and pre-process the original CryptoPunks' photos first. Then, we train the generator and discriminator networks using the training images. To discriminate between authentic and false pictures, we used the discriminator, and to create new images, we used the generator.

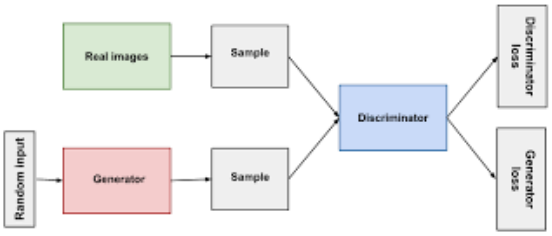

Figure 1: A visual representation of the GAN training process

5 Comparison of Architectures

For this project, Convolutional Networks and Feed Forward Networks are used. Convolutional networks generate outcomes that are significantly superior to those of plain feed forward networks. Compared to images generated using feed forward networks, those generated using convolutional networks are significantly sharper and more defined. Convolutional Networks also resulted in a significantly lower fake score.

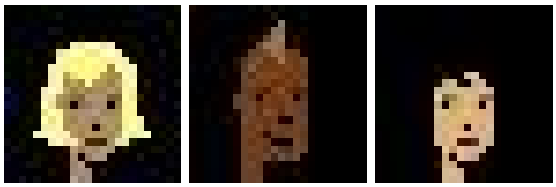

Figure 2: Original CryptoPunks

Figure 3: CryptoPunks Generated by using Convolutional Architecture based Generator and Discriminators

Figure 4: CryptoPunks Generated by using Fully Connected Architecture based Generator and Discriminators

6 Results

Following are the performance charts of the trained networks.

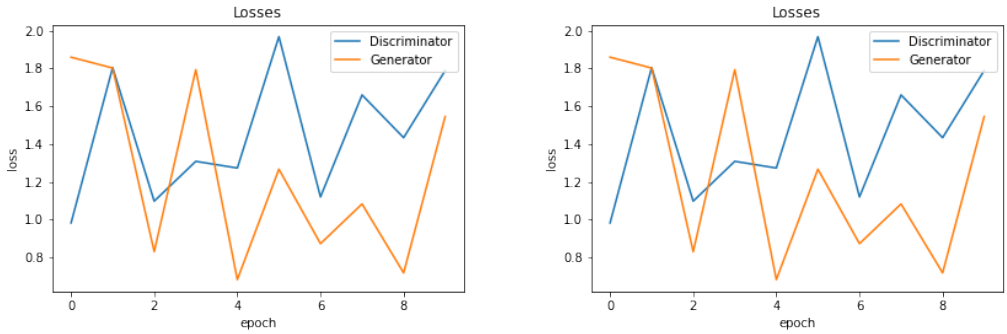

Figure 5: Results by Feed Forward based Generator and Discriminator

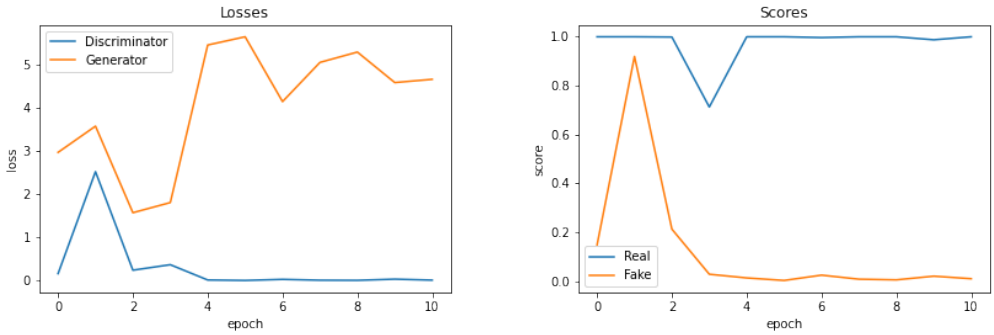

Figure 6: Results by CNN based Generator and Discriminator

7 Future Work

To create even better photos of CryptoPunks in the future, we might investigate the usage of different architectures like Stacked GANs or Wasserstein GANs (WGANs). We might also try utilizing variational auto encoders (VAE) to create images of other distinctive figures or things. To further enhance the findings acquired, we might further look at the usage of other optimization techniques or data augmentation approaches.

8 References

1. Brownlee, Jason. "What are Generative Adversarial Networks (GANs)?" Machine Learning Mastery. Accessed April 17, 2019. Machine Learning Mastery

2. Divyansh Jain. "GANs." GitHub, n.d. Accessed April 27, 2018. github