CPSC 8430 Deep Learning

Homework 4 Report

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Introduction:

GANs are a popular deep-learning architecture widely used for various generative tasks like image synthesis, style transfer, and text generation. DCGAN, WGAN, and ACGAN are some of the widely used GAN variants. In this report, we will evaluate and compare the performance of these three GAN variants on the CIFAR10 dataset.

CIFAR10 Dataset:

The CIFAR10 dataset comprises 60K images that are colored in 10 different classes, where each group has 6000 pictures. The images are of size 32x32. This Dataset has 50000 images for training and 10000 images for testing. This dataset is composed of one test batch and five training batches, each containing 10,000 images. The test batch consists of 1,000 images randomly selected from each of the ten classes, whereas the remaining images present in the training batches are in random order. It is possible that some training batches have more images of a particular class than another. However, in total, the training batches contain precisely 5,000 images from each of the ten classes. The classes are airplanes, cars, birds, cats, deer, dogs, frogs, horses, ships, and trucks.

DCGAN:

DCGAN, short for Deep Convolutional GAN, is a type of Generative Adversarial Network that was introduced in 2015 by Alec Radford, Luke Metz, and Soumith Chintala. It is designed to specifically address image generation tasks and incorporates convolutional neural networks (CNNs) in both the generator and discriminator networks.

In DCGAN, the generator network takes a noise vector as input and generates an image, while the discriminator network distinguishes between real and fake images. By utilizing CNN architecture in both networks, DCGAN can generate high-resolution images with greater realism than other GAN architectures.

Applications: face synthesis, object generation, and style transfer.

These are the images generated by the DCGAN network. These images don’t reveal much intent when compared to WGAN and ACGAN.

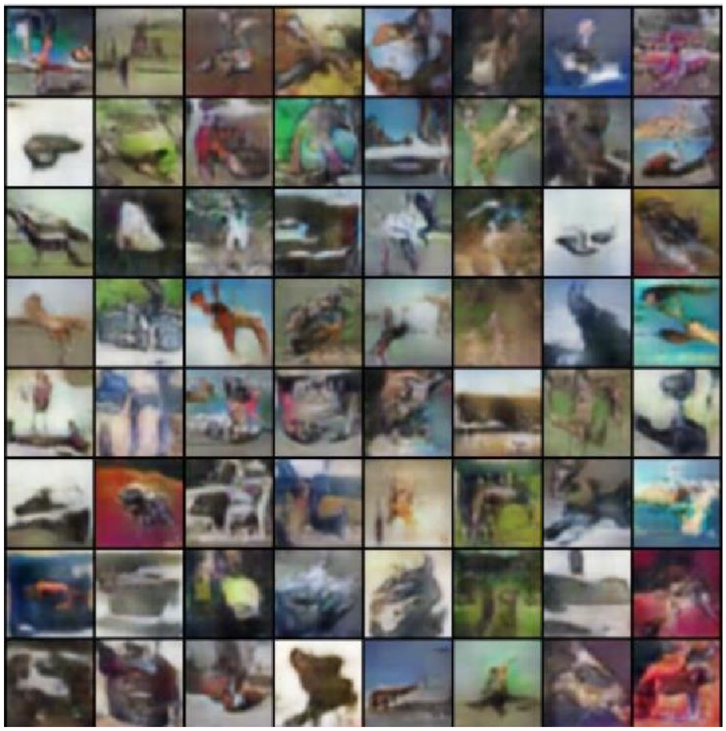

Figure 1: Images generated by DCGAN Network.

The below image is a plot of DCGAN Discriminator and Generator loss. As we can see that the plot is a bit unstable when compared to DCGAN and ACGAN.

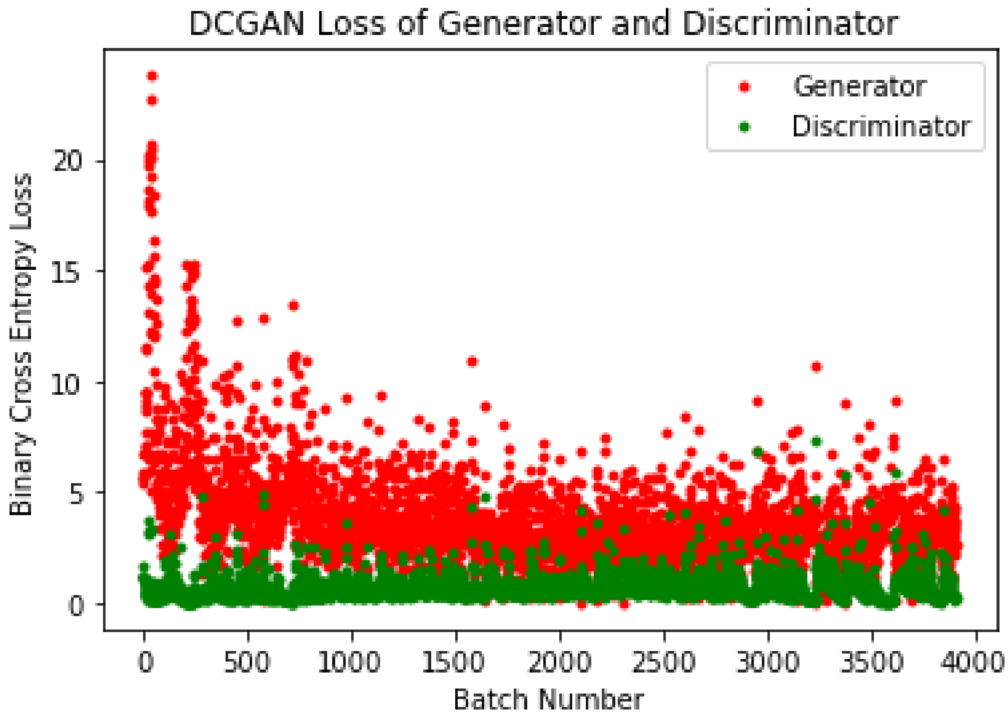

Figure 2: Plot of Loss of Generator and Discriminator.

WGAN:

WGAN, short for Wasserstein GAN, is a variation of the Generative Adversarial Network (GAN) model proposed in 2017. It aims to address the instability and mode collapse issues associated with traditional GANs. The modification involves transforming the discriminator into a Wasserstein distance estimator, which measures the distance between the real and generated data distributions. The discriminator maximizes the difference between the distances of the real and generated data, while the generator minimizes this distance, leading to a more stable training process and better control over the generated data distribution. WGAN has shown promise in producing high-quality images in image generation and style transfer applications.

Drawback: The challenge of tuning hyperparameters and the potential for mode collapse.

These are the images generated by the WGAN. In comparison with the DCGAN images, these images look a bit clear.

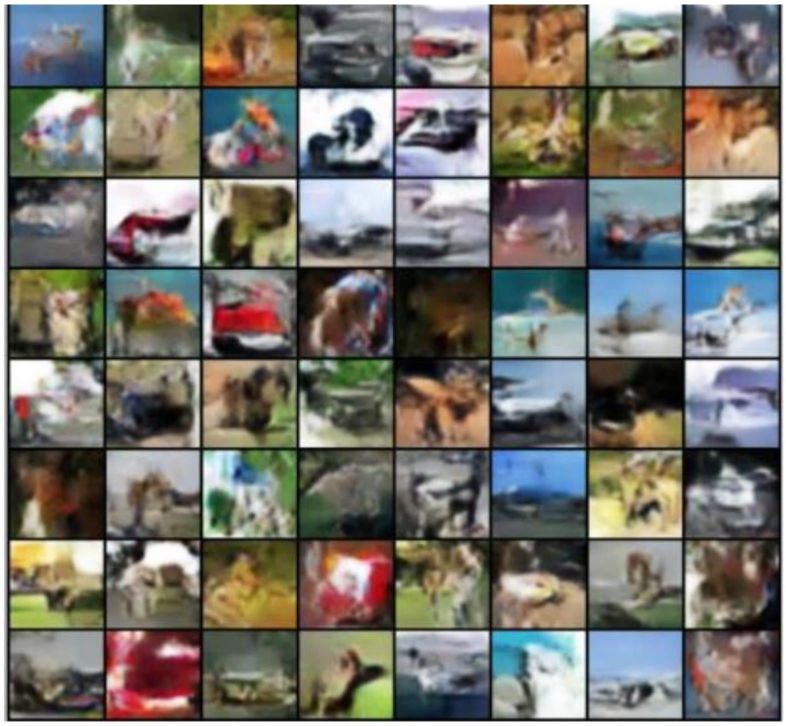

Figure 3: Images generated by WGAN Network.

The plot below shows the Loss of the Discriminator and Generator. WGAN plot seems stable when compared to DCGAN Network.

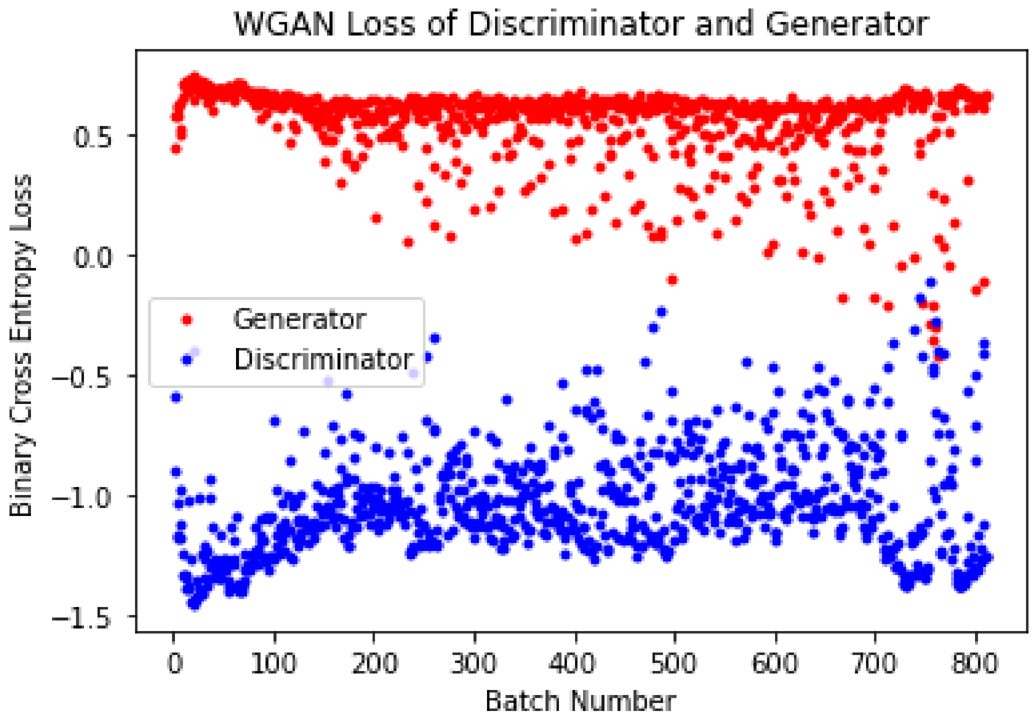

Figure 4: Plot WGAN loss of Discriminator and Generator.

Bonus Part:

ACGAN:

ACGAN, which stands for Auxiliary Classifier GAN, is a type of Generative Adversarial Network (GAN) that was introduced in 2017. It includes an additional classifier network that encourages the generator to produce more diverse samples, making it a modification of the traditional GAN.

In ACGAN, the generator produces fake samples by taking a noise vector as input, while the discriminator tries to differentiate between real and fake samples. However, ACGAN also involves an auxiliary classifier that predicts the class label of the generated sample. The generator is trained not just to generate realistic samples but also to produce samples that are classified as belonging to the correct class by the classifier network.

Applications:

- image synthesis and style transfer.

The below images are generated by the ACGAN network. In comparison to the DCGAN and WGAN networks, the Images produced by ACGAN make sense in identifying the image.

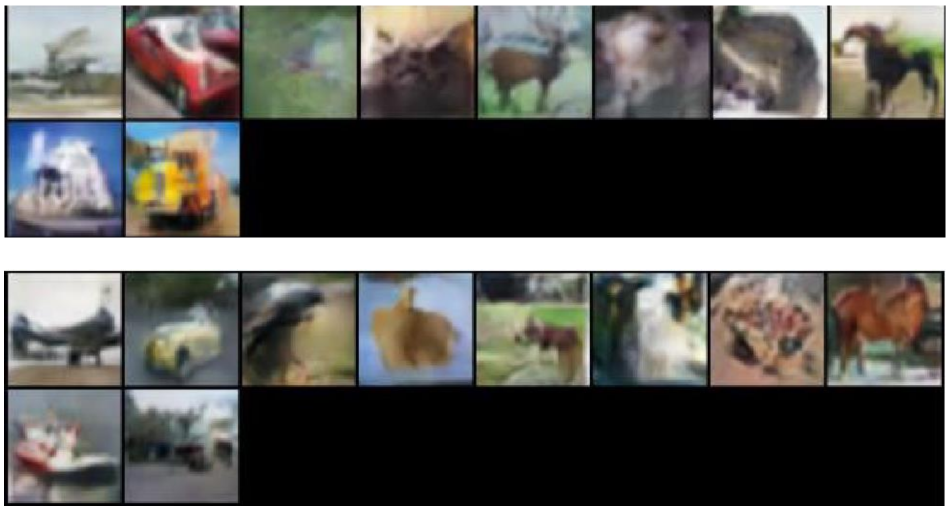

Figure 5:Images generated by ACGAN.

The below image shows the plot of ACGAN loss of Discriminator and Generator. When compared to DCGAN and WGAN, the plot is a bit steady.

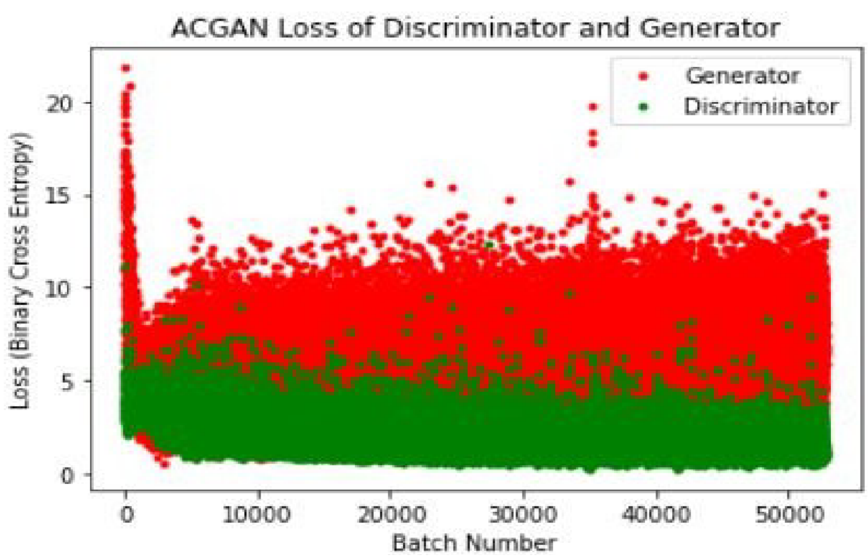

Figure 6: ACGAN Loss of Discriminator and Generator

Conclusion:

The image quality of DCGAN, WGAN, and ACGAN is as follows: DCGAN < WGAN < ACGAN, which concludes that ACGAN has good image quality with understandable shapes and textures.