# CSC580 Final Portfolio – Option 1

Name: Arun Saxena

Course: CSC580 – Deep Learning

Project Title: GANs for Image Generation

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## Part 1 – GAN Output Evaluation

At Epoch 0, the GAN generator output exhibits typical characteristics of an untrained model. The images generated are nearly uniform, low-contrast, and grayish. This is expected behavior, as the generator starts with randomly initialized weights and no prior learning of visual structure.

A grid of squares with a number of squares

AI-generated content may be incorrect.

A screenshot of a computer screen

AI-generated content may be incorrect.

By Epoch 2999, the generator's outputs have evolved into highly saturated pixel patterns. However, they lack semantic coherence or any resemblance to ships from the CIFAR-10 dataset. This typically indicates failure to learn meaningful features, likely due to a combination of adversarial imbalance and architecture depth limitations. The GAN may be experiencing mode collapse, where it settles into generating visually noisy outputs that do not improve across epochs.

The discriminator may have overpowered the generator, leading to vanishing gradients. Although the training procedure completed all 3000 epochs, the lack of visual fidelity in the generated outputs suggests that more advanced architecture or longer training time is needed. Generator improvement can be achieved through deeper layers, better regularization, conditional GANs (CGAN), or a Wasserstein loss variant (WGAN).

## Conclusion

The experiment confirms that while GANs are capable of powerful generation tasks, they require careful tuning, proper balancing between networks, and substantial training time. For complex datasets like CIFAR-10, especially when using a single class (ships), architectural enhancements are essential to achieving realistic output. The experiment highlights the importance of discriminator/generator balance and model complexity in successful GAN training.

## References

**Deepfake & Media Synthesis**

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**GANs Overview / Theory**

Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., ... & Bengio, Y. (2014).

Generative adversarial nets. In Advances in Neural Information Processing Systems (pp. 2672–2680).

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