Baseline Model:

The initial model was implemented by varying the number of epochs, specifically 10, 25, and 50.

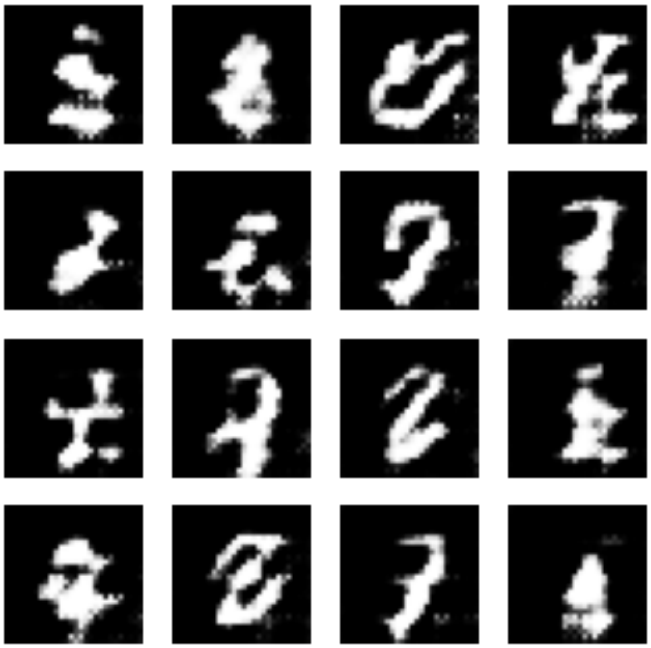

Fig 1: Sample image generated after 10 epochs

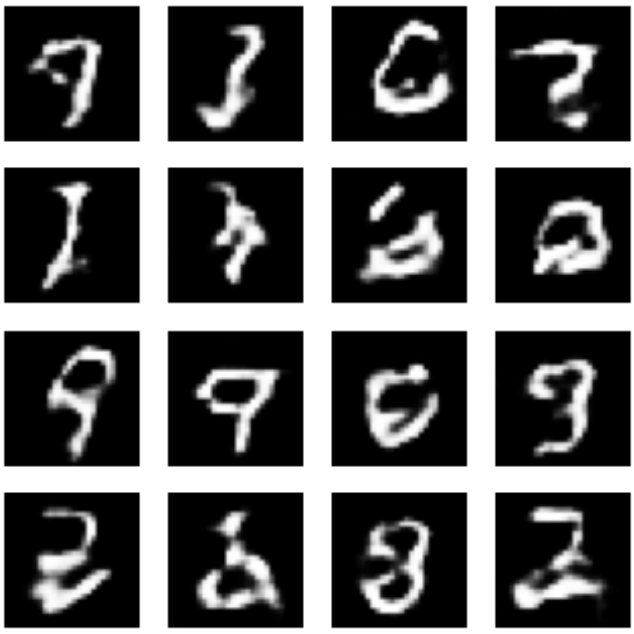

Fig 2: Sample image generated after 25 epochs

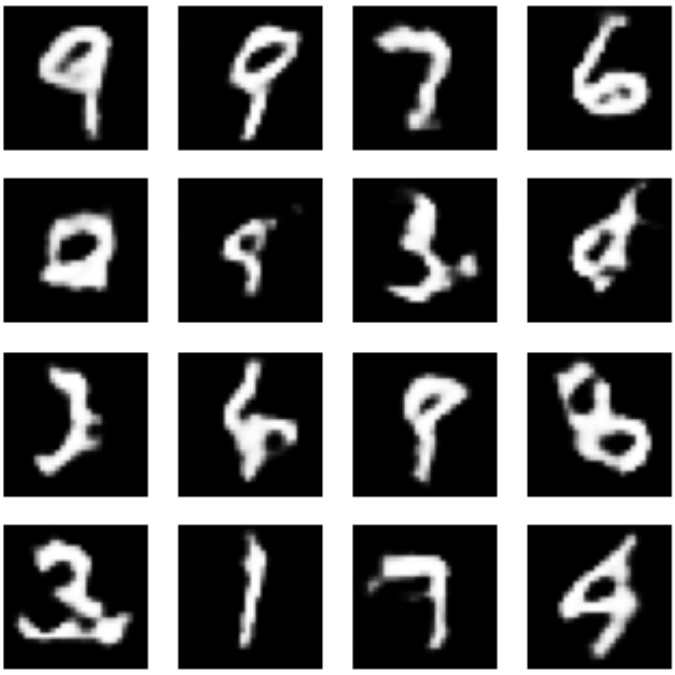

Fig 3: Sample image generated after 50 epochs

Observing the images presented above, it becomes apparent that the image quality improves as the number of epochs increases. When the GAN model was trained for only 10 epochs, the output images are hardly discernible. However, with 25 epochs, the legibility noticeably improves. In fact, it is possible to identify two numbers, namely 9 (located in the 3rd row, 2nd column) and 8 (found in the 4th row, 3rd column). While the remaining images are making progress, they cannot be definitively confirmed as specific numbers.

Upon reaching 50 epochs, 9 out of the 16 generated images can be identified. This observation indicates that, while keeping all other hyperparameters constant, enhancing the image quality of the generated images can be achieved by increasing the number of epochs.

ReLu Activation:

By maintaining the consistency of all remaining hyperparameters in the baseline model, a modification was made solely to the activation function within the generator's convolution network. Specifically, the LeakyReLu activation function was replaced with ReLu. As a result of this change, the following image was generated.

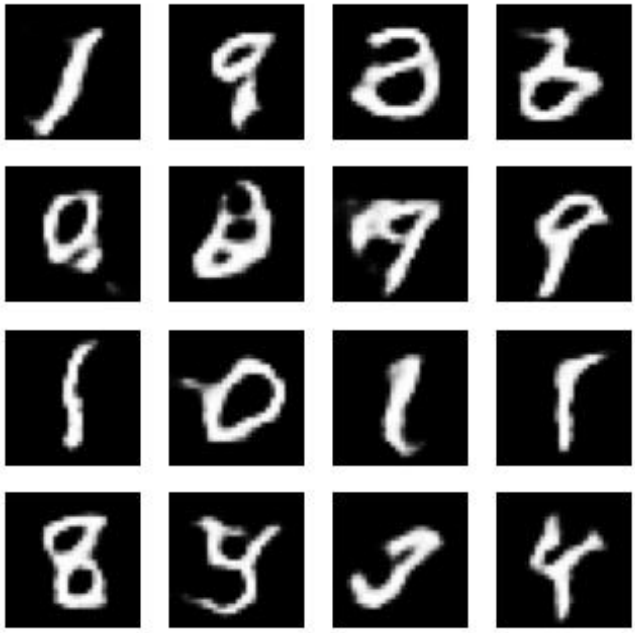

Fig 4: Sample image generated after 50 epochs using ReLu as the activation function.

Although the sharpness of the image remains comparable to that of the baseline model, the images produced using the ReLU activation function exhibit a higher level of completion and improved readability. Additionally, with a few more iterations, the generator employing the ReLU activation function can potentially generate fake images at an accelerated pace compared to the baseline model.

Tuning Hyperparameters:

In order to fine-tune the hyperparameters, I manually experimented with different settings. It was observed that when the noise dimension was set to a very high value or the learning rate was set to 0.1, no images were generated during the initial 10 epochs. However, by adjusting the hyperparameters, the following combination yielded an image slightly superior to the baseline model after 50 epochs.

Hyperparameters	Baseline Model	New Model
Dimensionality of Noise Vector	100	125
Batch Size	256	128
Learning rate	1e-4	1e-3
Momentum (Beta1)	Default 0.9	0.85
Momentum(Beta2)	Default 0.99	0.85

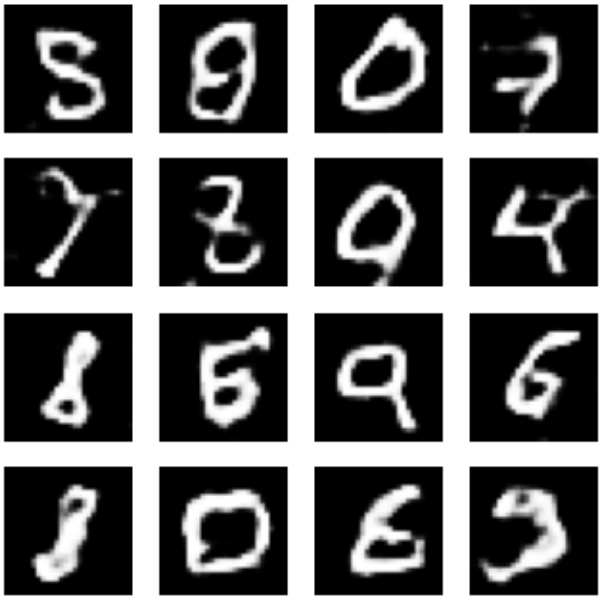

Fig 5: Sample image generated after 50 epochs after hyperparameter tuning.

The generated image exhibits improved quality, with 11 readable digits. Furthermore, the sharpness of the generated images surpasses that of the baseline model. With sufficient computational resources, advanced techniques like Grid Search or Random Search can be employed to identify optimal hyperparameter values, thereby further enhancing the image quality.