#1. Installation and Imports

```
# Install necessary libraries
!pip install tensorflow numpy matplotlib

# Import libraries
import os
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow.keras.layers import Dense, Reshape, Flatten
from tensorflow.keras.models import Sequential, load_model
```

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Requirement already satisfied: tensorflow in
/usr/local/lib/python3.10/dist-packages (2.15.0)
Requirement already satisfied: numpy in
/usr/local/lib/python3.10/dist-packages (1.25.2)
Requirement already satisfied: matplotlib in
/usr/local/lib/python3.10/dist-packages (3.7.1)
Requirement already satisfied: absl-py>=1.0.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.5.26 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1
in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.5.4)
Requirement already satisfied: google-pasta>=0.1.1 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (3.9.0)
Requirement already satisfied: libclang>=13.0.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (18.1.1)
Requirement already satisfied: ml-dtypes~=0.2.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: opt-einsum>=2.3.2 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (24.0)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!
=4.21.3,!=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (3.20.3)
Requirement already satisfied: setuptools in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (67.7.2)
Requirement already satisfied: six>=1.12.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (2.4.0)
Requirement already satisfied: typing-extensions>=3.6.6 in
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/usr/local/lib/python3.10/dist-packages (from tensorflow) (4.10.0)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.14.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.36.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.62.1)
Requirement already satisfied: tensorboard<2.16,>=2.15 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (2.15.2)
Requirement already satisfied: tensorflow-estimator<2.16,>=2.15.0
in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.15.0)
Requirement already satisfied: keras<2.16,>=2.15.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (2.15.0)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (1.2.0)
Requirement already satisfied: cycler>=0.10 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (4.50.0)
Requirement already satisfied: kiwisolver>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (1.4.5)
Requirement already satisfied: pillow>=6.2.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (9.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (3.1.2)
Requirement already satisfied: python-dateutil>=2.7 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (2.8.2)
Requirement already satisfied: wheel<1.0,>=0.23.0 in
/usr/local/lib/python3.10/dist-packages (from astunparse>=1.6.0-
>tensorflow) (0.43.0)
Requirement already satisfied: google-auth<3,>=1.6.3 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15-
>tensorflow) (2.27.0)
Requirement already satisfied: google-auth-oauthlib<2,>=0.5 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15-
>tensorflow) (1.2.0)
Requirement already satisfied: markdown>=2.6.8 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15-
>tensorflow) (3.6)
Requirement already satisfied: requests<3,>=2.21.0 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15-
>tensorflow) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0
in /usr/local/lib/python3.10/dist-packages (from
tensorboard<2.16,>=2.15->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15-
>tensorflow) (3.0.2)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in
```

```
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3-
>tensorboard<2.16,>=2.15->tensorflow) (5.3.3)
Requirement already satisfied: pyasn1-modules>=0.2.1 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3-
>tensorboard<2.16,>=2.15->tensorflow) (0.4.0)
Requirement already satisfied: rsa<5,>=3.1.4 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3-
>tensorboard<2.16,>=2.15->tensorflow) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in
/usr/local/lib/python3.10/dist-packages (from google-auth-
oauthlib<2,>=0.5->tensorboard<2.16,>=2.15->tensorflow) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard<2.16,>=2.15->tensorflow) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard<2.16,>=2.15->tensorflow) (3.6)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard<2.16,>=2.15->tensorflow) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard<2.16,>=2.15->tensorflow) (2024.2.2)
Requirement already satisfied: MarkupSafe>=2.1.1 in
/usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1-
>tensorboard<2.16,>=2.15->tensorflow) (2.1.5)
Requirement already satisfied: pyasn1<0.7.0,>=0.4.6 in
/usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1-
>google-auth<3,>=1.6.3->tensorboard<2.16,>=2.15->tensorflow) (0.6.0)
Requirement already satisfied: oauthlib>=3.0.0 in
/usr/local/lib/python3.10/dist-packages (from requests-
oauthlib>=0.7.0->google-auth-oauthlib<2,>=0.5-
>tensorboard<2.16,>=2.15->tensorflow) (3.2.2)
```

#2. Loading the Dataset (Sample Images)

```python
# Mount Google Drive to access the dataset
from google.colab import drive
drive.mount('/content/drive')

# Path to the sample images folder
sample_img_folder = '/content/sample_data/Sample_dataset_img'

# Check the sample images
sample_images = os.listdir(sample_img_folder)
print(f"Total sample images: {len(sample_images)}")
```

```
Drive already mounted at /content/drive; to attempt to forcibly
remount, call drive.mount("/content/drive", force_remount=True).
Total sample images: 1162
```

#3.Model Preparation and Training

```
# Generator model
generator = Sequential([
    Dense(256, input_dim=100, activation='relu'),
    Dense(512, activation='relu'),
    Dense(1024, activation='relu'),
    Dense(784, activation='sigmoid'),
    Reshape((28, 28, 1))
])

# Discriminator model
discriminator = Sequential([
    Flatten(input_shape=(28, 28, 1)),
    Dense(1024, activation='relu'),
    Dense(512, activation='relu'),
    Dense(256, activation='relu'),
    Dense(1, activation='sigmoid')
])

# Combined model (GAN)
gan = Sequential([generator, discriminator])

# Compile the discriminator
discriminator.compile(optimizer='adam', loss='binary_crossentropy',
metrics=['accuracy'])

# Compile the GAN
discriminator.trainable = False
gan.compile(optimizer='adam', loss='binary_crossentropy')
```

#4.Training the GAN

```
# Function to train the GAN
def train_gan(epochs, batch_size):
    for epoch in range(epochs):
        for _ in range(len(sample_images) // batch_size):
            # Generate random noise as input for the generator
            noise = np.random.normal(0, 1, (batch_size, 100))
            generated_images = generator.predict(noise)

            # Get a random batch of real images
            idx = np.random.randint(0, len(sample_images), batch_size)
            real_images = []
            for i in idx:
                img_path = os.path.join(sample_img_folder,
sample_images[i])
                img = plt.imread(img_path)
                real_images.append(img)
            real_images = np.array(real_images)

            # Train the discriminator
            d_loss_real = discriminator.train_on_batch(real_images,
np.ones(batch_size))
            d_loss_fake =
discriminator.train_on_batch(generated_images, np.zeros(batch_size))
            d_loss = 0.5 * np.add(d_loss_real, d_loss_fake)

            # Train the generator (via the GAN model)
            noise = np.random.normal(0, 1, (batch_size, 100))
            g_loss = gan.train_on_batch(noise, np.ones(batch_size))

        print(f"Epoch: {epoch + 1}, Discriminator Loss: {d_loss[0]},
Generator Loss: {g_loss}")
```

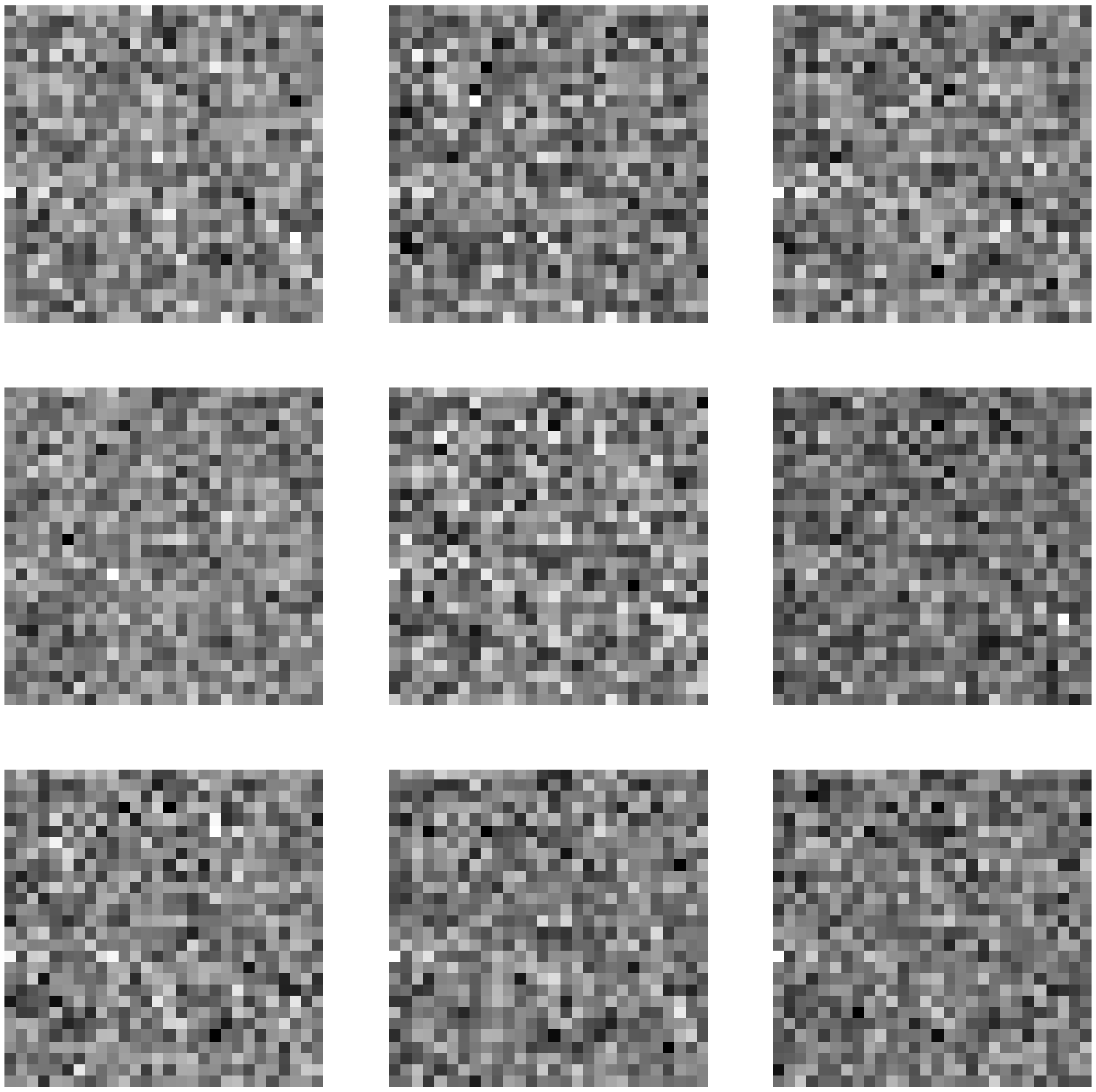
#5.Generating and Visualizing New Art

```
# Function to generate new art
def generate_art(num_images):
    noise = np.random.normal(0, 1, (num_images, 100))
    generated_images = generator.predict(noise)
    return generated_images

# Generate new art
num_images_to_generate = 9
generated_images = generate_art(num_images_to_generate)

# Visualize the generated images
plt.figure(figsize=(10, 10))
for i in range(num_images_to_generate):
    plt.subplot(3, 3, i + 1)
    plt.imshow(generated_images[i].reshape(28, 28), cmap='gray')
    plt.axis('off')
plt.show()

1/1 [==============================] - 0s 223ms/step
```



#6.Saving and Loading the Model

```
# Save the generator model
generator.save('generator_model.h5')

# Load the generator model
generator = load_model('generator_model.h5')

# Function to generate new art using the loaded model
def generate_art_with_loaded_model(num_images):
    noise = np.random.normal(0, 1, (num_images, 100))
    generated_images = generator.predict(noise)
    return generated_images
```

```python
# Generate new art with the loaded model
num_images_to_generate = 9
generated_images =
generate_art_with_loaded_model(num_images_to_generate)

# Visualize the generated images
plt.figure(figsize=(10, 10))
for i in range(num_images_to_generate):
    plt.subplot(3, 3, i + 1)
    plt.imshow(generated_images[i].reshape(28, 28), cmap='gray')
    plt.axis('off')
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/engine/
training.py:3103: UserWarning: You are saving your model as an HDF5
file via `model.save()`. This file format is considered legacy. We
recommend using instead the native Keras format, e.g.
`model.save('my_model.keras')`.
  saving_api.save_model(
WARNING:tensorflow:Compiled the loaded model, but the compiled metrics
have yet to be built. `model.compile_metrics` will be empty until you
train or evaluate the model.
WARNING:tensorflow:No training configuration found in the save file,
so the model was *not* compiled. Compile it manually.

1/1 [==============================] - 0s 102ms/step
```