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Ex No: 9 BUILD GENERATIVE ADVERSARIAL NEURAL NETWORK

Aim:

To build a generative adversarial neural network using Keras/TensorFlow.

Procedure:

1. Download and load the dataset.
2. Perform analysis and preprocessing of the dataset.
3. Build a simple neural network model using Keras/TensorFlow.
4. Compile and fit the model.
5. Perform prediction with the test dataset.
6. Calculate performance metrics.

Program:

```
import tensorflow as tf
from tensorflow.keras import layers
import numpy as np
import matplotlib.pyplot as plt
def build_generator(noise_dim):
    model = tf.keras.Sequential()

    # Dense layer to project the noise into a larger dimension
    model.add(layers.Dense(128, activation='relu', input_dim=noise_dim))

    # Add more dense layers
    model.add(layers.Dense(256, activation='relu'))
    model.add(layers.Dense(512, activation='relu'))

    # Final layer to output the data (usually using 'tanh' for image generation)
    model.add(layers.Dense(28 * 28, activation='tanh'))
```

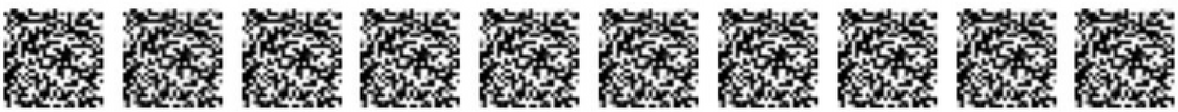
```
 model.add(layers.Reshape((28, 28))) # Shape output as 28x28 for images like MNIST

    return model
def build_discriminator():
    model = tf.keras.Sequential()

    # Flatten the input image
    model.add(layers.Flatten(input_shape=(28, 28)))

    # Add dense layers to classify real/fake
    model.add(layers.Dense(512, activation='relu'))
    model.add(layers.Dense(256, activation='relu'))

    # Final layer to output a single probability (real or fake)
    model.add(layers.Dense(1, activation='sigmoid'))

    return model

def build_gan(generator, discriminator):
    model = tf.keras.Sequential()
    model.add(generator)
    model.add(discriminator)

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

# Build the generator
generator = build_generator(noise_dim=100)
```

```
# Compile the GAN (discriminator is untrainable when training the generator)
discriminator.trainable = False
gan = build_gan(generator, discriminator)
gan.compile(loss='binary_crossentropy', optimizer='adam')

def train_gan(generator, discriminator, gan, epochs, batch_size, noise_dim):
    (X_train, _), _ = tf.keras.datasets.mnist.load_data() # Use MNIST as example
    X_train = X_train / 127.5 - 1.0 # Normalize images to [-1, 1]

    for epoch in range(epochs):
        # Select a random batch of real images
        idx = np.random.randint(0, X_train.shape[0], batch_size)
        real_images = X_train[idx]

        # Generate a batch of fake images
        noise = np.random.normal(0, 1, (batch_size, noise_dim))
        fake_images = generator.predict(noise)

        # Train the discriminator (real = 1, fake = 0)
        d_loss_real = discriminator.train_on_batch(real_images, np.ones((batch_size, 1)))
        d_loss_fake = discriminator.train_on_batch(fake_images, np.zeros((batch_size, 1)))

        # Train the generator (wants discriminator to predict all as real)
        noise = np.random.normal(0, 1, (batch_size, noise_dim))
        g_loss = gan.train_on_batch(noise, np.ones((batch_size, 1)))

        # Print progress
        if epoch % 100 == 0:
            print(f"{epoch} [D loss: {0.5 * np.add(d_loss_real, d_loss_fake)}] [G loss: {g_loss}]")
```

```
        # Optionally save generated samples to visualize progress

train_gan(generator, discriminator, gan, epochs=1000, batch_size=64, noise_dim=100)

def generate_images(generator, noise_dim, examples=10):
    noise = np.random.normal(0, 1, (examples, noise_dim))
    gen_images = generator.predict(noise)

    plt.figure(figsize=(10, 10))
    for i in range(examples):
        plt.subplot(1, 10, i+1)
        plt.imshow(gen_images[i], cmap='gray')
        plt.axis('off')
    plt.show()

# Call this function after training to visualize generated images
generate_images(generator, noise_dim=100)
```

Output:

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 73ms/step
```



```
[ ]:
2/2 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step
0 [D loss: [6.963869   0.01253389]] [G loss: [array(6.9694366, dtype=float32), array(6.9694366, dtype=float32), array(0.01252256, dtype=float32)]]
```

Result:

Generative Adversial Neural network has been successfully built.