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En esta práctica deberéis implementar una GAN condicional con el dataset FashionMNIST.

Podéis basaros en este ejemplo: https://keras.io/examples/generative/conditional_gan/.

Lo único que debéis cambiar es la entrada, tanto del G como del D, para incluir la clase que queréis asociar con la imagen generada.

In [1]:
```
# montamos la unidad drive donde tenemos los datos en la carpeta drive/My Drive
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

In [31]:
```
RESULTS_PATH = "/content/results/"
BASE_PATH = "/content/drive/MyDrive/ASIGNATURAS/VIU/06MIAR_Aprendizaje_no_Supervisa
%mkdir $RESULTS_PATH
%ls $BASE_PATH
```

```
cgan_generator_model_001.h5  cgan_generator_model_080.h5  generated_plot_e050.png
cgan_generator_model_010.h5  cgan_generator_model_090.h5  generated_plot_e060.png
cgan_generator_model_020.h5  cgan_generator_model_100.h5  generated_plot_e070.png
cgan_generator_model_030.h5  generated_plot_e001.png      generated_plot_e080.png
cgan_generator_model_040.h5  generated_plot_e010.png      generated_plot_e090.png
cgan_generator_model_050.h5  generated_plot_e020.png      generated_plot_e100.png
cgan_generator_model_060.h5  generated_plot_e030.png      generated_plot_e101.png
cgan_generator_model_070.h5  generated_plot_e040.png
```

In [30]:
```
# importamos las librerías necesarias
import numpy as np
import os
from tensorflow.keras.datasets.fashion_mnist import load_data
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Input, Embedding, Concatenate, Dense, Reshape,
import matplotlib.pyplot as plt
```

In [28]:
```
# definimos el discriminador: en este caso va a ser convolucional
def define_discriminator(in_shape=(28, 28, 1), n_classes=10):
    # En esta ocasión vamos a usar la API funcional de KERAS

    # creamos la entrada de la información condicional
    in_label = Input(shape=(1,))
    # embedding para entradas categóricas
    emb = Embedding(n_classes, 50)(in_label)
    # debemos añadir una capa densa que nos transforme el escalar que representa
    # nuestra clase a una imagen de (28, 28) para luego poder concatenar esa
    # información con la imagen
    n_nodes = in_shape[0] * in_shape[1]
    # mapping_cond_inf = Dense(n_nodes)(in_label)
    mapping_cond_inf = Dense(n_nodes)(emb)
    # canal adicional para las etiquetas
    mapping_cond_inf = Reshape((in_shape[0], in_shape[1], 1))(mapping_cond_inf)

    # entrada de la imagen
    in_image = Input(shape=in_shape)
    # concatenamos la info condicional con la imagen
    merge = Concatenate()([in_image, mapping_cond_inf])
    # downsample
```

```
    fe = Conv2D(128, (3, 3), padding='same')(merge)
    fe = MaxPooling2D((2, 2))(fe)
    fe = LeakyReLU(alpha=0.2)(fe)
    # downsample
    fe = Conv2D(128, (3, 3), padding='same')(fe)
    fe = MaxPooling2D((2, 2))(fe)
    fe = LeakyReLU(alpha=0.2)(fe)
    fe = Flatten()(fe)
    fe = Dropout(0.4)(fe)
    out_layer = Dense(1, activation='sigmoid')(fe)
    # definimos y compilamos el modelo (debemos indicarle las dos entradas que
    # va a tener: in_label e in_image)
    model = Model([in_image, in_label], out_layer, name="DISCRIMINATOR")
    opt = Adam(learning_rate=0.0002, beta_1=0.5)
    model.compile(loss='binary_crossentropy', optimizer=opt, metrics=['accuracy'])
    model.summary()
    return model
```

In [27]:

```
# definimos el generador
def define_generator(latent_dim, n_classes=10):
    # Aquí también vamos a utilizar la API funcional de Keras

    # creamos la entrada de la información condicional
    in_label = Input(shape=(1,))
    emb = Embedding(n_classes, 50)(in_label)
    n_nodes = 7 * 7
    mapping_cond_inf = Dense(n_nodes)(emb)
    mapping_cond_inf = Reshape((7, 7, 1))(mapping_cond_inf)

    # creamos la entrada de la información condicional
    in_label = Input(shape=(1,))
    # embedding para entradas categóricas
    emb = Embedding(n_classes, 50)(in_label)
    # debemos añadir una capa densa que nos transforme el escalar que representa
    # nuestra clase a una matriz de (N, N) para luego poder concatenar esa
    # información con la imagen
    n_nodes = 7 * 7 # Pista: N*N, donde N debe coincidir con las
    # dimensiones de "gen" más abajo para poder ser concatenado ##
    # mapping_cond_inf = Dense(## Aquí tu código. Pista: número de neuronas ##)(in_
    mapping_cond_inf = Dense(n_nodes)(emb)
    mapping_cond_inf = Reshape((7, 7, 1))(mapping_cond_inf)

    # entrada del código latene
    in_lat = Input(shape=(latent_dim,))
    # vamos a mapear nuestro código latente a un espacio bidimensional de mayor
    # número de dimensiones para poder tratar con él con nuestra CNN
    n_nodes = 128 * 7 * 7
    gen = Dense(n_nodes)(in_lat)
    gen = LeakyReLU(alpha=0.2)(gen)
    gen = Reshape((7, 7, 128))(gen)
    # concatenamos el código latente y la información
    merge = Concatenate()([gen, mapping_cond_inf])
    # aumentamos a 14x14
    gen = Conv2DTranspose(128, (4,4), padding='same')(merge)
    gen = UpSampling2D((2, 2))(gen)
    gen = LeakyReLU(alpha=0.2)(gen)
    # aumentamos a 28x28
    gen = Conv2DTranspose(128, (4,4), padding='same')(gen)
    gen = UpSampling2D((2, 2))(gen)
    gen = LeakyReLU(alpha=0.2)(gen)
    # salida del modelo (una imagen en escala de grises de 28x28)
    out_layer = Conv2D(1, (7,7), activation='tanh', padding='same')(gen)
    # definimos el modelo
    model = Model([in_lat, in_label], out_layer, name="GENERATOR")
```

```
    model.summary()
    return model
```

In [26]:
```
# definimos el modelo GAN combinando generador y discriminador, para entrenar el ge
def define_gan(g_model, d_model):
    # pesos del discriminador congelados
    d_model.trainable = False
    # obtener las entradas de ruido y etiquetas del modelo generador
    gen_noise, gen_label = g_model.input
    # obtener la imagen de salida del modelo generador
    gen_output = g_model.output
    # conectar la salida de imagen y la entrada de etiqueta del generador como entr
    gan_output = d_model([gen_output, gen_label])
    # definir el modelo gan como la toma de ruido y etiqueta y la salida de una cla
    model = Model([gen_noise, gen_label], gan_output)
    # compilamos modelo
    opt = Adam(learning_rate=0.0002, beta_1=0.5)
    model.compile(loss='binary_crossentropy', optimizer=opt)
    return model
```

In [14]:
```
# definimos las funciones para cargar el MNIST
def load_real_samples():
    # cargamos el dataset - ESTA VEZ QUEREMOS LAS IMÁGENES Y LAS CLASES
    (trainX, trainY), (_, _) = load_data()
    # expandimos la dimensión del batch
    X = np.expand_dims(trainX, axis=-1)
    # convertimos a float32
    X = X.astype('float32')
    # escalamos entre -1 y 1
    X = (X - 127.5) / 127.5
    # devolvemos tanto las imágenes como las clases
    return [X, trainY]

# nos creamos una función que nos devuelva n_samples del dataset (imagen, clase)
# y generamos las etiquetas de entrenamiento GAN: 1
def generate_real_samples(dataset, n_samples):
    # separamos las imágenes de las etiquetas
    images, labels = dataset
    # seleccionamos n_samples muestras aleatoriamente
    ix = np.random.randint(0, images.shape[0], n_samples)
    # las cogemos junto a su correspondiente clase
    X, labels = images[ix], labels[ix]
    # generamos las etiquetas para entrenar la GAN (1)
    y = np.ones((n_samples, 1))
    # debemos devolver, por un lado, X y labels (para condicionar la GAN),
    # y por el otro, la etiqueta que le asignamos: en este caso, al estar
    # entrenando el discriminador, etiqueta = 1
    return [X, labels], y
```

In [16]:
```
# generamos los vectores latentes que introduciremos al generador
def generate_latent_points(latent_dim, batch_size, n_classes=10):
    # generamos un vector de batch_size * latent_dim números aleatorios
    # latent_dim es la dimensión del vector latente
    # batch_size es el número de elementos por batch
    x_input = np.random.randn(latent_dim * batch_size)
    # redimensionamos el vector para que tenga un tamaño (batch_size, latent_dim)
    z_input = x_input.reshape(batch_size, latent_dim)
    # generamos clases aleatoriamente: la imagen producida por este código
    # latente y clase deberá ser una imagen realista que pertenezca a dicha
    # clase!
    labels = np.random.randint(0, n_classes, batch_size)
    # debemos devolver tanto el vector de ruido como la "clase": z_input y labels
    return [z_input, labels]
```

```
# creamos datos fake con el generador (dinero falsificado)
def generate_fake_samples(g_model, latent_dim, n_samples):
    # usamos la función anterior para generar los vectores latentes que
    # necesitamos para generar muestras fake acompañados de las clases
    # a las que queremos que pertenezcan las imágenes generadas
    z_input, labels_input = generate_latent_points(latent_dim, n_samples)
    # le introducimos los vectores latentes y las clases al generador para obtener
    # muestras similares a las reales
    images = g_model.predict([z_input, labels_input])
    # le asignamos la etiqueta 0 (porque utilizaremos esta función para
    # entrenar el D)
    y = np.zeros((n_samples,1))
    # debemos devolver, por un lado, images y labels_inputs (para condicionar la GA
    # y por el otro, la etiqueta que le asignamos: en este caso, al estar
    # entrenando el generador, etiqueta = 0
    return [images, labels_input], y
```

In [32]:
```
# función para guardar las imágenes generadas
def save_plot(examples, epoch, n=10, figsize=(20, 20)):
    examples = (examples * 127.5) + 127.5
    plt.figure(figsize=figsize)
    for i in range(n * n):
        plt.subplot(n, n, 1 + i)
        plt.axis('off')
        plt.imshow(examples[i, :, :, 0], cmap='gray_r')
    # guardamos las imágenes
    filename = os.path.join(RESULTS_PATH,'generated_plot_e%03d.png' % (epoch+1))
    plt.savefig(filename)
    plt.close()
```

In [33]:
```
# función para entrenar la GAN: el discriminador y el generador
def train(g_model, d_model, gan_model, dataset, latent_dim, n_epochs=100, n_batch=2
    bat_per_epo = int(dataset[0].shape[0] / n_batch)
    half_batch = int(n_batch / 2)
    # bucle para las epochs
    for epoch in range(n_epochs):
        # bucle para los batch
        for batch in range(bat_per_epo):

            # en esta ocasión vamos a separar las pérdidas del discriminador
            # cuando le metemos imágenes reales y cuando le metemos imágenes
            # fake para ver cómo lo hace con cada tipo
            # recordad que lo ideal es que llegue a un 50% de acc en cada uno

            # preparamos los datos reales
            [X_real, labels_real], y_real = generate_real_samples(dataset, half_bat
            # actualizamos el discriminador
            d_loss1, _ = d_model.train_on_batch([X_real, labels_real], y_real)

            # generamos datos falsos
            [X_fake, labels_fake], y_fake = generate_fake_samples(g_model, latent_c
            # actualizamos el discriminador
            d_loss2, _ = d_model.train_on_batch([X_fake, labels_fake], y_fake)

            # preparamos los puntos en el espacio latente: serán la entrada al
            # modelo GAN con el que entrenaremos el generador
            [z_input, labels_input] = generate_latent_points(latent_dim, n_batch)

            # creamos etiquetas invertidas para el generador: utilizamos el D(x)
            # para que piense que las muestras que le introducimos son reales, y
            # en caso de que diga que no son reales, aprovechamos la información
            # de sus gradientes para actualizar el G(z) para que la próxima vez
```

```
            # los datos generados por G(z) sean más plausibles (parecidos a los
            # reales)
            y_gan = np.ones((n_batch, 1))

            # como acabamos de ver, entrenamos el generador de forma que actualice
            # sus pesos usando los gradientes del discriminador
            # tened en cuenta que en este modelo (gan_model) el discriminador está
            # congelado, por lo que no se actualizan sus pesos: no queremos "untar"
            # a nuestro policía, lo que queremos es fabricar dinero más realista.
            g_loss = gan_model.train_on_batch([z_input, labels_input], y_gan)

            # mostramos el progreso
            print('>%d, %d/%d, d1=%.3f, d2=%.3f g=%.3f' %
                  (epoch+1, batch+1, bat_per_epo, d_loss1, d_loss2, g_loss))
        # evaluamos el desempeño del modelo cada 10 épocas
        if (epoch+1) % 10 == 0 or epoch == 0:
            # preparamos los datos reales
            [X_real, labels_real], y_real = generate_real_samples(dataset, half_bat
            # evaluamos el discriminador con datos reales
            _, acc_real = d_model.evaluate([X_real, labels_real], y_real, verbose=0
            # preparamos ejemplos fake
            [X_fake, labels_fake], y_fake = generate_fake_samples(g_model, latent_d
            # evaluamos el discriminador con datos fake
            _, acc_fake = d_model.evaluate([X_fake, labels_fake], y_fake, verbose=0
            # mostramos cómo de bueno es nuestro policía
            print('>Accuracy real: %.0f%%, fake: %.0f%%' % (acc_real*100, acc_fake*
            # guardamos las imágenes generadas
            save_plot(X_fake, epoch)
            # guardamos el generador para tenerlo disponible más tarde
            filename = os.path.join(RESULTS_PATH,'cgan_generator_model_%03d.h5' % (
            g_model.save(filename)
```

In [34]:

```
# size of the latent space
latent_dim = 100
# create the discriminator
d_model = define_discriminator()
# create the generator
g_model = define_generator(latent_dim)
# create the gan
gan_model = define_gan(g_model, d_model)
# load image data
dataset = load_real_samples()
```

```
Model: "DISCRIMINATOR"
__________________________________________________________________________________
________________
 Layer (type)                Output Shape                 Param #   Connected to
==================================================================================
================
 input_16 (InputLayer)       [(None, 1)]                  0         []

 embedding_9 (Embedding)     (None, 1, 50)                500       ['input_16[0]
[0]']

 dense_15 (Dense)            (None, 1, 784)               39984     ['embedding_9
[0][0]']

 input_17 (InputLayer)       [(None, 28, 28, 1)]          0         []

 reshape_12 (Reshape)        (None, 28, 28, 1)            0         ['dense_15[0]
[0]']

 concatenate_6 (Concatenate  (None, 28, 28, 2)            0         ['input_17[0]
[0]',
 )                                                                   'reshape_12
[0][0]']

 conv2d_9 (Conv2D)           (None, 28, 28, 128)          2432      ['concatenate_
6[0][0]']

 max_pooling2d_6 (MaxPoolin  (None, 14, 14, 128)          0         ['conv2d_9[0]
[0]']
 g2D)

 leaky_re_lu_15 (LeakyReLU)  (None, 14, 14, 128)          0         ['max_pooling2
d_6[0][0]']

 conv2d_10 (Conv2D)          (None, 14, 14, 128)          147584    ['leaky_re_lu_
15[0][0]']

 max_pooling2d_7 (MaxPoolin  (None, 7, 7, 128)            0         ['conv2d_10[0]
[0]']
 g2D)

 leaky_re_lu_16 (LeakyReLU)  (None, 7, 7, 128)            0         ['max_pooling2
d_7[0][0]']

 flatten_3 (Flatten)         (None, 6272)                 0         ['leaky_re_lu_
16[0][0]']

 dropout_3 (Dropout)         (None, 6272)                 0         ['flatten_3[0]
[0]']

 dense_16 (Dense)            (None, 1)                    6273      ['dropout_3[0]
[0]']

==================================================================================
================
Total params: 196773 (768.64 KB)
Trainable params: 196773 (768.64 KB)
Non-trainable params: 0 (0.00 Byte)
__________________________________________________________________________________
________________
Model: "GENERATOR"
__________________________________________________________________________________
________________
 Layer (type)                Output Shape                 Param #   Connected to
```

```
==================================================================================
================
 input_20 (InputLayer)       [(None, 100)]            0          []

 input_19 (InputLayer)       [(None, 1)]              0          []

 dense_19 (Dense)            (None, 6272)             633472     ['input_20[0]
[0]']

 embedding_11 (Embedding)    (None, 1, 50)            500        ['input_19[0]
[0]']

 leaky_re_lu_17 (LeakyReLU)  (None, 6272)             0          ['dense_19[0]
[0]']

 dense_18 (Dense)            (None, 1, 49)            2499       ['embedding_11
[0][0]']

 reshape_15 (Reshape)        (None, 7, 7, 128)        0          ['leaky_re_lu_
17[0][0]']

 reshape_14 (Reshape)        (None, 7, 7, 1)          0          ['dense_18[0]
[0]']

 concatenate_7 (Concatenate  (None, 7, 7, 129)        0          ['reshape_15
[0][0]',
 )                                                                'reshape_14
[0][0]']

 conv2d_transpose_6 (Conv2D  (None, 7, 7, 128)        264320     ['concatenate_
7[0][0]']
 Transpose)

 up_sampling2d_6 (UpSamplin  (None, 14, 14, 128)      0          ['conv2d_trans
pose_6[0][0]']
 g2D)

 leaky_re_lu_18 (LeakyReLU)  (None, 14, 14, 128)      0          ['up_sampling2
d_6[0][0]']

 conv2d_transpose_7 (Conv2D  (None, 14, 14, 128)      262272     ['leaky_re_lu_
18[0][0]']
 Transpose)

 up_sampling2d_7 (UpSamplin  (None, 28, 28, 128)      0          ['conv2d_trans
pose_7[0][0]']
 g2D)

 leaky_re_lu_19 (LeakyReLU)  (None, 28, 28, 128)      0          ['up_sampling2
d_7[0][0]']

 conv2d_11 (Conv2D)          (None, 28, 28, 1)        6273       ['leaky_re_lu_
19[0][0]']

==================================================================================
================
Total params: 1169336 (4.46 MB)
Trainable params: 1169336 (4.46 MB)
Non-trainable params: 0 (0.00 Byte)
__________________________________________________________________________________
________________
```

In [35]:

```
# train model
train(g_model, d_model, gan_model, dataset, latent_dim, n_epochs=3)
```

```
4/4 [==============================] - 0s 6ms/step
>1, 1/234, d1=0.686, d2=0.703 g=0.682
4/4 [==============================] - 0s 6ms/step
>1, 2/234, d1=0.565, d2=0.738 g=0.653
4/4 [==============================] - 0s 3ms/step
>1, 3/234, d1=0.489, d2=0.787 g=0.626
4/4 [==============================] - 0s 3ms/step
>1, 4/234, d1=0.438, d2=0.811 g=0.621
4/4 [==============================] - 0s 5ms/step
>1, 5/234, d1=0.397, d2=0.804 g=0.658
4/4 [==============================] - 0s 4ms/step
>1, 6/234, d1=0.385, d2=0.753 g=0.713
4/4 [==============================] - 0s 5ms/step
>1, 7/234, d1=0.378, d2=0.681 g=0.778
4/4 [==============================] - 0s 6ms/step
>1, 8/234, d1=0.382, d2=0.615 g=0.864
4/4 [==============================] - 0s 4ms/step
>1, 9/234, d1=0.341, d2=0.549 g=0.951
4/4 [==============================] - 0s 4ms/step
>1, 10/234, d1=0.331, d2=0.494 g=1.042
4/4 [==============================] - 0s 3ms/step
>1, 11/234, d1=0.305, d2=0.436 g=1.153
4/4 [==============================] - 0s 3ms/step
>1, 12/234, d1=0.337, d2=0.394 g=1.240
4/4 [==============================] - 0s 4ms/step
>1, 13/234, d1=0.285, d2=0.341 g=1.338
4/4 [==============================] - 0s 3ms/step
>1, 14/234, d1=0.275, d2=0.308 g=1.443
4/4 [==============================] - 0s 3ms/step
>1, 15/234, d1=0.284, d2=0.279 g=1.522
4/4 [==============================] - 0s 3ms/step
>1, 16/234, d1=0.258, d2=0.254 g=1.601
4/4 [==============================] - 0s 3ms/step
>1, 17/234, d1=0.202, d2=0.229 g=1.709
4/4 [==============================] - 0s 3ms/step
>1, 18/234, d1=0.187, d2=0.204 g=1.816
4/4 [==============================] - 0s 3ms/step
>1, 19/234, d1=0.181, d2=0.184 g=1.911
4/4 [==============================] - 0s 4ms/step
>1, 20/234, d1=0.174, d2=0.173 g=1.993
4/4 [==============================] - 0s 3ms/step
>1, 21/234, d1=0.139, d2=0.150 g=2.086
4/4 [==============================] - 0s 3ms/step
>1, 22/234, d1=0.196, d2=0.139 g=2.140
4/4 [==============================] - 0s 4ms/step
>1, 23/234, d1=0.107, d2=0.134 g=2.225
4/4 [==============================] - 0s 6ms/step
>1, 24/234, d1=0.155, d2=0.125 g=2.271
4/4 [==============================] - 0s 5ms/step
>1, 25/234, d1=0.111, d2=0.115 g=2.368
4/4 [==============================] - 0s 6ms/step
>1, 26/234, d1=0.138, d2=0.103 g=2.417
4/4 [==============================] - 0s 4ms/step
>1, 27/234, d1=0.121, d2=0.103 g=2.465
4/4 [==============================] - 0s 5ms/step
>1, 28/234, d1=0.090, d2=0.095 g=2.550
4/4 [==============================] - 0s 4ms/step
>1, 29/234, d1=0.132, d2=0.089 g=2.557
4/4 [==============================] - 0s 3ms/step
>1, 30/234, d1=0.117, d2=0.093 g=2.579
4/4 [==============================] - 0s 5ms/step
>1, 31/234, d1=0.099, d2=0.088 g=2.620
4/4 [==============================] - 0s 3ms/step
>1, 32/234, d1=0.087, d2=0.084 g=2.711
```

```
4/4 [==============================] - 0s 5ms/step
>1, 33/234, d1=0.078, d2=0.078 g=2.757
4/4 [==============================] - 0s 7ms/step
>1, 34/234, d1=0.051, d2=0.069 g=2.859
4/4 [==============================] - 0s 5ms/step
>1, 35/234, d1=0.081, d2=0.064 g=2.898
4/4 [==============================] - 0s 12ms/step
>1, 36/234, d1=0.119, d2=0.073 g=2.892
4/4 [==============================] - 0s 4ms/step
>1, 37/234, d1=0.048, d2=0.062 g=2.947
4/4 [==============================] - 0s 4ms/step
>1, 38/234, d1=0.067, d2=0.056 g=2.992
4/4 [==============================] - 0s 6ms/step
>1, 39/234, d1=0.054, d2=0.057 g=3.092
4/4 [==============================] - 0s 6ms/step
>1, 40/234, d1=0.044, d2=0.049 g=3.203
4/4 [==============================] - 0s 7ms/step
>1, 41/234, d1=0.082, d2=0.051 g=3.147
4/4 [==============================] - 0s 5ms/step
>1, 42/234, d1=0.051, d2=0.049 g=3.184
4/4 [==============================] - 0s 5ms/step
>1, 43/234, d1=0.022, d2=0.042 g=3.323
4/4 [==============================] - 0s 5ms/step
>1, 44/234, d1=0.055, d2=0.044 g=3.330
4/4 [==============================] - 0s 6ms/step
>1, 45/234, d1=0.030, d2=0.040 g=3.419
4/4 [==============================] - 0s 15ms/step
>1, 46/234, d1=0.041, d2=0.037 g=3.470
4/4 [==============================] - 0s 10ms/step
>1, 47/234, d1=0.061, d2=0.039 g=3.441
4/4 [==============================] - 0s 7ms/step
>1, 48/234, d1=0.033, d2=0.036 g=3.465
4/4 [==============================] - 0s 4ms/step
>1, 49/234, d1=0.039, d2=0.036 g=3.507
4/4 [==============================] - 0s 4ms/step
>1, 50/234, d1=0.036, d2=0.035 g=3.564
4/4 [==============================] - 0s 5ms/step
>1, 51/234, d1=0.042, d2=0.033 g=3.584
4/4 [==============================] - 0s 5ms/step
>1, 52/234, d1=0.035, d2=0.033 g=3.615
4/4 [==============================] - 0s 4ms/step
>1, 53/234, d1=0.020, d2=0.030 g=3.716
4/4 [==============================] - 0s 5ms/step
>1, 54/234, d1=0.024, d2=0.026 g=3.777
4/4 [==============================] - 0s 4ms/step
>1, 55/234, d1=0.038, d2=0.027 g=3.774
4/4 [==============================] - 0s 4ms/step
>1, 56/234, d1=0.044, d2=0.029 g=3.742
4/4 [==============================] - 0s 4ms/step
>1, 57/234, d1=0.010, d2=0.025 g=3.920
4/4 [==============================] - 0s 4ms/step
>1, 58/234, d1=0.012, d2=0.021 g=3.997
4/4 [==============================] - 0s 5ms/step
>1, 59/234, d1=0.031, d2=0.021 g=3.986
4/4 [==============================] - 0s 4ms/step
>1, 60/234, d1=0.011, d2=0.020 g=4.072
4/4 [==============================] - 0s 7ms/step
>1, 61/234, d1=0.031, d2=0.022 g=4.063
4/4 [==============================] - 0s 4ms/step
>1, 62/234, d1=0.022, d2=0.020 g=4.078
4/4 [==============================] - 0s 3ms/step
>1, 63/234, d1=0.023, d2=0.020 g=4.084
4/4 [==============================] - 0s 7ms/step
>1, 64/234, d1=0.021, d2=0.019 g=4.140
```

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4/4 [==============================] - 0s 5ms/step
>1, 65/234, d1=0.025, d2=0.019 g=4.112
4/4 [==============================] - 0s 4ms/step
>1, 66/234, d1=0.049, d2=0.023 g=4.015
4/4 [==============================] - 0s 3ms/step
>1, 67/234, d1=0.025, d2=0.022 g=4.037
4/4 [==============================] - 0s 4ms/step
>1, 68/234, d1=0.018, d2=0.020 g=4.126
4/4 [==============================] - 0s 4ms/step
>1, 69/234, d1=0.008, d2=0.017 g=4.204
4/4 [==============================] - 0s 5ms/step
>1, 70/234, d1=0.009, d2=0.015 g=4.368
4/4 [==============================] - 0s 9ms/step
>1, 71/234, d1=0.010, d2=0.014 g=4.410
4/4 [==============================] - 0s 5ms/step
>1, 72/234, d1=0.022, d2=0.015 g=4.330
4/4 [==============================] - 0s 5ms/step
>1, 73/234, d1=0.008, d2=0.015 g=4.404
4/4 [==============================] - 0s 5ms/step
>1, 74/234, d1=0.010, d2=0.013 g=4.479
4/4 [==============================] - 0s 5ms/step
>1, 75/234, d1=0.017, d2=0.014 g=4.462
4/4 [==============================] - 0s 7ms/step
>1, 76/234, d1=0.012, d2=0.014 g=4.526
4/4 [==============================] - 0s 8ms/step
>1, 77/234, d1=0.016, d2=0.014 g=4.482
4/4 [==============================] - 0s 8ms/step
>1, 78/234, d1=0.024, d2=0.015 g=4.470
4/4 [==============================] - 0s 5ms/step
>1, 79/234, d1=0.008, d2=0.015 g=4.382
4/4 [==============================] - 0s 5ms/step
>1, 80/234, d1=0.014, d2=0.721 g=3.381
4/4 [==============================] - 0s 5ms/step
>1, 81/234, d1=0.161, d2=21.684 g=0.000
4/4 [==============================] - 0s 5ms/step
>1, 82/234, d1=0.424, d2=16.108 g=0.000
4/4 [==============================] - 0s 6ms/step
>1, 83/234, d1=0.228, d2=9.256 g=0.003
4/4 [==============================] - 0s 10ms/step
>1, 84/234, d1=0.142, d2=4.881 g=0.068
4/4 [==============================] - 0s 4ms/step
>1, 85/234, d1=0.115, d2=2.064 g=0.513
4/4 [==============================] - 0s 4ms/step
>1, 86/234, d1=0.145, d2=0.846 g=1.100
4/4 [==============================] - 0s 4ms/step
>1, 87/234, d1=0.127, d2=0.329 g=1.708
4/4 [==============================] - 0s 4ms/step
>1, 88/234, d1=0.084, d2=0.161 g=2.206
4/4 [==============================] - 0s 8ms/step
>1, 89/234, d1=0.085, d2=0.107 g=2.558
4/4 [==============================] - 0s 5ms/step
>1, 90/234, d1=0.082, d2=0.084 g=2.697
4/4 [==============================] - 0s 5ms/step
>1, 91/234, d1=0.047, d2=0.065 g=2.879
4/4 [==============================] - 0s 3ms/step
>1, 92/234, d1=0.044, d2=0.061 g=2.982
4/4 [==============================] - 0s 4ms/step
>1, 93/234, d1=0.038, d2=0.055 g=3.089
4/4 [==============================] - 0s 4ms/step
>1, 94/234, d1=0.036, d2=0.047 g=3.217
4/4 [==============================] - 0s 4ms/step
>1, 95/234, d1=0.059, d2=0.044 g=3.270
4/4 [==============================] - 0s 3ms/step
>1, 96/234, d1=0.031, d2=0.046 g=3.193
```

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4/4 [==============================] - 0s 4ms/step
>1, 97/234, d1=0.027, d2=0.057 g=3.086
4/4 [==============================] - 0s 4ms/step
>1, 98/234, d1=0.022, d2=0.203 g=1.863
4/4 [==============================] - 0s 3ms/step
>1, 99/234, d1=0.026, d2=6.153 g=0.063
4/4 [==============================] - 0s 3ms/step
>1, 100/234, d1=0.107, d2=1.686 g=1.489
4/4 [==============================] - 0s 4ms/step
>1, 101/234, d1=0.576, d2=0.162 g=2.577
4/4 [==============================] - 0s 4ms/step
>1, 102/234, d1=0.756, d2=0.166 g=2.037
4/4 [==============================] - 0s 3ms/step
>1, 103/234, d1=0.524, d2=0.356 g=1.431
4/4 [==============================] - 0s 4ms/step
>1, 104/234, d1=0.352, d2=0.597 g=0.949
4/4 [==============================] - 0s 5ms/step
>1, 105/234, d1=0.254, d2=1.036 g=0.675
4/4 [==============================] - 0s 5ms/step
>1, 106/234, d1=0.241, d2=0.663 g=1.029
4/4 [==============================] - 0s 4ms/step
>1, 107/234, d1=0.248, d2=0.648 g=0.906
4/4 [==============================] - 0s 4ms/step
>1, 108/234, d1=0.205, d2=0.588 g=0.922
4/4 [==============================] - 0s 4ms/step
>1, 109/234, d1=0.224, d2=0.649 g=0.869
4/4 [==============================] - 0s 4ms/step
>1, 110/234, d1=0.246, d2=0.706 g=0.777
4/4 [==============================] - 0s 5ms/step
>1, 111/234, d1=0.240, d2=0.887 g=0.586
4/4 [==============================] - 0s 5ms/step
>1, 112/234, d1=0.245, d2=0.884 g=0.581
4/4 [==============================] - 0s 5ms/step
>1, 113/234, d1=0.203, d2=0.961 g=0.518
4/4 [==============================] - 0s 3ms/step
>1, 114/234, d1=0.258, d2=0.908 g=0.568
4/4 [==============================] - 0s 4ms/step
>1, 115/234, d1=0.222, d2=0.940 g=0.555
4/4 [==============================] - 0s 4ms/step
>1, 116/234, d1=0.224, d2=0.977 g=0.530
4/4 [==============================] - 0s 5ms/step
>1, 117/234, d1=0.235, d2=0.957 g=0.543
4/4 [==============================] - 0s 6ms/step
>1, 118/234, d1=0.259, d2=0.962 g=0.533
4/4 [==============================] - 0s 4ms/step
>1, 119/234, d1=0.284, d2=0.962 g=0.545
4/4 [==============================] - 0s 8ms/step
>1, 120/234, d1=0.318, d2=0.942 g=0.545
4/4 [==============================] - 0s 5ms/step
>1, 121/234, d1=0.291, d2=0.956 g=0.561
4/4 [==============================] - 0s 6ms/step
>1, 122/234, d1=0.295, d2=0.934 g=0.569
4/4 [==============================] - 0s 5ms/step
>1, 123/234, d1=0.397, d2=0.943 g=0.569
4/4 [==============================] - 0s 10ms/step
>1, 124/234, d1=0.403, d2=0.936 g=0.567
4/4 [==============================] - 0s 6ms/step
>1, 125/234, d1=0.298, d2=0.933 g=0.583
4/4 [==============================] - 0s 4ms/step
>1, 126/234, d1=0.386, d2=0.901 g=0.618
4/4 [==============================] - 0s 5ms/step
>1, 127/234, d1=0.387, d2=0.843 g=0.714
4/4 [==============================] - 0s 15ms/step
>1, 128/234, d1=0.410, d2=0.770 g=0.716
```

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4/4 [==============================] - 0s 5ms/step
>1, 129/234, d1=0.399, d2=1.050 g=0.518
4/4 [==============================] - 0s 5ms/step
>1, 130/234, d1=0.410, d2=0.984 g=0.583
4/4 [==============================] - 0s 6ms/step
>1, 131/234, d1=0.440, d2=0.979 g=0.560
4/4 [==============================] - 0s 5ms/step
>1, 132/234, d1=0.464, d2=1.052 g=0.526
4/4 [==============================] - 0s 5ms/step
>1, 133/234, d1=0.525, d2=1.053 g=0.547
4/4 [==============================] - 0s 4ms/step
>1, 134/234, d1=0.477, d2=1.034 g=0.551
4/4 [==============================] - 0s 8ms/step
>1, 135/234, d1=0.558, d2=1.039 g=0.558
4/4 [==============================] - 0s 6ms/step
>1, 136/234, d1=0.513, d2=1.008 g=0.570
4/4 [==============================] - 0s 4ms/step
>1, 137/234, d1=0.553, d2=0.992 g=0.585
4/4 [==============================] - 0s 5ms/step
>1, 138/234, d1=0.603, d2=0.956 g=0.600
4/4 [==============================] - 0s 5ms/step
>1, 139/234, d1=0.610, d2=0.994 g=0.618
4/4 [==============================] - 0s 5ms/step
>1, 140/234, d1=0.635, d2=0.946 g=0.632
4/4 [==============================] - 0s 5ms/step
>1, 141/234, d1=0.686, d2=0.926 g=0.644
4/4 [==============================] - 0s 5ms/step
>1, 142/234, d1=0.714, d2=0.940 g=0.641
4/4 [==============================] - 0s 6ms/step
>1, 143/234, d1=0.697, d2=0.915 g=0.649
4/4 [==============================] - 0s 4ms/step
>1, 144/234, d1=0.694, d2=0.914 g=0.680
4/4 [==============================] - 0s 4ms/step
>1, 145/234, d1=0.716, d2=0.939 g=0.698
4/4 [==============================] - 0s 5ms/step
>1, 146/234, d1=0.769, d2=0.880 g=0.713
4/4 [==============================] - 0s 8ms/step
>1, 147/234, d1=0.726, d2=0.863 g=0.739
4/4 [==============================] - 0s 6ms/step
>1, 148/234, d1=0.687, d2=0.829 g=0.771
4/4 [==============================] - 0s 4ms/step
>1, 149/234, d1=0.758, d2=0.801 g=0.770
4/4 [==============================] - 0s 4ms/step
>1, 150/234, d1=0.736, d2=0.830 g=0.737
4/4 [==============================] - 0s 4ms/step
>1, 151/234, d1=0.703, d2=0.789 g=0.777
4/4 [==============================] - 0s 7ms/step
>1, 152/234, d1=0.710, d2=0.759 g=0.832
4/4 [==============================] - 0s 10ms/step
>1, 153/234, d1=0.704, d2=0.715 g=0.860
4/4 [==============================] - 0s 8ms/step
>1, 154/234, d1=0.705, d2=0.711 g=0.879
4/4 [==============================] - 0s 5ms/step
>1, 155/234, d1=0.723, d2=0.697 g=0.881
4/4 [==============================] - 0s 5ms/step
>1, 156/234, d1=0.667, d2=0.713 g=0.834
4/4 [==============================] - 0s 5ms/step
>1, 157/234, d1=0.653, d2=0.698 g=0.920
4/4 [==============================] - 0s 7ms/step
>1, 158/234, d1=0.626, d2=0.619 g=1.000
4/4 [==============================] - 0s 5ms/step
>1, 159/234, d1=0.613, d2=0.764 g=0.772
4/4 [==============================] - 0s 4ms/step
>1, 160/234, d1=0.573, d2=0.871 g=0.791
```

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4/4 [==============================] - 0s 4ms/step
>1, 161/234, d1=0.609, d2=0.611 g=1.062
4/4 [==============================] - 0s 4ms/step
>1, 162/234, d1=0.607, d2=0.461 g=1.275
4/4 [==============================] - 0s 8ms/step
>1, 163/234, d1=0.536, d2=0.359 g=1.430
4/4 [==============================] - 0s 7ms/step
>1, 164/234, d1=0.481, d2=0.306 g=1.532
4/4 [==============================] - 0s 6ms/step
>1, 165/234, d1=0.413, d2=0.282 g=1.639
4/4 [==============================] - 0s 8ms/step
>1, 166/234, d1=0.434, d2=0.262 g=1.681
4/4 [==============================] - 0s 5ms/step
>1, 167/234, d1=0.307, d2=0.230 g=1.785
4/4 [==============================] - 0s 7ms/step
>1, 168/234, d1=0.330, d2=0.229 g=1.823
4/4 [==============================] - 0s 5ms/step
>1, 169/234, d1=0.304, d2=0.203 g=1.913
4/4 [==============================] - 0s 4ms/step
>1, 170/234, d1=0.331, d2=0.187 g=1.919
4/4 [==============================] - 0s 4ms/step
>1, 171/234, d1=0.298, d2=0.185 g=1.888
4/4 [==============================] - 0s 4ms/step
>1, 172/234, d1=0.224, d2=0.178 g=1.986
4/4 [==============================] - 0s 5ms/step
>1, 173/234, d1=0.239, d2=0.174 g=2.050
4/4 [==============================] - 0s 4ms/step
>1, 174/234, d1=0.278, d2=0.167 g=2.051
4/4 [==============================] - 0s 5ms/step
>1, 175/234, d1=0.254, d2=0.171 g=2.064
4/4 [==============================] - 0s 3ms/step
>1, 176/234, d1=0.218, d2=0.163 g=2.082
4/4 [==============================] - 0s 4ms/step
>1, 177/234, d1=0.177, d2=0.154 g=2.109
4/4 [==============================] - 0s 3ms/step
>1, 178/234, d1=0.209, d2=0.195 g=1.927
4/4 [==============================] - 0s 3ms/step
>1, 179/234, d1=0.247, d2=0.316 g=1.565
4/4 [==============================] - 0s 4ms/step
>1, 180/234, d1=0.217, d2=2.766 g=0.166
4/4 [==============================] - 0s 3ms/step
>1, 181/234, d1=0.284, d2=1.875 g=0.418
4/4 [==============================] - 0s 4ms/step
>1, 182/234, d1=0.304, d2=1.125 g=0.759
4/4 [==============================] - 0s 3ms/step
>1, 183/234, d1=0.402, d2=0.969 g=0.808
4/4 [==============================] - 0s 4ms/step
>1, 184/234, d1=0.425, d2=0.967 g=0.781
4/4 [==============================] - 0s 3ms/step
>1, 185/234, d1=0.601, d2=0.869 g=0.817
4/4 [==============================] - 0s 4ms/step
>1, 186/234, d1=0.597, d2=0.872 g=0.815
4/4 [==============================] - 0s 3ms/step
>1, 187/234, d1=0.720, d2=0.708 g=0.907
4/4 [==============================] - 0s 4ms/step
>1, 188/234, d1=0.822, d2=0.781 g=0.890
4/4 [==============================] - 0s 4ms/step
>1, 189/234, d1=0.805, d2=0.728 g=0.932
4/4 [==============================] - 0s 5ms/step
>1, 190/234, d1=0.813, d2=0.696 g=0.904
4/4 [==============================] - 0s 7ms/step
>1, 191/234, d1=0.815, d2=0.681 g=0.951
4/4 [==============================] - 0s 8ms/step
>1, 192/234, d1=0.811, d2=0.681 g=0.966
```

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4/4 [==============================] - 0s 4ms/step
>1, 193/234, d1=0.791, d2=0.668 g=0.999
4/4 [==============================] - 0s 4ms/step
>1, 194/234, d1=0.801, d2=0.624 g=1.038
4/4 [==============================] - 0s 5ms/step
>1, 195/234, d1=0.791, d2=0.592 g=1.002
4/4 [==============================] - 0s 4ms/step
>1, 196/234, d1=0.776, d2=0.625 g=1.002
4/4 [==============================] - 0s 5ms/step
>1, 197/234, d1=0.750, d2=0.630 g=0.990
4/4 [==============================] - 0s 3ms/step
>1, 198/234, d1=0.716, d2=0.589 g=1.006
4/4 [==============================] - 0s 5ms/step
>1, 199/234, d1=0.701, d2=0.607 g=0.998
4/4 [==============================] - 0s 5ms/step
>1, 200/234, d1=0.723, d2=0.733 g=0.886
4/4 [==============================] - 0s 6ms/step
>1, 201/234, d1=0.716, d2=0.629 g=0.992
4/4 [==============================] - 0s 4ms/step
>1, 202/234, d1=0.723, d2=0.608 g=0.993
4/4 [==============================] - 0s 6ms/step
>1, 203/234, d1=0.652, d2=0.689 g=0.907
4/4 [==============================] - 0s 4ms/step
>1, 204/234, d1=0.722, d2=0.754 g=0.850
4/4 [==============================] - 0s 3ms/step
>1, 205/234, d1=0.709, d2=0.631 g=0.975
4/4 [==============================] - 0s 4ms/step
>1, 206/234, d1=0.679, d2=0.536 g=1.104
4/4 [==============================] - 0s 4ms/step
>1, 207/234, d1=0.572, d2=0.541 g=1.131
4/4 [==============================] - 0s 4ms/step
>1, 208/234, d1=0.584, d2=0.854 g=0.754
4/4 [==============================] - 0s 4ms/step
>1, 209/234, d1=0.652, d2=1.007 g=0.683
4/4 [==============================] - 0s 5ms/step
>1, 210/234, d1=0.671, d2=0.664 g=1.018
4/4 [==============================] - 0s 4ms/step
>1, 211/234, d1=0.683, d2=0.501 g=1.217
4/4 [==============================] - 0s 3ms/step
>1, 212/234, d1=0.628, d2=0.440 g=1.279
4/4 [==============================] - 0s 4ms/step
>1, 213/234, d1=0.586, d2=0.591 g=1.014
4/4 [==============================] - 0s 4ms/step
>1, 214/234, d1=0.614, d2=0.970 g=0.644
4/4 [==============================] - 0s 3ms/step
>1, 215/234, d1=0.622, d2=0.922 g=0.740
4/4 [==============================] - 0s 5ms/step
>1, 216/234, d1=0.719, d2=0.670 g=0.969
4/4 [==============================] - 0s 4ms/step
>1, 217/234, d1=0.685, d2=0.516 g=1.161
4/4 [==============================] - 0s 5ms/step
>1, 218/234, d1=0.621, d2=0.481 g=1.202
4/4 [==============================] - 0s 5ms/step
>1, 219/234, d1=0.571, d2=0.610 g=0.986
4/4 [==============================] - 0s 3ms/step
>1, 220/234, d1=0.622, d2=1.001 g=0.662
4/4 [==============================] - 0s 5ms/step
>1, 221/234, d1=0.643, d2=0.908 g=0.765
4/4 [==============================] - 0s 4ms/step
>1, 222/234, d1=0.710, d2=0.602 g=1.039
4/4 [==============================] - 0s 5ms/step
>1, 223/234, d1=0.700, d2=0.525 g=1.139
4/4 [==============================] - 0s 6ms/step
>1, 224/234, d1=0.695, d2=0.567 g=1.064
```

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4/4 [==============================] - 0s 4ms/step
>1, 225/234, d1=0.706, d2=0.708 g=0.872
4/4 [==============================] - 0s 4ms/step
>1, 226/234, d1=0.681, d2=0.761 g=0.827
4/4 [==============================] - 0s 4ms/step
>1, 227/234, d1=0.711, d2=0.701 g=0.928
4/4 [==============================] - 0s 13ms/step
>1, 228/234, d1=0.805, d2=0.579 g=1.032
4/4 [==============================] - 0s 6ms/step
>1, 229/234, d1=0.680, d2=0.532 g=1.072
4/4 [==============================] - 0s 5ms/step
>1, 230/234, d1=0.677, d2=0.535 g=1.080
4/4 [==============================] - 0s 3ms/step
>1, 231/234, d1=0.660, d2=0.589 g=0.972
4/4 [==============================] - 0s 4ms/step
>1, 232/234, d1=0.674, d2=0.788 g=0.789
4/4 [==============================] - 0s 4ms/step
>1, 233/234, d1=0.686, d2=0.806 g=0.777
4/4 [==============================] - 0s 4ms/step
>1, 234/234, d1=0.724, d2=0.639 g=0.987
8/8 [==============================] - 0s 3ms/step
>Accuracy real: 49%, fake: 100%
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.py:3079: UserWar
ning: You are saving your model as an HDF5 file via `model.save()`. This file form
at 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 mo
del.
```

```
4/4 [==============================] - 0s 5ms/step
>2, 1/234, d1=0.733, d2=0.517 g=1.107
4/4 [==============================] - 0s 4ms/step
>2, 2/234, d1=0.725, d2=0.580 g=1.046
4/4 [==============================] - 0s 4ms/step
>2, 3/234, d1=0.629, d2=0.652 g=0.888
4/4 [==============================] - 0s 5ms/step
>2, 4/234, d1=0.666, d2=0.691 g=0.856
4/4 [==============================] - 0s 4ms/step
>2, 5/234, d1=0.686, d2=0.659 g=0.867
4/4 [==============================] - 0s 4ms/step
>2, 6/234, d1=0.663, d2=0.636 g=0.956
4/4 [==============================] - 0s 5ms/step
>2, 7/234, d1=0.625, d2=0.561 g=1.035
4/4 [==============================] - 0s 4ms/step
>2, 8/234, d1=0.624, d2=0.510 g=1.121
4/4 [==============================] - 0s 5ms/step
>2, 9/234, d1=0.605, d2=0.477 g=1.142
4/4 [==============================] - 0s 4ms/step
>2, 10/234, d1=0.569, d2=0.499 g=1.098
4/4 [==============================] - 0s 5ms/step
>2, 11/234, d1=0.545, d2=0.650 g=0.878
4/4 [==============================] - 0s 4ms/step
>2, 12/234, d1=0.567, d2=0.902 g=0.685
4/4 [==============================] - 0s 4ms/step
>2, 13/234, d1=0.627, d2=0.813 g=0.812
4/4 [==============================] - 0s 3ms/step
>2, 14/234, d1=0.611, d2=0.605 g=1.001
4/4 [==============================] - 0s 3ms/step
>2, 15/234, d1=0.648, d2=0.498 g=1.133
4/4 [==============================] - 0s 3ms/step
>2, 16/234, d1=0.627, d2=0.475 g=1.114
4/4 [==============================] - 0s 4ms/step
>2, 17/234, d1=0.632, d2=0.601 g=0.932
4/4 [==============================] - 0s 7ms/step
>2, 18/234, d1=0.630, d2=0.756 g=0.768
4/4 [==============================] - 0s 4ms/step
>2, 19/234, d1=0.561, d2=0.732 g=0.796
4/4 [==============================] - 0s 5ms/step
>2, 20/234, d1=0.627, d2=0.699 g=0.878
4/4 [==============================] - 0s 4ms/step
>2, 21/234, d1=0.642, d2=0.600 g=0.940
4/4 [==============================] - 0s 5ms/step
>2, 22/234, d1=0.617, d2=0.557 g=1.027
4/4 [==============================] - 0s 4ms/step
>2, 23/234, d1=0.574, d2=0.529 g=1.009
4/4 [==============================] - 0s 4ms/step
>2, 24/234, d1=0.577, d2=0.584 g=0.945
4/4 [==============================] - 0s 6ms/step
>2, 25/234, d1=0.544, d2=0.695 g=0.823
4/4 [==============================] - 0s 6ms/step
>2, 26/234, d1=0.602, d2=0.756 g=0.762
4/4 [==============================] - 0s 5ms/step
>2, 27/234, d1=0.605, d2=0.694 g=0.881
4/4 [==============================] - 0s 8ms/step
>2, 28/234, d1=0.633, d2=0.592 g=0.975
4/4 [==============================] - 0s 5ms/step
>2, 29/234, d1=0.616, d2=0.575 g=0.956
4/4 [==============================] - 0s 6ms/step
>2, 30/234, d1=0.623, d2=0.628 g=0.905
4/4 [==============================] - 0s 6ms/step
>2, 31/234, d1=0.577, d2=0.650 g=0.847
4/4 [==============================] - 0s 4ms/step
>2, 32/234, d1=0.590, d2=0.656 g=0.878
```

```
4/4 [==============================] - 0s 4ms/step
>2, 33/234, d1=0.591, d2=0.667 g=0.899
4/4 [==============================] - 0s 4ms/step
>2, 34/234, d1=0.631, d2=0.612 g=0.908
4/4 [==============================] - 0s 4ms/step
>2, 35/234, d1=0.605, d2=0.625 g=0.928
4/4 [==============================] - 0s 3ms/step
>2, 36/234, d1=0.568, d2=0.575 g=0.901
4/4 [==============================] - 0s 5ms/step
>2, 37/234, d1=0.611, d2=0.641 g=0.830
4/4 [==============================] - 0s 4ms/step
>2, 38/234, d1=0.563, d2=0.663 g=0.831
4/4 [==============================] - 0s 4ms/step
>2, 39/234, d1=0.577, d2=0.630 g=0.866
4/4 [==============================] - 0s 4ms/step
>2, 40/234, d1=0.593, d2=0.645 g=0.879
4/4 [==============================] - 0s 4ms/step
>2, 41/234, d1=0.587, d2=0.627 g=0.876
4/4 [==============================] - 0s 4ms/step
>2, 42/234, d1=0.565, d2=0.627 g=0.869
4/4 [==============================] - 0s 4ms/step
>2, 43/234, d1=0.595, d2=0.637 g=0.873
4/4 [==============================] - 0s 4ms/step
>2, 44/234, d1=0.576, d2=0.647 g=0.880
4/4 [==============================] - 0s 6ms/step
>2, 45/234, d1=0.609, d2=0.646 g=0.864
4/4 [==============================] - 0s 4ms/step
>2, 46/234, d1=0.614, d2=0.629 g=0.863
4/4 [==============================] - 0s 4ms/step
>2, 47/234, d1=0.577, d2=0.639 g=0.876
4/4 [==============================] - 0s 5ms/step
>2, 48/234, d1=0.635, d2=0.615 g=0.855
4/4 [==============================] - 0s 4ms/step
>2, 49/234, d1=0.551, d2=0.658 g=0.849
4/4 [==============================] - 0s 4ms/step
>2, 50/234, d1=0.634, d2=0.627 g=0.849
4/4 [==============================] - 0s 3ms/step
>2, 51/234, d1=0.589, d2=0.635 g=0.870
4/4 [==============================] - 0s 3ms/step
>2, 52/234, d1=0.625, d2=0.639 g=0.869
4/4 [==============================] - 0s 4ms/step
>2, 53/234, d1=0.594, d2=0.634 g=0.888
4/4 [==============================] - 0s 5ms/step
>2, 54/234, d1=0.593, d2=0.643 g=0.898
4/4 [==============================] - 0s 4ms/step
>2, 55/234, d1=0.628, d2=0.611 g=0.885
4/4 [==============================] - 0s 4ms/step
>2, 56/234, d1=0.608, d2=0.627 g=0.890
4/4 [==============================] - 0s 4ms/step
>2, 57/234, d1=0.618, d2=0.626 g=0.931
4/4 [==============================] - 0s 4ms/step
>2, 58/234, d1=0.650, d2=0.597 g=0.971
4/4 [==============================] - 0s 4ms/step
>2, 59/234, d1=0.616, d2=0.574 g=0.973
4/4 [==============================] - 0s 4ms/step
>2, 60/234, d1=0.616, d2=0.553 g=0.996
4/4 [==============================] - 0s 4ms/step
>2, 61/234, d1=0.588, d2=0.573 g=0.942
4/4 [==============================] - 0s 4ms/step
>2, 62/234, d1=0.613, d2=0.674 g=0.827
4/4 [==============================] - 0s 7ms/step
>2, 63/234, d1=0.626, d2=0.718 g=0.822
4/4 [==============================] - 0s 4ms/step
>2, 64/234, d1=0.607, d2=0.656 g=0.937
```

```
4/4 [==============================] - 0s 4ms/step
>2, 65/234, d1=0.609, d2=0.537 g=1.081
4/4 [==============================] - 0s 4ms/step
>2, 66/234, d1=0.574, d2=0.492 g=1.145
4/4 [==============================] - 0s 4ms/step
>2, 67/234, d1=0.590, d2=0.497 g=1.089
4/4 [==============================] - 0s 4ms/step
>2, 68/234, d1=0.548, d2=0.650 g=0.905
4/4 [==============================] - 0s 4ms/step
>2, 69/234, d1=0.595, d2=0.843 g=0.744
4/4 [==============================] - 0s 3ms/step
>2, 70/234, d1=0.648, d2=0.828 g=0.786
4/4 [==============================] - 0s 3ms/step
>2, 71/234, d1=0.636, d2=0.708 g=0.941
4/4 [==============================] - 0s 5ms/step
>2, 72/234, d1=0.607, d2=0.533 g=1.143
4/4 [==============================] - 0s 4ms/step
>2, 73/234, d1=0.591, d2=0.455 g=1.243
4/4 [==============================] - 0s 3ms/step
>2, 74/234, d1=0.606, d2=0.420 g=1.274
4/4 [==============================] - 0s 3ms/step
>2, 75/234, d1=0.588, d2=0.458 g=1.160
4/4 [==============================] - 0s 4ms/step
>2, 76/234, d1=0.529, d2=0.531 g=1.021
4/4 [==============================] - 0s 6ms/step
>2, 77/234, d1=0.581, d2=0.698 g=0.796
4/4 [==============================] - 0s 4ms/step
>2, 78/234, d1=0.582, d2=1.009 g=0.640
4/4 [==============================] - 0s 4ms/step
>2, 79/234, d1=0.583, d2=0.764 g=0.873
4/4 [==============================] - 0s 4ms/step
>2, 80/234, d1=0.630, d2=0.522 g=1.117
4/4 [==============================] - 0s 5ms/step
>2, 81/234, d1=0.608, d2=0.416 g=1.253
4/4 [==============================] - 0s 6ms/step
>2, 82/234, d1=0.566, d2=0.392 g=1.299
4/4 [==============================] - 0s 7ms/step
>2, 83/234, d1=0.487, d2=0.508 g=1.121
4/4 [==============================] - 0s 8ms/step
>2, 84/234, d1=0.502, d2=0.677 g=0.886
4/4 [==============================] - 0s 3ms/step
>2, 85/234, d1=0.541, d2=0.763 g=0.777
4/4 [==============================] - 0s 7ms/step
>2, 86/234, d1=0.562, d2=0.746 g=0.815
4/4 [==============================] - 0s 6ms/step
>2, 87/234, d1=0.635, d2=0.701 g=0.877
4/4 [==============================] - 0s 6ms/step
>2, 88/234, d1=0.697, d2=0.620 g=0.975
4/4 [==============================] - 0s 9ms/step
>2, 89/234, d1=0.685, d2=0.515 g=1.059
4/4 [==============================] - 0s 9ms/step
>2, 90/234, d1=0.684, d2=0.463 g=1.139
4/4 [==============================] - 0s 7ms/step
>2, 91/234, d1=0.667, d2=0.480 g=1.205
4/4 [==============================] - 0s 5ms/step
>2, 92/234, d1=0.635, d2=0.481 g=1.185
4/4 [==============================] - 0s 4ms/step
>2, 93/234, d1=0.602, d2=0.522 g=1.162
4/4 [==============================] - 0s 3ms/step
>2, 94/234, d1=0.606, d2=0.646 g=0.996
4/4 [==============================] - 0s 3ms/step
>2, 95/234, d1=0.707, d2=0.915 g=0.758
4/4 [==============================] - 0s 4ms/step
>2, 96/234, d1=0.770, d2=0.787 g=0.917
```

```
4/4 [==============================] - 0s 4ms/step
>2, 97/234, d1=0.770, d2=0.533 g=1.126
4/4 [==============================] - 0s 4ms/step
>2, 98/234, d1=0.756, d2=0.469 g=1.222
4/4 [==============================] - 0s 5ms/step
>2, 99/234, d1=0.673, d2=0.475 g=1.192
4/4 [==============================] - 0s 4ms/step
>2, 100/234, d1=0.704, d2=0.487 g=1.145
4/4 [==============================] - 0s 5ms/step
>2, 101/234, d1=0.678, d2=0.531 g=1.143
4/4 [==============================] - 0s 4ms/step
>2, 102/234, d1=0.733, d2=0.567 g=1.128
4/4 [==============================] - 0s 4ms/step
>2, 103/234, d1=0.694, d2=0.523 g=1.135
4/4 [==============================] - 0s 4ms/step
>2, 104/234, d1=0.789, d2=0.521 g=1.133
4/4 [==============================] - 0s 4ms/step
>2, 105/234, d1=0.794, d2=0.512 g=1.125
4/4 [==============================] - 0s 3ms/step
>2, 106/234, d1=0.751, d2=0.528 g=1.168
4/4 [==============================] - 0s 3ms/step
>2, 107/234, d1=0.756, d2=0.503 g=1.224
4/4 [==============================] - 0s 4ms/step
>2, 108/234, d1=0.704, d2=0.446 g=1.277
4/4 [==============================] - 0s 3ms/step
>2, 109/234, d1=0.689, d2=0.399 g=1.351
4/4 [==============================] - 0s 3ms/step
>2, 110/234, d1=0.617, d2=0.387 g=1.384
4/4 [==============================] - 0s 3ms/step
>2, 111/234, d1=0.595, d2=0.356 g=1.493
4/4 [==============================] - 0s 3ms/step
>2, 112/234, d1=0.584, d2=0.311 g=1.556
4/4 [==============================] - 0s 4ms/step
>2, 113/234, d1=0.544, d2=0.317 g=1.560
4/4 [==============================] - 0s 4ms/step
>2, 114/234, d1=0.507, d2=0.300 g=1.592
4/4 [==============================] - 0s 4ms/step
>2, 115/234, d1=0.530, d2=0.339 g=1.514
4/4 [==============================] - 0s 4ms/step
>2, 116/234, d1=0.460, d2=0.363 g=1.459
4/4 [==============================] - 0s 4ms/step
>2, 117/234, d1=0.526, d2=0.422 g=1.366
4/4 [==============================] - 0s 3ms/step
>2, 118/234, d1=0.540, d2=0.596 g=1.067
4/4 [==============================] - 0s 4ms/step
>2, 119/234, d1=0.559, d2=1.072 g=0.705
4/4 [==============================] - 0s 4ms/step
>2, 120/234, d1=0.678, d2=1.324 g=0.574
4/4 [==============================] - 0s 4ms/step
>2, 121/234, d1=0.715, d2=0.915 g=0.735
4/4 [==============================] - 0s 4ms/step
>2, 122/234, d1=0.737, d2=0.639 g=0.966
4/4 [==============================] - 0s 4ms/step
>2, 123/234, d1=0.732, d2=0.499 g=1.123
4/4 [==============================] - 0s 5ms/step
>2, 124/234, d1=0.597, d2=0.401 g=1.266
4/4 [==============================] - 0s 4ms/step
>2, 125/234, d1=0.529, d2=0.341 g=1.405
4/4 [==============================] - 0s 4ms/step
>2, 126/234, d1=0.469, d2=0.310 g=1.464
4/4 [==============================] - 0s 3ms/step
>2, 127/234, d1=0.446, d2=0.274 g=1.535
4/4 [==============================] - 0s 3ms/step
>2, 128/234, d1=0.397, d2=0.267 g=1.552
```

```
4/4 [==============================] - 0s 4ms/step
>2, 129/234, d1=0.359, d2=0.249 g=1.645
4/4 [==============================] - 0s 3ms/step
>2, 130/234, d1=0.323, d2=0.239 g=1.686
4/4 [==============================] - 0s 3ms/step
>2, 131/234, d1=0.326, d2=0.217 g=1.735
4/4 [==============================] - 0s 6ms/step
>2, 132/234, d1=0.289, d2=0.207 g=1.793
4/4 [==============================] - 0s 4ms/step
>2, 133/234, d1=0.290, d2=0.199 g=1.831
4/4 [==============================] - 0s 3ms/step
>2, 134/234, d1=0.268, d2=0.199 g=1.848
4/4 [==============================] - 0s 4ms/step
>2, 135/234, d1=0.218, d2=0.210 g=1.916
4/4 [==============================] - 0s 4ms/step
>2, 136/234, d1=0.250, d2=0.224 g=1.825
4/4 [==============================] - 0s 5ms/step
>2, 137/234, d1=0.214, d2=0.406 g=1.594
4/4 [==============================] - 0s 3ms/step
>2, 138/234, d1=0.253, d2=0.885 g=1.054
4/4 [==============================] - 0s 4ms/step
>2, 139/234, d1=0.349, d2=1.487 g=0.661
4/4 [==============================] - 0s 4ms/step
>2, 140/234, d1=0.491, d2=1.329 g=0.689
4/4 [==============================] - 0s 4ms/step
>2, 141/234, d1=0.765, d2=0.987 g=0.891
4/4 [==============================] - 0s 4ms/step
>2, 142/234, d1=0.916, d2=0.700 g=1.189
4/4 [==============================] - 0s 4ms/step
>2, 143/234, d1=1.021, d2=0.466 g=1.301
4/4 [==============================] - 0s 4ms/step
>2, 144/234, d1=0.936, d2=0.419 g=1.476
4/4 [==============================] - 0s 7ms/step
>2, 145/234, d1=0.816, d2=0.364 g=1.512
4/4 [==============================] - 0s 3ms/step
>2, 146/234, d1=0.720, d2=0.314 g=1.599
4/4 [==============================] - 0s 5ms/step
>2, 147/234, d1=0.631, d2=0.292 g=1.676
4/4 [==============================] - 0s 4ms/step
>2, 148/234, d1=0.629, d2=0.282 g=1.636
4/4 [==============================] - 0s 12ms/step
>2, 149/234, d1=0.567, d2=0.277 g=1.593
4/4 [==============================] - 0s 5ms/step
>2, 150/234, d1=0.455, d2=0.283 g=1.601
4/4 [==============================] - 0s 5ms/step
>2, 151/234, d1=0.498, d2=0.338 g=1.570
4/4 [==============================] - 0s 8ms/step
>2, 152/234, d1=0.476, d2=0.354 g=1.533
4/4 [==============================] - 0s 8ms/step
>2, 153/234, d1=0.455, d2=0.410 g=1.416
4/4 [==============================] - 0s 9ms/step
>2, 154/234, d1=0.603, d2=0.530 g=1.306
4/4 [==============================] - 0s 6ms/step
>2, 155/234, d1=0.637, d2=0.657 g=1.031
4/4 [==============================] - 0s 6ms/step
>2, 156/234, d1=0.647, d2=0.857 g=0.949
4/4 [==============================] - 0s 6ms/step
>2, 157/234, d1=0.658, d2=0.721 g=1.024
4/4 [==============================] - 0s 4ms/step
>2, 158/234, d1=0.803, d2=0.548 g=1.234
4/4 [==============================] - 0s 3ms/step
>2, 159/234, d1=0.741, d2=0.389 g=1.406
4/4 [==============================] - 0s 4ms/step
>2, 160/234, d1=0.670, d2=0.311 g=1.493
```

```
4/4 [==============================] - 0s 4ms/step
>2, 161/234, d1=0.609, d2=0.291 g=1.559
4/4 [==============================] - 0s 4ms/step
>2, 162/234, d1=0.561, d2=0.285 g=1.526
4/4 [==============================] - 0s 3ms/step
>2, 163/234, d1=0.410, d2=0.328 g=1.617
4/4 [==============================] - 0s 4ms/step
>2, 164/234, d1=0.402, d2=0.351 g=1.583
4/4 [==============================] - 0s 3ms/step
>2, 165/234, d1=0.424, d2=0.364 g=1.469
4/4 [==============================] - 0s 4ms/step
>2, 166/234, d1=0.421, d2=0.439 g=1.409
4/4 [==============================] - 0s 4ms/step
>2, 167/234, d1=0.538, d2=0.491 g=1.373
4/4 [==============================] - 0s 4ms/step
>2, 168/234, d1=0.538, d2=0.506 g=1.235
4/4 [==============================] - 0s 4ms/step
>2, 169/234, d1=0.601, d2=0.582 g=1.257
4/4 [==============================] - 0s 4ms/step
>2, 170/234, d1=0.683, d2=0.543 g=1.290
4/4 [==============================] - 0s 3ms/step
>2, 171/234, d1=0.674, d2=0.479 g=1.342
4/4 [==============================] - 0s 3ms/step
>2, 172/234, d1=0.666, d2=0.437 g=1.375
4/4 [==============================] - 0s 4ms/step
>2, 173/234, d1=0.740, d2=0.392 g=1.422
4/4 [==============================] - 0s 4ms/step
>2, 174/234, d1=0.628, d2=0.362 g=1.546
4/4 [==============================] - 0s 6ms/step
>2, 175/234, d1=0.573, d2=0.303 g=1.574
4/4 [==============================] - 0s 3ms/step
>2, 176/234, d1=0.599, d2=0.305 g=1.608
4/4 [==============================] - 0s 3ms/step
>2, 177/234, d1=0.546, d2=0.291 g=1.606
4/4 [==============================] - 0s 5ms/step
>2, 178/234, d1=0.462, d2=0.277 g=1.662
4/4 [==============================] - 0s 4ms/step
>2, 179/234, d1=0.467, d2=0.298 g=1.671
4/4 [==============================] - 0s 4ms/step
>2, 180/234, d1=0.444, d2=0.285 g=1.719
4/4 [==============================] - 0s 3ms/step
>2, 181/234, d1=0.516, d2=0.296 g=1.632
4/4 [==============================] - 0s 4ms/step
>2, 182/234, d1=0.426, d2=0.326 g=1.626
4/4 [==============================] - 0s 4ms/step
>2, 183/234, d1=0.458, d2=0.342 g=1.603
4/4 [==============================] - 0s 4ms/step
>2, 184/234, d1=0.424, d2=0.377 g=1.469
4/4 [==============================] - 0s 4ms/step
>2, 185/234, d1=0.484, d2=0.481 g=1.335
4/4 [==============================] - 0s 5ms/step
>2, 186/234, d1=0.495, d2=0.559 g=1.273
4/4 [==============================] - 0s 4ms/step
>2, 187/234, d1=0.566, d2=0.628 g=1.185
4/4 [==============================] - 0s 4ms/step
>2, 188/234, d1=0.585, d2=0.596 g=1.120
4/4 [==============================] - 0s 4ms/step
>2, 189/234, d1=0.626, d2=0.560 g=1.156
4/4 [==============================] - 0s 4ms/step
>2, 190/234, d1=0.560, d2=0.431 g=1.277
4/4 [==============================] - 0s 3ms/step
>2, 191/234, d1=0.545, d2=0.360 g=1.469
4/4 [==============================] - 0s 3ms/step
>2, 192/234, d1=0.517, d2=0.318 g=1.526
```

```
4/4 [==============================] - 0s 4ms/step
>2, 193/234, d1=0.439, d2=0.277 g=1.706
4/4 [==============================] - 0s 4ms/step
>2, 194/234, d1=0.425, d2=0.249 g=1.751
4/4 [==============================] - 0s 4ms/step
>2, 195/234, d1=0.352, d2=0.225 g=1.795
4/4 [==============================] - 0s 4ms/step
>2, 196/234, d1=0.320, d2=0.239 g=1.871
4/4 [==============================] - 0s 6ms/step
>2, 197/234, d1=0.324, d2=0.236 g=1.796
4/4 [==============================] - 0s 4ms/step
>2, 198/234, d1=0.316, d2=0.243 g=1.750
4/4 [==============================] - 0s 4ms/step
>2, 199/234, d1=0.297, d2=0.379 g=1.575
4/4 [==============================] - 0s 4ms/step
>2, 200/234, d1=0.285, d2=0.441 g=1.433
4/4 [==============================] - 0s 3ms/step
>2, 201/234, d1=0.414, d2=0.589 g=1.165
4/4 [==============================] - 0s 3ms/step
>2, 202/234, d1=0.504, d2=0.721 g=1.118
4/4 [==============================] - 0s 4ms/step
>2, 203/234, d1=0.554, d2=0.703 g=1.143
4/4 [==============================] - 0s 5ms/step
>2, 204/234, d1=0.700, d2=0.610 g=1.281
4/4 [==============================] - 0s 3ms/step
>2, 205/234, d1=0.682, d2=0.498 g=1.410
4/4 [==============================] - 0s 4ms/step
>2, 206/234, d1=0.716, d2=0.408 g=1.550
4/4 [==============================] - 0s 5ms/step
>2, 207/234, d1=0.665, d2=0.288 g=1.704
4/4 [==============================] - 0s 5ms/step
>2, 208/234, d1=0.600, d2=0.258 g=1.796
4/4 [==============================] - 0s 5ms/step
>2, 209/234, d1=0.518, d2=0.271 g=1.856
4/4 [==============================] - 0s 6ms/step
>2, 210/234, d1=0.493, d2=0.249 g=1.925
4/4 [==============================] - 0s 5ms/step
>2, 211/234, d1=0.440, d2=0.259 g=1.928
4/4 [==============================] - 0s 4ms/step
>2, 212/234, d1=0.447, d2=0.253 g=1.920
4/4 [==============================] - 0s 4ms/step
>2, 213/234, d1=0.397, d2=0.243 g=1.791
4/4 [==============================] - 0s 6ms/step
>2, 214/234, d1=0.387, d2=0.310 g=1.813
4/4 [==============================] - 0s 4ms/step
>2, 215/234, d1=0.474, d2=0.356 g=1.663
4/4 [==============================] - 0s 5ms/step
>2, 216/234, d1=0.418, d2=0.439 g=1.572
4/4 [==============================] - 0s 3ms/step
>2, 217/234, d1=0.470, d2=0.560 g=1.443
4/4 [==============================] - 0s 8ms/step
>2, 218/234, d1=0.587, d2=0.703 g=1.202
4/4 [==============================] - 0s 6ms/step
>2, 219/234, d1=0.673, d2=0.670 g=1.182
4/4 [==============================] - 0s 8ms/step
>2, 220/234, d1=0.688, d2=0.450 g=1.487
4/4 [==============================] - 0s 5ms/step
>2, 221/234, d1=0.614, d2=0.302 g=1.667
4/4 [==============================] - 0s 6ms/step
>2, 222/234, d1=0.615, d2=0.251 g=1.750
4/4 [==============================] - 0s 4ms/step
>2, 223/234, d1=0.425, d2=0.249 g=1.836
4/4 [==============================] - 0s 5ms/step
>2, 224/234, d1=0.375, d2=0.227 g=1.871
```

```
4/4 [==============================] - 0s 11ms/step
>2, 225/234, d1=0.340, d2=0.231 g=1.874
4/4 [==============================] - 0s 6ms/step
>2, 226/234, d1=0.354, d2=0.292 g=1.748
4/4 [==============================] - 0s 4ms/step
>2, 227/234, d1=0.318, d2=0.365 g=1.638
4/4 [==============================] - 0s 4ms/step
>2, 228/234, d1=0.361, d2=0.447 g=1.633
4/4 [==============================] - 0s 4ms/step
>2, 229/234, d1=0.537, d2=0.481 g=1.499
4/4 [==============================] - 0s 3ms/step
>2, 230/234, d1=0.539, d2=0.498 g=1.462
4/4 [==============================] - 0s 4ms/step
>2, 231/234, d1=0.536, d2=0.478 g=1.567
4/4 [==============================] - 0s 4ms/step
>2, 232/234, d1=0.677, d2=0.437 g=1.620
4/4 [==============================] - 0s 8ms/step
>2, 233/234, d1=0.603, d2=0.370 g=1.628
4/4 [==============================] - 0s 15ms/step
>2, 234/234, d1=0.687, d2=0.344 g=1.757
4/4 [==============================] - 0s 6ms/step
>3, 1/234, d1=0.664, d2=0.283 g=1.857
4/4 [==============================] - 0s 4ms/step
>3, 2/234, d1=0.497, d2=0.272 g=1.859
4/4 [==============================] - 0s 5ms/step
>3, 3/234, d1=0.486, d2=0.240 g=1.902
4/4 [==============================] - 0s 8ms/step
>3, 4/234, d1=0.397, d2=0.224 g=1.981
4/4 [==============================] - 0s 8ms/step
>3, 5/234, d1=0.345, d2=0.210 g=2.050
4/4 [==============================] - 0s 4ms/step
>3, 6/234, d1=0.342, d2=0.230 g=2.038
4/4 [==============================] - 0s 4ms/step
>3, 7/234, d1=0.361, d2=0.209 g=2.017
4/4 [==============================] - 0s 4ms/step
>3, 8/234, d1=0.388, d2=0.294 g=1.784
4/4 [==============================] - 0s 4ms/step
>3, 9/234, d1=0.403, d2=0.348 g=1.679
4/4 [==============================] - 0s 4ms/step
>3, 10/234, d1=0.380, d2=0.404 g=1.549
4/4 [==============================] - 0s 3ms/step
>3, 11/234, d1=0.459, d2=0.471 g=1.471
4/4 [==============================] - 0s 4ms/step
>3, 12/234, d1=0.548, d2=0.507 g=1.346
4/4 [==============================] - 0s 4ms/step
>3, 13/234, d1=0.431, d2=0.479 g=1.453
4/4 [==============================] - 0s 4ms/step
>3, 14/234, d1=0.537, d2=0.375 g=1.541
4/4 [==============================] - 0s 4ms/step
>3, 15/234, d1=0.520, d2=0.316 g=1.675
4/4 [==============================] - 0s 4ms/step
>3, 16/234, d1=0.466, d2=0.253 g=1.774
4/4 [==============================] - 0s 5ms/step
>3, 17/234, d1=0.471, d2=0.233 g=1.867
4/4 [==============================] - 0s 4ms/step
>3, 18/234, d1=0.431, d2=0.236 g=1.879
4/4 [==============================] - 0s 3ms/step
>3, 19/234, d1=0.333, d2=0.248 g=1.978
4/4 [==============================] - 0s 3ms/step
>3, 20/234, d1=0.331, d2=0.231 g=2.055
4/4 [==============================] - 0s 4ms/step
>3, 21/234, d1=0.324, d2=0.195 g=2.004
4/4 [==============================] - 0s 4ms/step
>3, 22/234, d1=0.339, d2=0.268 g=1.792
```

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4/4 [==============================] - 0s 4ms/step
>3, 23/234, d1=0.283, d2=0.323 g=1.839
4/4 [==============================] - 0s 5ms/step
>3, 24/234, d1=0.365, d2=0.401 g=1.688
4/4 [==============================] - 0s 4ms/step
>3, 25/234, d1=0.333, d2=0.441 g=1.620
4/4 [==============================] - 0s 5ms/step
>3, 26/234, d1=0.448, d2=0.501 g=1.511
4/4 [==============================] - 0s 5ms/step
>3, 27/234, d1=0.554, d2=0.437 g=1.595
4/4 [==============================] - 0s 5ms/step
>3, 28/234, d1=0.572, d2=0.431 g=1.583
4/4 [==============================] - 0s 4ms/step
>3, 29/234, d1=0.575, d2=0.443 g=1.702
4/4 [==============================] - 0s 4ms/step
>3, 30/234, d1=0.545, d2=0.302 g=1.922
4/4 [==============================] - 0s 5ms/step
>3, 31/234, d1=0.517, d2=0.260 g=2.054
4/4 [==============================] - 0s 6ms/step
>3, 32/234, d1=0.432, d2=0.219 g=2.264
4/4 [==============================] - 0s 4ms/step
>3, 33/234, d1=0.493, d2=0.182 g=2.224
4/4 [==============================] - 0s 6ms/step
>3, 34/234, d1=0.407, d2=0.200 g=2.208
4/4 [==============================] - 0s 4ms/step
>3, 35/234, d1=0.359, d2=0.207 g=2.109
4/4 [==============================] - 0s 4ms/step
>3, 36/234, d1=0.283, d2=0.205 g=2.248
4/4 [==============================] - 0s 5ms/step
>3, 37/234, d1=0.343, d2=0.195 g=2.254
4/4 [==============================] - 0s 4ms/step
>3, 38/234, d1=0.224, d2=0.205 g=2.217
4/4 [==============================] - 0s 5ms/step
>3, 39/234, d1=0.274, d2=0.223 g=2.075
4/4 [==============================] - 0s 5ms/step
>3, 40/234, d1=0.331, d2=0.271 g=1.865
4/4 [==============================] - 0s 4ms/step
>3, 41/234, d1=0.308, d2=0.454 g=1.767
4/4 [==============================] - 0s 5ms/step
>3, 42/234, d1=0.332, d2=0.529 g=1.550
4/4 [==============================] - 0s 4ms/step
>3, 43/234, d1=0.519, d2=0.630 g=1.377
4/4 [==============================] - 0s 3ms/step
>3, 44/234, d1=0.547, d2=0.464 g=1.513
4/4 [==============================] - 0s 4ms/step
>3, 45/234, d1=0.532, d2=0.351 g=1.741
4/4 [==============================] - 0s 4ms/step
>3, 46/234, d1=0.548, d2=0.237 g=2.012
4/4 [==============================] - 0s 5ms/step
>3, 47/234, d1=0.465, d2=0.233 g=2.143
4/4 [==============================] - 0s 4ms/step
>3, 48/234, d1=0.412, d2=0.198 g=2.111
4/4 [==============================] - 0s 4ms/step
>3, 49/234, d1=0.284, d2=0.209 g=2.223
4/4 [==============================] - 0s 3ms/step
>3, 50/234, d1=0.350, d2=0.202 g=2.185
4/4 [==============================] - 0s 4ms/step
>3, 51/234, d1=0.297, d2=0.255 g=2.082
4/4 [==============================] - 0s 7ms/step
>3, 52/234, d1=0.266, d2=0.274 g=2.102
4/4 [==============================] - 0s 6ms/step
>3, 53/234, d1=0.285, d2=0.347 g=1.862
4/4 [==============================] - 0s 6ms/step
>3, 54/234, d1=0.349, d2=0.393 g=1.773
```

```
4/4 [==============================] - 0s 3ms/step
>3, 55/234, d1=0.340, d2=0.442 g=1.639
4/4 [==============================] - 0s 3ms/step
>3, 56/234, d1=0.455, d2=0.421 g=1.617
4/4 [==============================] - 0s 3ms/step
>3, 57/234, d1=0.484, d2=0.441 g=1.667
4/4 [==============================] - 0s 4ms/step
>3, 58/234, d1=0.536, d2=0.363 g=1.740
4/4 [==============================] - 0s 5ms/step
>3, 59/234, d1=0.505, d2=0.380 g=1.918
4/4 [==============================] - 0s 7ms/step
>3, 60/234, d1=0.492, d2=0.231 g=2.147
4/4 [==============================] - 0s 7ms/step
>3, 61/234, d1=0.480, d2=0.199 g=2.322
4/4 [==============================] - 0s 5ms/step
>3, 62/234, d1=0.441, d2=0.180 g=2.356
4/4 [==============================] - 0s 5ms/step
>3, 63/234, d1=0.405, d2=0.199 g=2.488
4/4 [==============================] - 0s 3ms/step
>3, 64/234, d1=0.369, d2=0.170 g=2.443
4/4 [==============================] - 0s 3ms/step
>3, 65/234, d1=0.304, d2=0.178 g=2.435
4/4 [==============================] - 0s 6ms/step
>3, 66/234, d1=0.289, d2=0.203 g=2.476
4/4 [==============================] - 0s 4ms/step
>3, 67/234, d1=0.301, d2=0.205 g=2.194
4/4 [==============================] - 0s 8ms/step
>3, 68/234, d1=0.280, d2=0.297 g=1.913
4/4 [==============================] - 0s 8ms/step
>3, 69/234, d1=0.387, d2=0.614 g=1.714
4/4 [==============================] - 0s 6ms/step
>3, 70/234, d1=0.410, d2=0.852 g=1.410
4/4 [==============================] - 0s 7ms/step
>3, 71/234, d1=0.591, d2=0.590 g=1.535
4/4 [==============================] - 0s 4ms/step
>3, 72/234, d1=0.650, d2=0.279 g=1.990
4/4 [==============================] - 0s 4ms/step
>3, 73/234, d1=0.685, d2=0.208 g=2.110
4/4 [==============================] - 0s 6ms/step
>3, 74/234, d1=0.469, d2=0.224 g=2.059
4/4 [==============================] - 0s 6ms/step
>3, 75/234, d1=0.327, d2=0.213 g=2.212
4/4 [==============================] - 0s 5ms/step
>3, 76/234, d1=0.367, d2=0.181 g=2.263
4/4 [==============================] - 0s 4ms/step
>3, 77/234, d1=0.289, d2=0.170 g=2.298
4/4 [==============================] - 0s 3ms/step
>3, 78/234, d1=0.288, d2=0.173 g=2.372
4/4 [==============================] - 0s 3ms/step
>3, 79/234, d1=0.238, d2=0.182 g=2.488
4/4 [==============================] - 0s 3ms/step
>3, 80/234, d1=0.213, d2=0.161 g=2.465
4/4 [==============================] - 0s 4ms/step
>3, 81/234, d1=0.203, d2=0.131 g=2.653
4/4 [==============================] - 0s 6ms/step
>3, 82/234, d1=0.225, d2=0.114 g=2.478
4/4 [==============================] - 0s 4ms/step
>3, 83/234, d1=0.205, d2=0.364 g=2.330
4/4 [==============================] - 0s 5ms/step
>3, 84/234, d1=0.237, d2=0.536 g=1.939
4/4 [==============================] - 0s 4ms/step
>3, 85/234, d1=0.309, d2=0.522 g=1.812
4/4 [==============================] - 0s 5ms/step
>3, 86/234, d1=0.593, d2=0.509 g=1.744
```

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4/4 [==============================] - 0s 5ms/step
>3, 87/234, d1=0.604, d2=0.474 g=1.930
4/4 [==============================] - 0s 5ms/step
>3, 88/234, d1=0.786, d2=0.388 g=2.101
4/4 [==============================] - 0s 4ms/step
>3, 89/234, d1=0.600, d2=0.251 g=2.440
4/4 [==============================] - 0s 6ms/step
>3, 90/234, d1=0.561, d2=0.236 g=2.490
4/4 [==============================] - 0s 7ms/step
>3, 91/234, d1=0.516, d2=0.226 g=2.529
4/4 [==============================] - 0s 6ms/step
>3, 92/234, d1=0.377, d2=0.185 g=2.595
4/4 [==============================] - 0s 5ms/step
>3, 93/234, d1=0.341, d2=0.182 g=2.591
4/4 [==============================] - 0s 4ms/step
>3, 94/234, d1=0.343, d2=0.142 g=2.670
4/4 [==============================] - 0s 5ms/step
>3, 95/234, d1=0.337, d2=0.178 g=2.594
4/4 [==============================] - 0s 4ms/step
>3, 96/234, d1=0.248, d2=0.176 g=2.474
4/4 [==============================] - 0s 5ms/step
>3, 97/234, d1=0.242, d2=0.155 g=2.476
4/4 [==============================] - 0s 6ms/step
>3, 98/234, d1=0.282, d2=0.195 g=2.259
4/4 [==============================] - 0s 5ms/step
>3, 99/234, d1=0.311, d2=0.249 g=2.070
4/4 [==============================] - 0s 4ms/step
>3, 100/234, d1=0.334, d2=0.306 g=2.007
4/4 [==============================] - 0s 4ms/step
>3, 101/234, d1=0.323, d2=0.383 g=1.921
4/4 [==============================] - 0s 4ms/step
>3, 102/234, d1=0.334, d2=0.473 g=1.652
4/4 [==============================] - 0s 5ms/step
>3, 103/234, d1=0.352, d2=0.425 g=1.551
4/4 [==============================] - 0s 5ms/step
>3, 104/234, d1=0.386, d2=0.476 g=1.771
4/4 [==============================] - 0s 5ms/step
>3, 105/234, d1=0.434, d2=0.304 g=2.017
4/4 [==============================] - 0s 5ms/step
>3, 106/234, d1=0.491, d2=0.226 g=2.140
4/4 [==============================] - 0s 4ms/step
>3, 107/234, d1=0.365, d2=0.187 g=2.146
4/4 [==============================] - 0s 3ms/step
>3, 108/234, d1=0.382, d2=0.229 g=2.270
4/4 [==============================] - 0s 3ms/step
>3, 109/234, d1=0.283, d2=0.211 g=2.355
4/4 [==============================] - 0s 3ms/step
>3, 110/234, d1=0.258, d2=0.191 g=2.404
4/4 [==============================] - 0s 4ms/step
>3, 111/234, d1=0.269, d2=0.210 g=2.185
4/4 [==============================] - 0s 3ms/step
>3, 112/234, d1=0.182, d2=0.298 g=2.107
4/4 [==============================] - 0s 4ms/step
>3, 113/234, d1=0.321, d2=0.317 g=1.923
4/4 [==============================] - 0s 3ms/step
>3, 114/234, d1=0.318, d2=0.407 g=1.854
4/4 [==============================] - 0s 4ms/step
>3, 115/234, d1=0.403, d2=0.402 g=1.884
4/4 [==============================] - 0s 3ms/step
>3, 116/234, d1=0.418, d2=0.332 g=1.994
4/4 [==============================] - 0s 4ms/step
>3, 117/234, d1=0.415, d2=0.273 g=2.189
4/4 [==============================] - 0s 4ms/step
>3, 118/234, d1=0.436, d2=0.221 g=2.349
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4/4 [==============================] - 0s 4ms/step
>3, 119/234, d1=0.431, d2=0.206 g=2.339
4/4 [==============================] - 0s 3ms/step
>3, 120/234, d1=0.482, d2=0.205 g=2.171
4/4 [==============================] - 0s 4ms/step
>3, 121/234, d1=0.349, d2=0.291 g=2.290
4/4 [==============================] - 0s 5ms/step
>3, 122/234, d1=0.359, d2=0.216 g=2.346
4/4 [==============================] - 0s 3ms/step
>3, 123/234, d1=0.301, d2=0.271 g=2.328
4/4 [==============================] - 0s 4ms/step
>3, 124/234, d1=0.409, d2=0.380 g=1.773
4/4 [==============================] - 0s 3ms/step
>3, 125/234, d1=0.415, d2=0.512 g=1.516
4/4 [==============================] - 0s 4ms/step
>3, 126/234, d1=0.448, d2=0.536 g=1.766
4/4 [==============================] - 0s 4ms/step
>3, 127/234, d1=0.463, d2=0.305 g=2.125
4/4 [==============================] - 0s 4ms/step
>3, 128/234, d1=0.476, d2=0.293 g=2.009
4/4 [==============================] - 0s 4ms/step
>3, 129/234, d1=0.388, d2=0.524 g=1.438
4/4 [==============================] - 0s 3ms/step
>3, 130/234, d1=0.465, d2=0.523 g=1.728
4/4 [==============================] - 0s 5ms/step
>3, 131/234, d1=0.510, d2=0.532 g=1.768
4/4 [==============================] - 0s 6ms/step
>3, 132/234, d1=0.689, d2=0.747 g=1.307
4/4 [==============================] - 0s 4ms/step
>3, 133/234, d1=0.691, d2=0.512 g=1.424
4/4 [==============================] - 0s 3ms/step
>3, 134/234, d1=0.603, d2=0.781 g=1.038
4/4 [==============================] - 0s 4ms/step
>3, 135/234, d1=0.603, d2=0.874 g=0.953
4/4 [==============================] - 0s 4ms/step
>3, 136/234, d1=0.735, d2=0.755 g=0.915
4/4 [==============================] - 0s 4ms/step
>3, 137/234, d1=0.757, d2=0.940 g=0.974
4/4 [==============================] - 0s 4ms/step
>3, 138/234, d1=0.683, d2=0.922 g=0.809
4/4 [==============================] - 0s 5ms/step
>3, 139/234, d1=0.825, d2=0.980 g=0.732
4/4 [==============================] - 0s 4ms/step
>3, 140/234, d1=0.781, d2=1.130 g=0.598
4/4 [==============================] - 0s 5ms/step
>3, 141/234, d1=0.764, d2=1.071 g=0.657
4/4 [==============================] - 0s 5ms/step
>3, 142/234, d1=0.818, d2=1.046 g=0.630
4/4 [==============================] - 0s 4ms/step
>3, 143/234, d1=0.797, d2=1.021 g=0.684
4/4 [==============================] - 0s 4ms/step
>3, 144/234, d1=0.802, d2=0.908 g=0.700
4/4 [==============================] - 0s 4ms/step
>3, 145/234, d1=0.918, d2=0.963 g=0.713
4/4 [==============================] - 0s 5ms/step
>3, 146/234, d1=0.712, d2=0.935 g=0.754
4/4 [==============================] - 0s 4ms/step
>3, 147/234, d1=0.703, d2=0.941 g=0.695
4/4 [==============================] - 0s 4ms/step
>3, 148/234, d1=0.764, d2=0.974 g=0.627
4/4 [==============================] - 0s 4ms/step
>3, 149/234, d1=0.798, d2=0.991 g=0.617
4/4 [==============================] - 0s 5ms/step
>3, 150/234, d1=0.704, d2=0.866 g=0.679
```

```
4/4 [==============================] - 0s 7ms/step
>3, 151/234, d1=0.743, d2=0.892 g=0.702
4/4 [==============================] - 0s 5ms/step
>3, 152/234, d1=0.747, d2=0.843 g=0.687
4/4 [==============================] - 0s 5ms/step
>3, 153/234, d1=0.884, d2=0.872 g=0.725
4/4 [==============================] - 0s 5ms/step
>3, 154/234, d1=0.756, d2=0.796 g=0.724
4/4 [==============================] - 0s 4ms/step
>3, 155/234, d1=0.663, d2=0.818 g=0.756
4/4 [==============================] - 0s 6ms/step
>3, 156/234, d1=0.648, d2=0.766 g=0.757
4/4 [==============================] - 0s 4ms/step
>3, 157/234, d1=0.760, d2=0.751 g=0.787
4/4 [==============================] - 0s 4ms/step
>3, 158/234, d1=0.657, d2=0.731 g=0.819
4/4 [==============================] - 0s 4ms/step
>3, 159/234, d1=0.708, d2=0.713 g=0.802
4/4 [==============================] - 0s 6ms/step
>3, 160/234, d1=0.619, d2=0.675 g=0.860
4/4 [==============================] - 0s 6ms/step
>3, 161/234, d1=0.533, d2=0.648 g=0.899
4/4 [==============================] - 0s 6ms/step
>3, 162/234, d1=0.543, d2=0.618 g=0.956
4/4 [==============================] - 0s 5ms/step
>3, 163/234, d1=0.587, d2=0.624 g=0.911
4/4 [==============================] - 0s 4ms/step
>3, 164/234, d1=0.554, d2=0.619 g=0.903
4/4 [==============================] - 0s 4ms/step
>3, 165/234, d1=0.670, d2=0.671 g=0.825
4/4 [==============================] - 0s 3ms/step
>3, 166/234, d1=0.550, d2=0.752 g=0.834
4/4 [==============================] - 0s 4ms/step
>3, 167/234, d1=0.599, d2=0.691 g=0.834
4/4 [==============================] - 0s 4ms/step
>3, 168/234, d1=0.579, d2=0.679 g=0.831
4/4 [==============================] - 0s 4ms/step
>3, 169/234, d1=0.571, d2=0.767 g=0.859
4/4 [==============================] - 0s 4ms/step
>3, 170/234, d1=0.561, d2=0.685 g=0.882
4/4 [==============================] - 0s 4ms/step
>3, 171/234, d1=0.652, d2=0.647 g=0.907
4/4 [==============================] - 0s 4ms/step
>3, 172/234, d1=0.678, d2=0.694 g=0.838
4/4 [==============================] - 0s 5ms/step
>3, 173/234, d1=0.602, d2=0.714 g=0.790
4/4 [==============================] - 0s 4ms/step
>3, 174/234, d1=0.682, d2=0.736 g=0.784
4/4 [==============================] - 0s 4ms/step
>3, 175/234, d1=0.604, d2=0.721 g=0.843
4/4 [==============================] - 0s 4ms/step
>3, 176/234, d1=0.563, d2=0.711 g=0.860
4/4 [==============================] - 0s 5ms/step
>3, 177/234, d1=0.625, d2=0.655 g=0.825
4/4 [==============================] - 0s 3ms/step
>3, 178/234, d1=0.538, d2=0.695 g=0.815
4/4 [==============================] - 0s 5ms/step
>3, 179/234, d1=0.606, d2=0.644 g=0.836
4/4 [==============================] - 0s 3ms/step
>3, 180/234, d1=0.614, d2=0.666 g=0.860
4/4 [==============================] - 0s 5ms/step
>3, 181/234, d1=0.618, d2=0.639 g=0.834
4/4 [==============================] - 0s 4ms/step
>3, 182/234, d1=0.638, d2=0.645 g=0.864
```

```
4/4 [==============================] - 0s 4ms/step
>3, 183/234, d1=0.583, d2=0.672 g=0.832
4/4 [==============================] - 0s 4ms/step
>3, 184/234, d1=0.565, d2=0.638 g=0.852
4/4 [==============================] - 0s 5ms/step
>3, 185/234, d1=0.604, d2=0.678 g=0.850
4/4 [==============================] - 0s 3ms/step
>3, 186/234, d1=0.564, d2=0.682 g=0.852
4/4 [==============================] - 0s 4ms/step
>3, 187/234, d1=0.611, d2=0.676 g=0.837
4/4 [==============================] - 0s 5ms/step
>3, 188/234, d1=0.585, d2=0.739 g=0.841
4/4 [==============================] - 0s 5ms/step
>3, 189/234, d1=0.562, d2=0.682 g=0.843
4/4 [==============================] - 0s 4ms/step
>3, 190/234, d1=0.667, d2=0.715 g=0.830
4/4 [==============================] - 0s 5ms/step
>3, 191/234, d1=0.618, d2=0.779 g=0.814
4/4 [==============================] - 0s 4ms/step
>3, 192/234, d1=0.623, d2=0.775 g=0.781
4/4 [==============================] - 0s 4ms/step
>3, 193/234, d1=0.627, d2=0.833 g=0.788
4/4 [==============================] - 0s 5ms/step
>3, 194/234, d1=0.644, d2=0.824 g=0.784
4/4 [==============================] - 0s 4ms/step
>3, 195/234, d1=0.706, d2=0.773 g=0.870
4/4 [==============================] - 0s 5ms/step
>3, 196/234, d1=0.712, d2=0.673 g=0.933
4/4 [==============================] - 0s 5ms/step
>3, 197/234, d1=0.692, d2=0.615 g=0.971
4/4 [==============================] - 0s 5ms/step
>3, 198/234, d1=0.696, d2=0.583 g=1.049
4/4 [==============================] - 0s 5ms/step
>3, 199/234, d1=0.662, d2=0.533 g=1.094
4/4 [==============================] - 0s 5ms/step
>3, 200/234, d1=0.645, d2=0.498 g=1.131
4/4 [==============================] - 0s 4ms/step
>3, 201/234, d1=0.593, d2=0.478 g=1.127
4/4 [==============================] - 0s 4ms/step
>3, 202/234, d1=0.613, d2=0.512 g=1.077
4/4 [==============================] - 0s 4ms/step
>3, 203/234, d1=0.627, d2=0.561 g=0.974
4/4 [==============================] - 0s 5ms/step
>3, 204/234, d1=0.491, d2=0.700 g=0.831
4/4 [==============================] - 0s 4ms/step
>3, 205/234, d1=0.486, d2=0.786 g=0.759
4/4 [==============================] - 0s 4ms/step
>3, 206/234, d1=0.671, d2=0.819 g=0.747
4/4 [==============================] - 0s 5ms/step
>3, 207/234, d1=0.625, d2=0.795 g=0.744
4/4 [==============================] - 0s 4ms/step
>3, 208/234, d1=0.662, d2=0.746 g=0.776
4/4 [==============================] - 0s 6ms/step
>3, 209/234, d1=0.737, d2=0.677 g=0.835
4/4 [==============================] - 0s 5ms/step
>3, 210/234, d1=0.672, d2=0.687 g=0.828
4/4 [==============================] - 0s 5ms/step
>3, 211/234, d1=0.711, d2=0.716 g=0.894
4/4 [==============================] - 0s 4ms/step
>3, 212/234, d1=0.685, d2=0.656 g=0.893
4/4 [==============================] - 0s 4ms/step
>3, 213/234, d1=0.644, d2=0.631 g=0.904
4/4 [==============================] - 0s 5ms/step
>3, 214/234, d1=0.617, d2=0.591 g=0.950
```

```
4/4 [==============================] - 0s 4ms/step
>3, 215/234, d1=0.677, d2=0.605 g=0.929
4/4 [==============================] - 0s 5ms/step
>3, 216/234, d1=0.678, d2=0.601 g=0.950
4/4 [==============================] - 0s 7ms/step
>3, 217/234, d1=0.653, d2=0.619 g=0.900
4/4 [==============================] - 0s 5ms/step
>3, 218/234, d1=0.654, d2=0.633 g=0.884
4/4 [==============================] - 0s 6ms/step
>3, 219/234, d1=0.649, d2=0.643 g=0.897
4/4 [==============================] - 0s 3ms/step
>3, 220/234, d1=0.678, d2=0.681 g=0.892
4/4 [==============================] - 0s 6ms/step
>3, 221/234, d1=0.653, d2=0.639 g=0.896
4/4 [==============================] - 0s 5ms/step
>3, 222/234, d1=0.643, d2=0.658 g=0.900
4/4 [==============================] - 0s 5ms/step
>3, 223/234, d1=0.707, d2=0.588 g=0.923
4/4 [==============================] - 0s 5ms/step
>3, 224/234, d1=0.759, d2=0.673 g=0.896
4/4 [==============================] - 0s 5ms/step
>3, 225/234, d1=0.688, d2=0.667 g=0.914
4/4 [==============================] - 0s 5ms/step
>3, 226/234, d1=0.676, d2=0.615 g=0.913
4/4 [==============================] - 0s 6ms/step
>3, 227/234, d1=0.677, d2=0.603 g=0.915
4/4 [==============================] - 0s 4ms/step
>3, 228/234, d1=0.764, d2=0.601 g=0.931
4/4 [==============================] - 0s 6ms/step
>3, 229/234, d1=0.683, d2=0.600 g=0.913
4/4 [==============================] - 0s 7ms/step
>3, 230/234, d1=0.695, d2=0.626 g=0.943
4/4 [==============================] - 0s 6ms/step
>3, 231/234, d1=0.759, d2=0.570 g=0.924
4/4 [==============================] - 0s 4ms/step
>3, 232/234, d1=0.686, d2=0.595 g=0.945
4/4 [==============================] - 0s 6ms/step
>3, 233/234, d1=0.684, d2=0.578 g=0.945
4/4 [==============================] - 0s 3ms/step
>3, 234/234, d1=0.711, d2=0.623 g=0.927
```

No se me guardó el notebook y perdí el notebook ejecutado, pero estuve entrenándolo 100 épocas y tengo los pesos en google Drive. No voy a repetir las horas de ejecución que estuve porque fueron muchas y ya me quedan pocas unidades de ejecución de Google Colab, y también por cuestión de tiempo. Voy a mostrar las imágenes generadas y cargar los pesos.

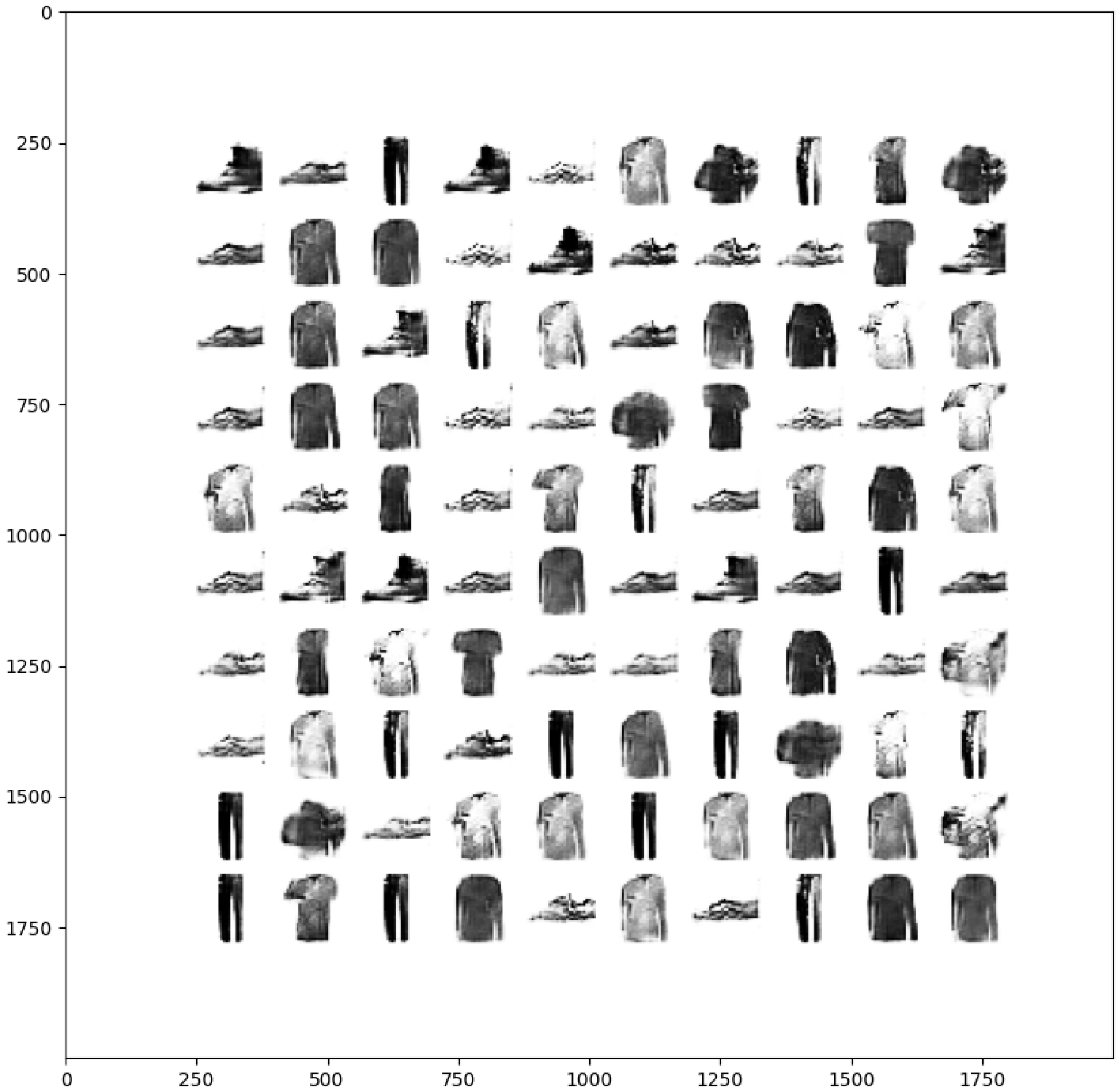
In [36]:
```
%ls $RESULTS_PATH # pesos generados por el entrenamiento de 3 épocas anterior
```

```
cgan_generator_model_001.h5  generated_plot_e001.png
```

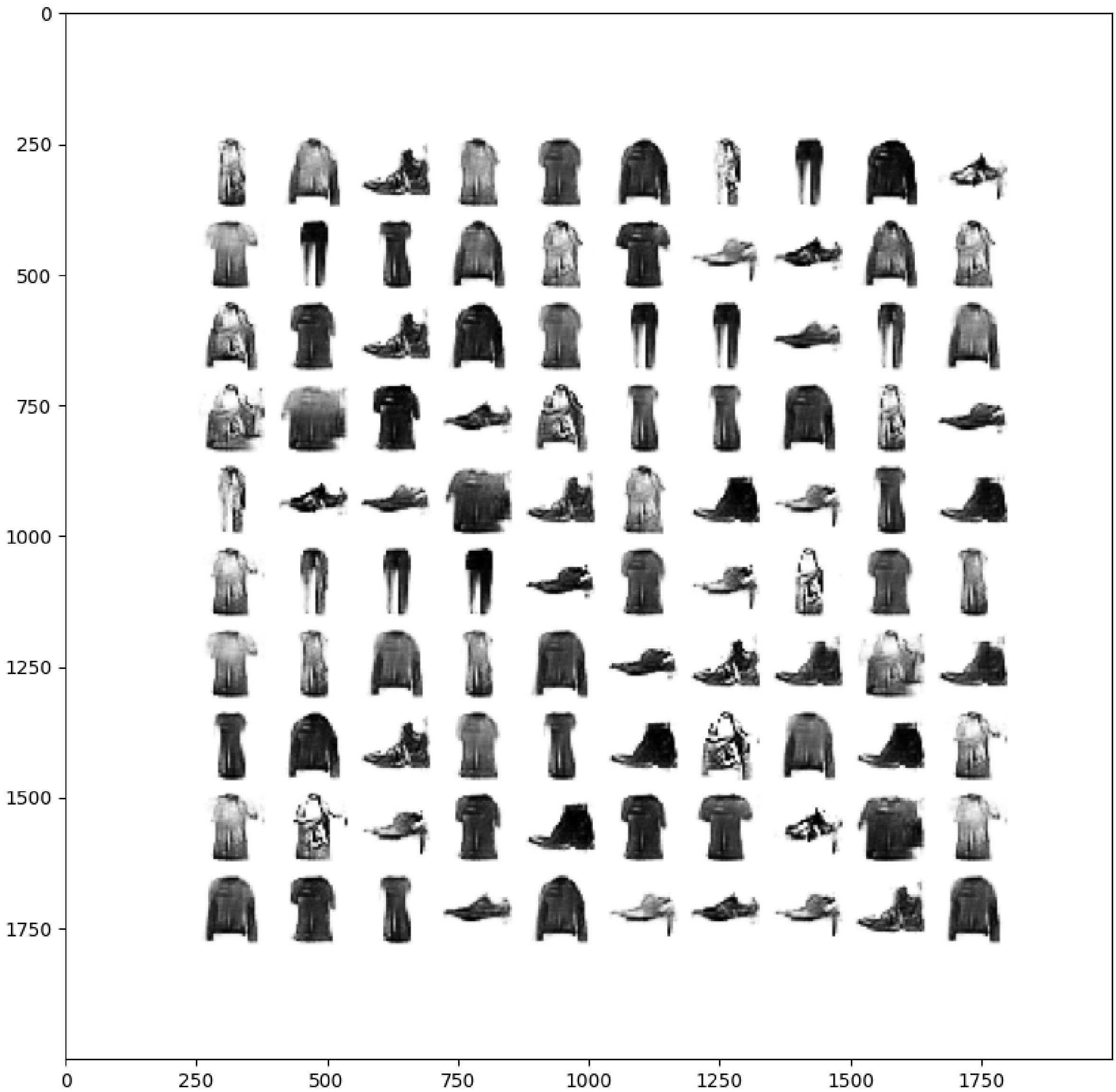
In [37]:
```
%ls $BASE_PATH # pesos generados por
```

```
cgan_generator_model_001.h5  cgan_generator_model_080.h5  generated_plot_e050.png
cgan_generator_model_010.h5  cgan_generator_model_090.h5  generated_plot_e060.png
cgan_generator_model_020.h5  cgan_generator_model_100.h5  generated_plot_e070.png
cgan_generator_model_030.h5  generated_plot_e001.png      generated_plot_e080.png
cgan_generator_model_040.h5  generated_plot_e010.png      generated_plot_e090.png
cgan_generator_model_050.h5  generated_plot_e020.png      generated_plot_e100.png
cgan_generator_model_060.h5  generated_plot_e030.png      generated_plot_e101.png
cgan_generator_model_070.h5  generated_plot_e040.png
```

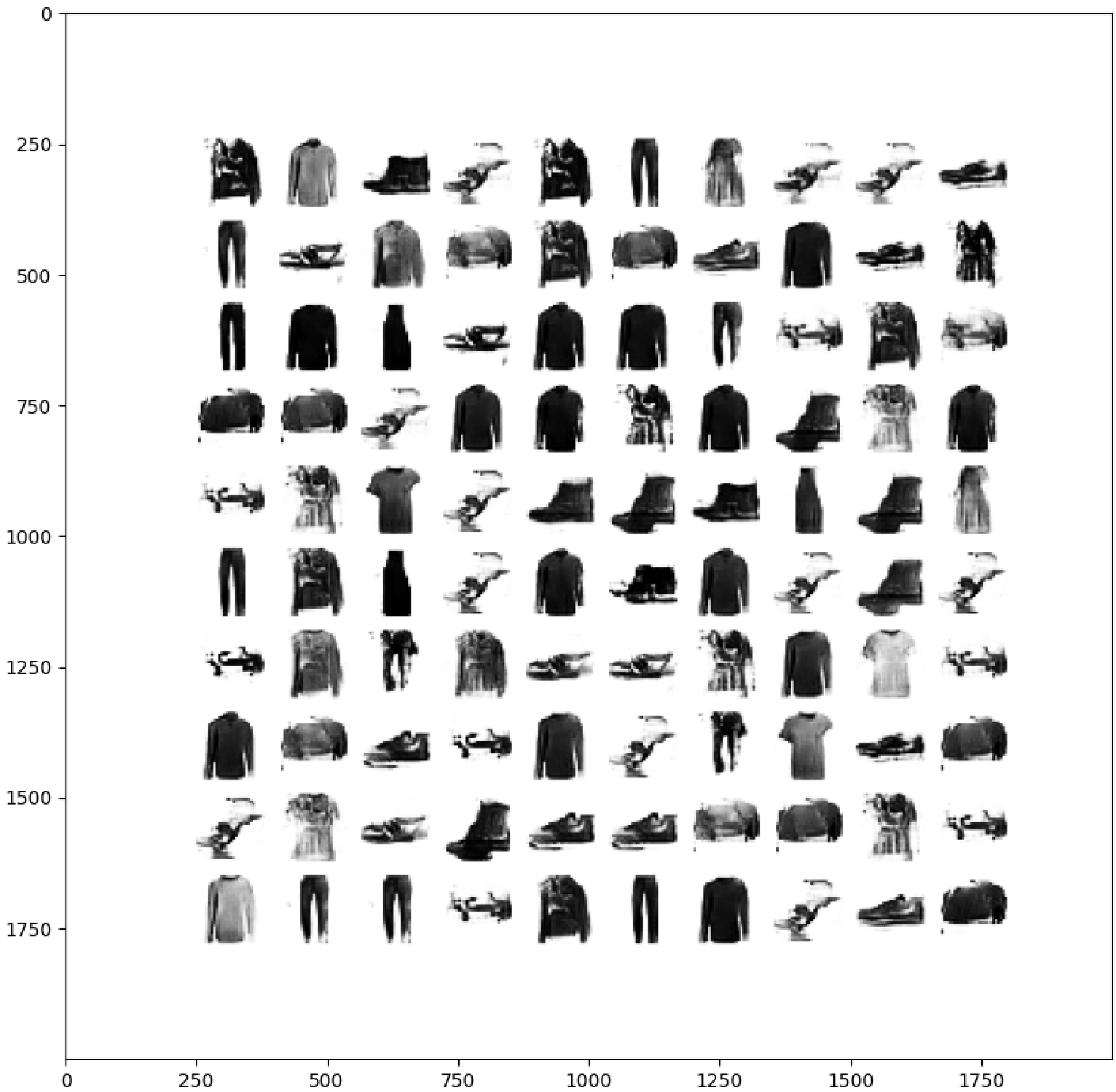
In [38]:
```
plt.figure(figsize=(10, 10))
plt.imshow(plt.imread(os.path.join(BASE_PATH,'generated_plot_e001.png')))
plt.show()
```



In [39]:
```
plt.figure(figsize=(10, 10))
plt.imshow(plt.imread(os.path.join(BASE_PATH,'generated_plot_e010.png')))
plt.show()
```



In [40]:
```
plt.figure(figsize=(10, 10))
plt.imshow(plt.imread(os.path.join(BASE_PATH,'generated_plot_e100.png')))
plt.show()
```



In [51]:
```python
# vamos a generar imágenes de una determinada clase
from tensorflow.keras.models import load_model

# cargamos el modelo
model = load_model(os.path.join(BASE_PATH,'cgan_generator_model_100.h5'))
# generate images
latent_points, labels = generate_latent_points(100, 100)
# specify labels
labels = np.asarray([x for _ in range(10) for x in range(10)])
# generate images
X  = model.predict([latent_points, labels])
# scale from [-1,1] to [0,1]
X = (X + 1) / 2.0
# plot the result
save_plot(X, 100)
```

```
WARNING:tensorflow:No training configuration found in the save file, so the model
was *not* compiled. Compile it manually.
WARNING:tensorflow:5 out of the last 13 calls to <function Model.make_predict_func
tion.<locals>.predict_function at 0x7a8b51b52200> triggered tf.function retracing.
Tracing is expensive and the excessive number of tracings could be due to (1) crea
ting @tf.function repeatedly in a loop, (2) passing tensors with different shapes,
(3) passing Python objects instead of tensors. For (1), please define your @tf.fun
ction outside of the loop. For (2), @tf.function has reduce_retracing=True option
that can avoid unnecessary retracing. For (3), please refer to https://www.tensorf
low.org/guide/function#controlling_retracing and https://www.tensorflow.org/api_do
cs/python/tf/function for  more details.
```

```
4/4 [==============================] - 0s 5ms/step
```

In [53]:
```
plt.figure(figsize=(10, 10))
plt.imshow(plt.imread(os.path.join(RESULTS_PATH,'generated_plot_e101.png')))
plt.show()
```