import numpy as np  
import matplotlib.pyplot as plt  
from tensorflow.keras.layers import Input, Dense  
from tensorflow.keras.models import Model  
from sklearn.datasets import fetch\_lfw\_people  
from skimage.transform import resize  
  
# Load the LFW dataset  
lfw\_people = fetch\_lfw\_people(min\_faces\_per\_person=70, resize=0.4)  
  
# Normalize pixel values to be between 0 and 1  
X = lfw\_people.images.astype('float32') / 255.0  
  
# Resize images to 64x64  
X\_resized = np.array([resize(img, (64, 64), anti\_aliasing=True) for img in X])  
  
# Flatten the images for the autoencoder  
X\_flattened = X\_resized.reshape((len(X\_resized), np.prod(X\_resized.shape[1:])))  
  
# Define the autoencoder model  
encoding\_dim = 128 # Size of the encoded representations  
input\_img = Input(shape=(X\_flattened.shape[1],))  
encoded = Dense(encoding\_dim, activation='relu')(input\_img)  
decoded = Dense(X\_flattened.shape[1], activation='sigmoid')(encoded)  
  
autoencoder = Model(input\_img, decoded)  
  
# Compile the autoencoder  
autoencoder.compile(optimizer='adam', loss='binary\_crossentropy')  
  
# Train the autoencoder  
autoencoder.fit(X\_flattened, X\_flattened, epochs=50, batch\_size=256, shuffle=True, validation\_split=0.2)  
  
# Create a separate encoder model  
encoder = Model(input\_img, encoded)  
  
# Encode the images  
encoded\_imgs = encoder.predict(X\_flattened)  
  
# Decode the encoded images  
decoded\_imgs = autoencoder.predict(X\_flattened)  
  
# Display original and reconstructed images  
n = 10 # Number of images to display  
plt.figure(figsize=(20, 4))  
for i in range(n):  
 # Original images  
 ax = plt.subplot(2, n, i + 1)  
 plt.imshow(X\_flattened[i].reshape(64, 64), cmap='gray')  
 ax.get\_xaxis().set\_visible(False)  
 ax.get\_yaxis().set\_visible(False)  
  
 # Reconstructed images  
 ax = plt.subplot(2, n, i + 1 + n)  
 plt.imshow(decoded\_imgs[i].reshape(64, 64), cmap='gray')  
 ax.get\_xaxis().set\_visible(False)  
 ax.get\_yaxis().set\_visible(False)  
  
plt.show()

Epoch 1/50  
5/5 [==============================] - 2s 150ms/step - loss: 0.6924 - val\_loss: 0.6904  
Epoch 2/50  
5/5 [==============================] - 0s 88ms/step - loss: 0.6892 - val\_loss: 0.6854  
Epoch 3/50  
5/5 [==============================] - 0s 92ms/step - loss: 0.6827 - val\_loss: 0.6739  
Epoch 4/50  
5/5 [==============================] - 1s 95ms/step - loss: 0.6679 - val\_loss: 0.6508  
Epoch 5/50  
5/5 [==============================] - 1s 104ms/step - loss: 0.6402 - val\_loss: 0.6119  
Epoch 6/50  
5/5 [==============================] - 1s 126ms/step - loss: 0.5960 - val\_loss: 0.5557  
Epoch 7/50  
5/5 [==============================] - 1s 143ms/step - loss: 0.5344 - val\_loss: 0.4837  
Epoch 8/50  
5/5 [==============================] - 1s 154ms/step - loss: 0.4583 - val\_loss: 0.4009  
Epoch 9/50  
5/5 [==============================] - 1s 137ms/step - loss: 0.3739 - val\_loss: 0.3158  
Epoch 10/50  
5/5 [==============================] - 1s 115ms/step - loss: 0.2901 - val\_loss: 0.2377  
Epoch 11/50  
5/5 [==============================] - 0s 90ms/step - loss: 0.2157 - val\_loss: 0.1731  
Epoch 12/50  
5/5 [==============================] - 0s 92ms/step - loss: 0.1561 - val\_loss: 0.1246  
Epoch 13/50  
5/5 [==============================] - 0s 82ms/step - loss: 0.1123 - val\_loss: 0.0905  
Epoch 14/50  
5/5 [==============================] - 0s 87ms/step - loss: 0.0822 - val\_loss: 0.0678  
Epoch 15/50  
5/5 [==============================] - 0s 88ms/step - loss: 0.0622 - val\_loss: 0.0528  
Epoch 16/50  
5/5 [==============================] - 0s 94ms/step - loss: 0.0490 - val\_loss: 0.0428  
Epoch 17/50  
5/5 [==============================] - 0s 87ms/step - loss: 0.0403 - val\_loss: 0.0362  
Epoch 18/50  
5/5 [==============================] - 0s 83ms/step - loss: 0.0343 - val\_loss: 0.0315  
Epoch 19/50  
5/5 [==============================] - 0s 90ms/step - loss: 0.0302 - val\_loss: 0.0282  
Epoch 20/50  
5/5 [==============================] - 0s 90ms/step - loss: 0.0272 - val\_loss: 0.0258  
Epoch 21/50  
5/5 [==============================] - 0s 93ms/step - loss: 0.0250 - val\_loss: 0.0240  
Epoch 22/50  
5/5 [==============================] - 0s 85ms/step - loss: 0.0234 - val\_loss: 0.0226  
Epoch 23/50  
5/5 [==============================] - 0s 91ms/step - loss: 0.0221 - val\_loss: 0.0215  
Epoch 24/50  
5/5 [==============================] - 0s 86ms/step - loss: 0.0211 - val\_loss: 0.0206  
Epoch 25/50  
5/5 [==============================] - 0s 82ms/step - loss: 0.0203 - val\_loss: 0.0199  
Epoch 26/50  
5/5 [==============================] - 0s 92ms/step - loss: 0.0196 - val\_loss: 0.0193  
Epoch 27/50  
5/5 [==============================] - 0s 85ms/step - loss: 0.0191 - val\_loss: 0.0188  
Epoch 28/50  
5/5 [==============================] - 0s 88ms/step - loss: 0.0186 - val\_loss: 0.0183  
Epoch 29/50  
5/5 [==============================] - 0s 79ms/step - loss: 0.0182 - val\_loss: 0.0180  
Epoch 30/50  
5/5 [==============================] - 0s 88ms/step - loss: 0.0178 - val\_loss: 0.0176  
Epoch 31/50  
5/5 [==============================] - 0s 88ms/step - loss: 0.0175 - val\_loss: 0.0173  
Epoch 32/50  
5/5 [==============================] - 0s 81ms/step - loss: 0.0173 - val\_loss: 0.0171  
Epoch 33/50  
5/5 [==============================] - 1s 125ms/step - loss: 0.0170 - val\_loss: 0.0169  
Epoch 34/50  
5/5 [==============================] - 1s 126ms/step - loss: 0.0168 - val\_loss: 0.0167  
Epoch 35/50  
5/5 [==============================] - 1s 119ms/step - loss: 0.0166 - val\_loss: 0.0165  
Epoch 36/50  
5/5 [==============================] - 1s 126ms/step - loss: 0.0165 - val\_loss: 0.0163  
Epoch 37/50  
5/5 [==============================] - 1s 124ms/step - loss: 0.0163 - val\_loss: 0.0162  
Epoch 38/50  
5/5 [==============================] - 0s 84ms/step - loss: 0.0162 - val\_loss: 0.0161  
Epoch 39/50  
5/5 [==============================] - 0s 88ms/step - loss: 0.0161 - val\_loss: 0.0160  
Epoch 40/50  
5/5 [==============================] - 0s 88ms/step - loss: 0.0160 - val\_loss: 0.0159  
Epoch 41/50  
5/5 [==============================] - 0s 89ms/step - loss: 0.0159 - val\_loss: 0.0158  
Epoch 42/50  
5/5 [==============================] - 0s 84ms/step - loss: 0.0158 - val\_loss: 0.0157  
Epoch 43/50  
5/5 [==============================] - 0s 82ms/step - loss: 0.0157 - val\_loss: 0.0156  
Epoch 44/50  
5/5 [==============================] - 0s 87ms/step - loss: 0.0157 - val\_loss: 0.0156  
Epoch 45/50  
5/5 [==============================] - 0s 93ms/step - loss: 0.0156 - val\_loss: 0.0155  
Epoch 46/50  
5/5 [==============================] - 0s 86ms/step - loss: 0.0155 - val\_loss: 0.0154  
Epoch 47/50  
5/5 [==============================] - 0s 87ms/step - loss: 0.0155 - val\_loss: 0.0154  
Epoch 48/50  
5/5 [==============================] - 0s 87ms/step - loss: 0.0154 - val\_loss: 0.0154  
Epoch 49/50  
5/5 [==============================] - 0s 87ms/step - loss: 0.0154 - val\_loss: 0.0153  
Epoch 50/50  
5/5 [==============================] - 0s 80ms/step - loss: 0.0154 - val\_loss: 0.0153  
41/41 [==============================] - 0s 5ms/step  
41/41 [==============================] - 0s 9ms/step

