In [1]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call driv
e.mount("/content/drive", force_remount=True).
```

In [ ]:
```
import os
import pickle
from skimage.io import imread
from skimage.transform import resize
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, LabelEncoder
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import classification_report, accuracy_score
from sklearn.model_selection import GridSearchCV
```

In [ ]:
```
input_dir ="/content/drive/MyDrive/Dataset"
categories = ['training_fake','training_real']
```

In [ ]:
```
data = []
labels =[]
```

In [ ]:
```
for category_idx,category in enumerate(categories):
    for file in os.listdir(os.path.join(input_dir, category)):
        img_path = os.path.join(input_dir, category, file)
        img = imread(img_path)
        img = resize(img, (15,15))
        data.append(img.flatten())
        labels.append(category_idx)

data = np.asarray(data)
labels = np.asarray(labels)
```

In [ ]:
```
x_train, x_test , y_train, y_test = train_test_split(data, labels, test_size = 0.2,
```

In [ ]:
```
data
```

Out[ ]:
```
array([[0.21686637, 0.26607724, 0.12056783, ..., 0.43321461, 0.39738475,
        0.28061314],
       [0.59848347, 0.58460734, 0.41847801, ..., 0.63072004, 0.58678159,
        0.44366264],
       [0.7456379 , 0.30116916, 0.40968557, ..., 0.30615458, 0.23674222,
        0.18954393],
       ...,
       [0.26574721, 0.36874194, 0.37025733, ..., 0.10381542, 0.02566318,
        0.10717465],
       [0.44435289, 0.34354007, 0.24239725, ..., 0.32116241, 0.26774909,
        0.16193692],
       [0.79065056, 0.90475585, 0.91075612, ..., 0.59132982, 0.42368649,
        0.44422604]])
```

In [ ]:
```
labels
```

Out[ ]:
```
array([0, 0, 0, ..., 1, 1, 1])
```

In [ ]:
```
count_0 = np.sum(labels == 0)
count_1 = np.sum(labels == 1)
```

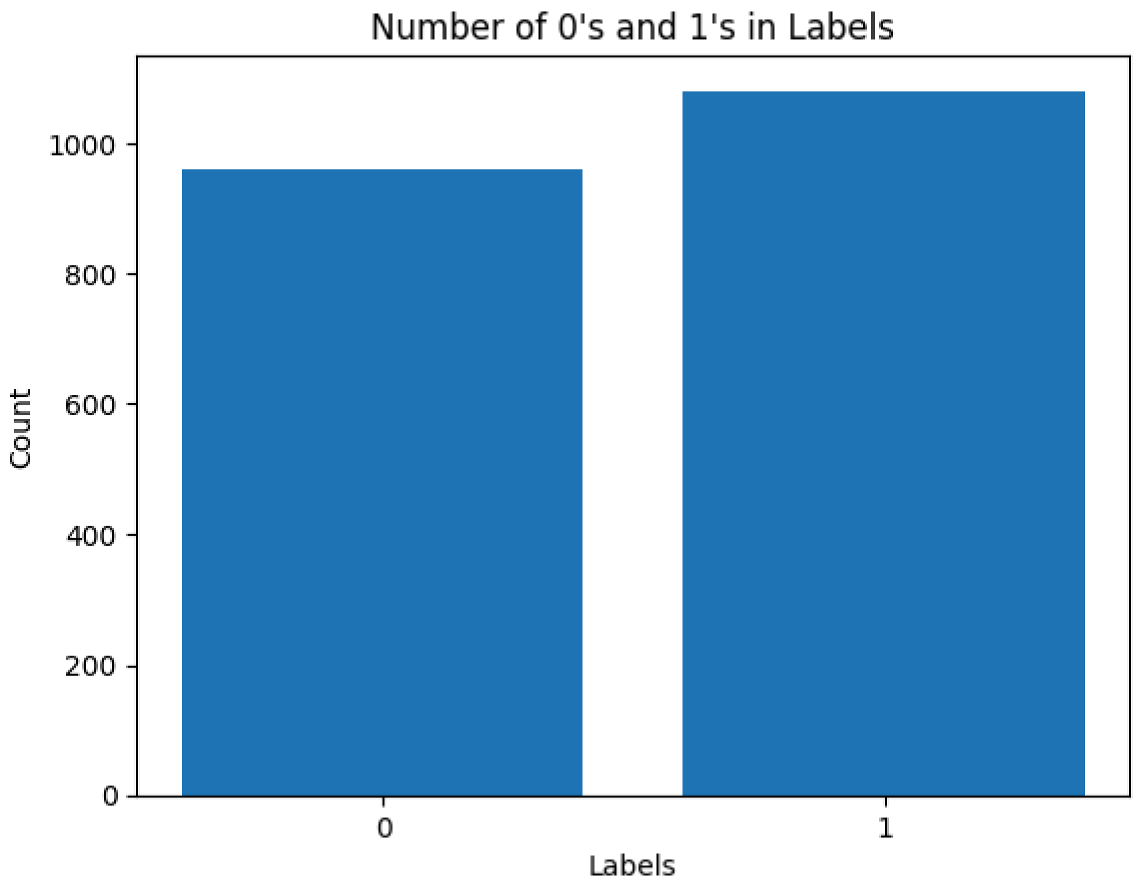
In [ ]:
```
print(count_0, count_1)
```

```
960 1081
```

In [ ]:
```
import matplotlib.pyplot as plt

counts = [count_0, count_1]

plt.bar(['0', '1'], counts)
plt.xlabel('Labels')
plt.ylabel('Count')
plt.title('Number of 0\'s and 1\'s in Labels')
plt.show()
```



In [ ]:
```
classifier =  SVC()

parameters = [{'gamma':[0.01, 0.001, 0.0001 ], 'C':[1,10,100,1000]}]

grid_search = GridSearchCV(classifier, parameters)
grid_search.fit(x_train, y_train)
best_estimator = grid_search.best_estimator_
y_prediction = best_estimator.predict(x_test)
svm_accuracy = accuracy_score(y_test, y_prediction)
print("SVM Accuracy:", svm_accuracy)
svm_classification_report = classification_report(y_test,y_prediction)
print("\nSVM Classification Report:\n", svm_classification_report)


#KNN
knn_model = KNeighborsClassifier()
knn_model.fit(x_train, y_train)
knn_predictions = knn_model.predict(x_test)
knn_accuracy = accuracy_score(y_test, knn_predictions)
print("KNN Accuracy:", knn_accuracy)
knn_classification_report = classification_report(y_test, knn_predictions)
```

```
print("\nKNN Classification Report:\n", knn_classification_report)


#DECISION TREE
dt_model = DecisionTreeClassifier()
dt_model.fit(x_train, y_train)
dt_predictions = dt_model.predict(x_test)
dt_accuracy = accuracy_score(y_test, dt_predictions)
print("\nDecision Tree Accuracy:", dt_accuracy)
dt_classification_report = classification_report(y_test, dt_predictions)
print("Decision Tree Classification Report:\n", dt_classification_report)
```

```
SVM Accuracy: 0.5843520782396088

SVM Classification Report:
               precision    recall  f1-score   support

           0       0.56      0.51      0.54       192
           1       0.60      0.65      0.62       217

    accuracy                           0.58       409
   macro avg       0.58      0.58      0.58       409
weighted avg       0.58      0.58      0.58       409

KNN Accuracy: 0.5232273838630807

KNN Classification Report:
               precision    recall  f1-score   support

           0       0.49      0.54      0.51       192
           1       0.56      0.51      0.53       217

    accuracy                           0.52       409
   macro avg       0.52      0.52      0.52       409
weighted avg       0.53      0.52      0.52       409


Decision Tree Accuracy: 0.5330073349633252
Decision Tree Classification Report:
               precision    recall  f1-score   support

           0       0.50      0.52      0.51       192
           1       0.56      0.55      0.55       217

    accuracy                           0.53       409
   macro avg       0.53      0.53      0.53       409
weighted avg       0.53      0.53      0.53       409
```

In [ ]:

```
import os
import pickle
import numpy as np
from skimage.io import imread
from skimage.transform import resize
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report, accuracy_score
import tensorflow as tf
from tensorflow.keras import layers, models
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

In [ ]:

```
data = []
labels = []
```

```
for category_idx, category in enumerate(categories):
    for file in os.listdir(os.path.join(input_dir, category)):
        img_path = os.path.join(input_dir, category, file)
        img = imread(img_path)
        img = resize(img, (64, 64))
        data.append(img)
        labels.append(category_idx)

data = np.asarray(data)
labels = np.asarray(labels)

# Perform train/test split
x_train, x_test, y_train, y_test = train_test_split(data, labels, test_size=0.2, sh

# Encode labels
label_encoder = LabelEncoder()
y_train_encoded = label_encoder.fit_transform(y_train)
y_test_encoded = label_encoder.transform(y_test)

# Data Augmentation
datagen = ImageDataGenerator(
    rotation_range=20,
    width_shift_range=0.1,
    height_shift_range=0.1,
    horizontal_flip=True,
    vertical_flip=True,
    zoom_range=0.1,
    fill_mode='nearest')

# CNN Model
model = models.Sequential([
    layers.Conv2D(32, (3, 3), activation='relu', input_shape=(64, 64, 3)),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(64, (3, 3), activation='relu'),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(128, (3, 3), activation='relu'),
    layers.MaxPooling2D((2, 2)),
    layers.Flatten(),
    layers.Dropout(0.5),
    layers.Dense(128, activation='relu'),
    layers.Dense(2, activation='softmax')
])


model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

history = model.fit(datagen.flow(x_train, y_train_encoded, batch_size=32),
                    steps_per_epoch=len(x_train) / 32, epochs=100,
                    validation_data=(x_test, y_test_encoded))

test_loss, test_accuracy = model.evaluate(x_test, y_test_encoded)
print("CNN Accuracy:", test_accuracy)

y_pred = np.argmax(model.predict(x_test), axis=-1)

y_pred_decoded = label_encoder.inverse_transform(y_pred)


cnn_classification_report = classification_report(y_test, y_pred_decoded)
print("\nCNN Classification Report:\n", cnn_classification_report)
```

```
Epoch 1/100
51/51 [==============================] - 18s 306ms/step - loss: 0.7005 - accuracy:
0.4945 - val_loss: 0.6926 - val_accuracy: 0.5306
Epoch 2/100
51/51 [==============================] - 13s 262ms/step - loss: 0.6924 - accuracy:
0.5294 - val_loss: 0.6918 - val_accuracy: 0.5306
Epoch 3/100
51/51 [==============================] - 14s 274ms/step - loss: 0.6909 - accuracy:
0.5227 - val_loss: 0.7085 - val_accuracy: 0.5306
Epoch 4/100
51/51 [==============================] - 12s 230ms/step - loss: 0.6946 - accuracy:
0.5276 - val_loss: 0.6919 - val_accuracy: 0.5306
Epoch 5/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6920 - accuracy:
0.5294 - val_loss: 0.6912 - val_accuracy: 0.5306
Epoch 6/100
51/51 [==============================] - 12s 227ms/step - loss: 0.6916 - accuracy:
0.5294 - val_loss: 0.6910 - val_accuracy: 0.5306
Epoch 7/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6924 - accuracy:
0.5276 - val_loss: 0.6910 - val_accuracy: 0.5306
Epoch 8/100
51/51 [==============================] - 13s 251ms/step - loss: 0.6909 - accuracy:
0.5294 - val_loss: 0.6895 - val_accuracy: 0.5355
Epoch 9/100
51/51 [==============================] - 13s 251ms/step - loss: 0.6893 - accuracy:
0.5411 - val_loss: 0.6865 - val_accuracy: 0.5379
Epoch 10/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6912 - accuracy:
0.5453 - val_loss: 0.6897 - val_accuracy: 0.5330
Epoch 11/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6906 - accuracy:
0.5319 - val_loss: 0.6886 - val_accuracy: 0.5281
Epoch 12/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6906 - accuracy:
0.5386 - val_loss: 0.6861 - val_accuracy: 0.5477
Epoch 13/100
51/51 [==============================] - 15s 290ms/step - loss: 0.6861 - accuracy:
0.5429 - val_loss: 0.6846 - val_accuracy: 0.5550
Epoch 14/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6876 - accuracy:
0.5613 - val_loss: 0.6866 - val_accuracy: 0.5232
Epoch 15/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6847 - accuracy:
0.5527 - val_loss: 0.6839 - val_accuracy: 0.5648
Epoch 16/100
51/51 [==============================] - 15s 290ms/step - loss: 0.6837 - accuracy:
0.5668 - val_loss: 0.6723 - val_accuracy: 0.5819
Epoch 17/100
51/51 [==============================] - 13s 255ms/step - loss: 0.6809 - accuracy:
0.5613 - val_loss: 0.6727 - val_accuracy: 0.5697
Epoch 18/100
51/51 [==============================] - 12s 235ms/step - loss: 0.6851 - accuracy:
0.5496 - val_loss: 0.6860 - val_accuracy: 0.5575
Epoch 19/100
51/51 [==============================] - 11s 220ms/step - loss: 0.6824 - accuracy:
0.5680 - val_loss: 0.6828 - val_accuracy: 0.5770
Epoch 20/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6756 - accuracy:
0.5821 - val_loss: 0.6742 - val_accuracy: 0.5746
Epoch 21/100
51/51 [==============================] - 12s 229ms/step - loss: 0.6802 - accuracy:
0.5754 - val_loss: 0.6718 - val_accuracy: 0.5917
Epoch 22/100
```

```
51/51 [==============================] - 12s 227ms/step - loss: 0.6788 - accuracy:
0.5784 - val_loss: 0.6790 - val_accuracy: 0.6039
Epoch 23/100
51/51 [==============================] - 17s 335ms/step - loss: 0.6799 - accuracy:
0.5686 - val_loss: 0.6758 - val_accuracy: 0.5795
Epoch 24/100
51/51 [==============================] - 11s 217ms/step - loss: 0.6748 - accuracy:
0.5723 - val_loss: 0.6769 - val_accuracy: 0.5746
Epoch 25/100
51/51 [==============================] - 13s 245ms/step - loss: 0.6795 - accuracy:
0.5925 - val_loss: 0.6726 - val_accuracy: 0.6088
Epoch 26/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6745 - accuracy:
0.5778 - val_loss: 0.6728 - val_accuracy: 0.5966
Epoch 27/100
51/51 [==============================] - 14s 265ms/step - loss: 0.6729 - accuracy:
0.5864 - val_loss: 0.6695 - val_accuracy: 0.6137
Epoch 28/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6800 - accuracy:
0.5600 - val_loss: 0.6748 - val_accuracy: 0.6210
Epoch 29/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6749 - accuracy:
0.5760 - val_loss: 0.6695 - val_accuracy: 0.5917
Epoch 30/100
51/51 [==============================] - 12s 227ms/step - loss: 0.6704 - accuracy:
0.5705 - val_loss: 0.6754 - val_accuracy: 0.5819
Epoch 31/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6742 - accuracy:
0.5748 - val_loss: 0.6669 - val_accuracy: 0.5917
Epoch 32/100
51/51 [==============================] - 12s 220ms/step - loss: 0.6712 - accuracy:
0.5870 - val_loss: 0.6718 - val_accuracy: 0.5966
Epoch 33/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6688 - accuracy:
0.5888 - val_loss: 0.6809 - val_accuracy: 0.5770
Epoch 34/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6733 - accuracy:
0.5876 - val_loss: 0.6701 - val_accuracy: 0.5966
Epoch 35/100
51/51 [==============================] - 13s 254ms/step - loss: 0.6600 - accuracy:
0.6066 - val_loss: 0.6814 - val_accuracy: 0.6015
Epoch 36/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6690 - accuracy:
0.5876 - val_loss: 0.6747 - val_accuracy: 0.5721
Epoch 37/100
51/51 [==============================] - 12s 243ms/step - loss: 0.6659 - accuracy:
0.6005 - val_loss: 0.6785 - val_accuracy: 0.5623
Epoch 38/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6605 - accuracy:
0.5907 - val_loss: 0.6675 - val_accuracy: 0.5941
Epoch 39/100
51/51 [==============================] - 15s 287ms/step - loss: 0.6656 - accuracy:
0.6115 - val_loss: 0.6702 - val_accuracy: 0.5892
Epoch 40/100
51/51 [==============================] - 13s 251ms/step - loss: 0.6631 - accuracy:
0.6195 - val_loss: 0.6623 - val_accuracy: 0.6015
Epoch 41/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6653 - accuracy:
0.5993 - val_loss: 0.6663 - val_accuracy: 0.5917
Epoch 42/100
51/51 [==============================] - 13s 241ms/step - loss: 0.6691 - accuracy:
0.5968 - val_loss: 0.6739 - val_accuracy: 0.5892
Epoch 43/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6655 - accuracy:
```

```
0.5913 - val_loss: 0.6678 - val_accuracy: 0.6186
Epoch 44/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6529 - accuracy:
0.6085 - val_loss: 0.6744 - val_accuracy: 0.5844
Epoch 45/100
51/51 [==============================] - 12s 226ms/step - loss: 0.6701 - accuracy:
0.5938 - val_loss: 0.6675 - val_accuracy: 0.5966
Epoch 46/100
51/51 [==============================] - 15s 291ms/step - loss: 0.6580 - accuracy:
0.6152 - val_loss: 0.6656 - val_accuracy: 0.6064
Epoch 47/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6563 - accuracy:
0.6091 - val_loss: 0.6667 - val_accuracy: 0.5746
Epoch 48/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6714 - accuracy:
0.5839 - val_loss: 0.6540 - val_accuracy: 0.6333
Epoch 49/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6513 - accuracy:
0.6078 - val_loss: 0.6646 - val_accuracy: 0.5892
Epoch 50/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6605 - accuracy:
0.6023 - val_loss: 0.6711 - val_accuracy: 0.5917
Epoch 51/100
51/51 [==============================] - 12s 240ms/step - loss: 0.6561 - accuracy:
0.6060 - val_loss: 0.6619 - val_accuracy: 0.5917
Epoch 52/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6649 - accuracy:
0.6029 - val_loss: 0.6738 - val_accuracy: 0.6064
Epoch 53/100
51/51 [==============================] - 12s 241ms/step - loss: 0.6564 - accuracy:
0.6036 - val_loss: 0.6672 - val_accuracy: 0.5917
Epoch 54/100
51/51 [==============================] - 11s 220ms/step - loss: 0.6524 - accuracy:
0.6201 - val_loss: 0.6713 - val_accuracy: 0.6015
Epoch 55/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6553 - accuracy:
0.6170 - val_loss: 0.6783 - val_accuracy: 0.6259
Epoch 56/100
51/51 [==============================] - 12s 229ms/step - loss: 0.6483 - accuracy:
0.6134 - val_loss: 0.6676 - val_accuracy: 0.5941
Epoch 57/100
51/51 [==============================] - 12s 225ms/step - loss: 0.6479 - accuracy:
0.6225 - val_loss: 0.6648 - val_accuracy: 0.5941
Epoch 58/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6554 - accuracy:
0.6256 - val_loss: 0.6606 - val_accuracy: 0.5966
Epoch 59/100
51/51 [==============================] - 11s 220ms/step - loss: 0.6575 - accuracy:
0.5931 - val_loss: 0.6664 - val_accuracy: 0.6161
Epoch 60/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6570 - accuracy:
0.6097 - val_loss: 0.6642 - val_accuracy: 0.5917
Epoch 61/100
51/51 [==============================] - 12s 225ms/step - loss: 0.6513 - accuracy:
0.6299 - val_loss: 0.6680 - val_accuracy: 0.6088
Epoch 62/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6422 - accuracy:
0.6189 - val_loss: 0.6622 - val_accuracy: 0.6015
Epoch 63/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6512 - accuracy:
0.6262 - val_loss: 0.6611 - val_accuracy: 0.6112
Epoch 64/100
51/51 [==============================] - 12s 228ms/step - loss: 0.6564 - accuracy:
0.6103 - val_loss: 0.6692 - val_accuracy: 0.6137
```

```
Epoch 65/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6501 - accuracy:
0.6164 - val_loss: 0.6672 - val_accuracy: 0.5819
Epoch 66/100
51/51 [==============================] - 11s 219ms/step - loss: 0.6532 - accuracy:
0.6036 - val_loss: 0.6579 - val_accuracy: 0.6039
Epoch 67/100
51/51 [==============================] - 13s 261ms/step - loss: 0.6426 - accuracy:
0.6201 - val_loss: 0.6649 - val_accuracy: 0.5868
Epoch 68/100
51/51 [==============================] - 12s 224ms/step - loss: 0.6459 - accuracy:
0.6244 - val_loss: 0.6695 - val_accuracy: 0.5990
Epoch 69/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6488 - accuracy:
0.6072 - val_loss: 0.6607 - val_accuracy: 0.6112
Epoch 70/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6500 - accuracy:
0.6385 - val_loss: 0.6588 - val_accuracy: 0.6235
Epoch 71/100
51/51 [==============================] - 12s 225ms/step - loss: 0.6399 - accuracy:
0.6360 - val_loss: 0.6677 - val_accuracy: 0.6112
Epoch 72/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6534 - accuracy:
0.6140 - val_loss: 0.6677 - val_accuracy: 0.5941
Epoch 73/100
51/51 [==============================] - 12s 221ms/step - loss: 0.6359 - accuracy:
0.6434 - val_loss: 0.6626 - val_accuracy: 0.6112
Epoch 74/100
51/51 [==============================] - 15s 291ms/step - loss: 0.6454 - accuracy:
0.6244 - val_loss: 0.6592 - val_accuracy: 0.6015
Epoch 75/100
51/51 [==============================] - 15s 287ms/step - loss: 0.6420 - accuracy:
0.6232 - val_loss: 0.6614 - val_accuracy: 0.6259
Epoch 76/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6328 - accuracy:
0.6373 - val_loss: 0.6583 - val_accuracy: 0.6284
Epoch 77/100
51/51 [==============================] - 12s 221ms/step - loss: 0.6419 - accuracy:
0.6176 - val_loss: 0.6514 - val_accuracy: 0.6015
Epoch 78/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6368 - accuracy:
0.6164 - val_loss: 0.6577 - val_accuracy: 0.6186
Epoch 79/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6455 - accuracy:
0.6342 - val_loss: 0.6667 - val_accuracy: 0.6137
Epoch 80/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6404 - accuracy:
0.6219 - val_loss: 0.6577 - val_accuracy: 0.6210
Epoch 81/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6362 - accuracy:
0.6268 - val_loss: 0.6551 - val_accuracy: 0.6039
Epoch 82/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6321 - accuracy:
0.6489 - val_loss: 0.6696 - val_accuracy: 0.6112
Epoch 83/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6338 - accuracy:
0.6385 - val_loss: 0.6640 - val_accuracy: 0.6064
Epoch 84/100
51/51 [==============================] - 12s 228ms/step - loss: 0.6277 - accuracy:
0.6311 - val_loss: 0.6673 - val_accuracy: 0.5941
Epoch 85/100
51/51 [==============================] - 12s 225ms/step - loss: 0.6368 - accuracy:
0.6385 - val_loss: 0.6588 - val_accuracy: 0.6088
Epoch 86/100
```

```
51/51 [==============================] - 13s 248ms/step - loss: 0.6342 - accuracy:
0.6538 - val_loss: 0.6617 - val_accuracy: 0.6161
Epoch 87/100
51/51 [==============================] - 12s 229ms/step - loss: 0.6346 - accuracy:
0.6225 - val_loss: 0.6508 - val_accuracy: 0.6357
Epoch 88/100
51/51 [==============================] - 15s 284ms/step - loss: 0.6405 - accuracy:
0.6330 - val_loss: 0.6629 - val_accuracy: 0.6039
Epoch 89/100
51/51 [==============================] - 11s 222ms/step - loss: 0.6315 - accuracy:
0.6526 - val_loss: 0.6574 - val_accuracy: 0.5966
Epoch 90/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6339 - accuracy:
0.6281 - val_loss: 0.6530 - val_accuracy: 0.6015
Epoch 91/100
51/51 [==============================] - 11s 217ms/step - loss: 0.6248 - accuracy:
0.6409 - val_loss: 0.6475 - val_accuracy: 0.6088
Epoch 92/100
51/51 [==============================] - 12s 237ms/step - loss: 0.6291 - accuracy:
0.6464 - val_loss: 0.6640 - val_accuracy: 0.5721
Epoch 93/100
51/51 [==============================] - 13s 249ms/step - loss: 0.6374 - accuracy:
0.6238 - val_loss: 0.6560 - val_accuracy: 0.6137
Epoch 94/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6324 - accuracy:
0.6483 - val_loss: 0.6528 - val_accuracy: 0.5990
Epoch 95/100
51/51 [==============================] - 11s 222ms/step - loss: 0.6306 - accuracy:
0.6336 - val_loss: 0.6498 - val_accuracy: 0.6235
Epoch 96/100
51/51 [==============================] - 13s 250ms/step - loss: 0.6289 - accuracy:
0.6324 - val_loss: 0.6506 - val_accuracy: 0.6015
Epoch 97/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6195 - accuracy:
0.6501 - val_loss: 0.6607 - val_accuracy: 0.6161
Epoch 98/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6297 - accuracy:
0.6385 - val_loss: 0.6851 - val_accuracy: 0.5819
Epoch 99/100
51/51 [==============================] - 13s 247ms/step - loss: 0.6207 - accuracy:
0.6538 - val_loss: 0.6638 - val_accuracy: 0.6235
Epoch 100/100
51/51 [==============================] - 13s 248ms/step - loss: 0.6205 - accuracy:
0.6452 - val_loss: 0.6575 - val_accuracy: 0.6210
13/13 [==============================] - 1s 48ms/step - loss: 0.6575 - accuracy:
0.6210
CNN Accuracy: 0.621026873588562
13/13 [==============================] - 1s 52ms/step

CNN Classification Report:
              precision    recall  f1-score   support

           0       0.60      0.58      0.59       192
           1       0.64      0.66      0.65       217

    accuracy                           0.62       409
   macro avg       0.62      0.62      0.62       409
weighted avg       0.62      0.62      0.62       409
```

In [ ]:

```
x_train, x_test, y_train, y_test = train_test_split(data, labels, test_size=0.2, sh

label_encoder = LabelEncoder()
y_train_encoded = label_encoder.fit_transform(y_train)
```

```python
y_test_encoded = label_encoder.transform(y_test)


datagen = ImageDataGenerator(
    rotation_range=20,
    width_shift_range=0.1,
    height_shift_range=0.1,
    horizontal_flip=True,
    vertical_flip=True,
    zoom_range=0.1,
    fill_mode='nearest')

model = models.Sequential([
    layers.Conv2D(32, (3, 3), activation='relu', input_shape=(64, 64, 3)),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(64, (3, 3), activation='relu'),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(128, (3, 3), activation='relu'),
    layers.MaxPooling2D((2, 2)),
    layers.Flatten(),
    layers.Dropout(0.5),
    layers.Dense(128, activation='relu'),
    layers.Dense(2, activation='softmax')
])

model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

history = model.fit(datagen.flow(x_train, y_train_encoded, batch_size=16),
                    steps_per_epoch=len(x_train) / 32, epochs=200,
                    validation_data=(x_test, y_test_encoded))

test_loss, test_accuracy = model.evaluate(x_test, y_test_encoded)
print("CNN Accuracy:", test_accuracy)

y_pred = np.argmax(model.predict(x_test), axis=-1)

y_pred_decoded = label_encoder.inverse_transform(y_pred)

cnn_classification_report = classification_report(y_test, y_pred_decoded)
print("\nCNN Classification Report:\n", cnn_classification_report)
```

```
Epoch 1/200
51/51 [==============================] - 11s 190ms/step - loss: 0.7007 - accuracy:
0.5037 - val_loss: 0.6963 - val_accuracy: 0.4694
Epoch 2/200
51/51 [==============================] - 13s 240ms/step - loss: 0.6951 - accuracy:
0.5086 - val_loss: 0.6915 - val_accuracy: 0.5232
Epoch 3/200
51/51 [==============================] - 12s 229ms/step - loss: 0.6942 - accuracy:
0.5245 - val_loss: 0.6918 - val_accuracy: 0.5306
Epoch 4/200
51/51 [==============================] - 8s 158ms/step - loss: 0.6919 - accuracy:
0.5282 - val_loss: 0.6914 - val_accuracy: 0.5306
Epoch 5/200
51/51 [==============================] - 7s 139ms/step - loss: 0.6935 - accuracy:
0.5245 - val_loss: 0.6915 - val_accuracy: 0.5306
Epoch 6/200
51/51 [==============================] - 8s 157ms/step - loss: 0.6890 - accuracy:
0.5551 - val_loss: 0.6917 - val_accuracy: 0.5306
Epoch 7/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6927 - accuracy:
0.5233 - val_loss: 0.6900 - val_accuracy: 0.5306
Epoch 8/200
51/51 [==============================] - 7s 133ms/step - loss: 0.6912 - accuracy:
0.5282 - val_loss: 0.6911 - val_accuracy: 0.5306
Epoch 9/200
51/51 [==============================] - 7s 137ms/step - loss: 0.6911 - accuracy:
0.5233 - val_loss: 0.6895 - val_accuracy: 0.5306
Epoch 10/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6902 - accuracy:
0.5490 - val_loss: 0.6905 - val_accuracy: 0.5306
Epoch 11/200
51/51 [==============================] - 8s 157ms/step - loss: 0.6920 - accuracy:
0.5355 - val_loss: 0.6916 - val_accuracy: 0.5306
Epoch 12/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6919 - accuracy:
0.5221 - val_loss: 0.6901 - val_accuracy: 0.5306
Epoch 13/200
51/51 [==============================] - 9s 168ms/step - loss: 0.6935 - accuracy:
0.5282 - val_loss: 0.6903 - val_accuracy: 0.5306
Epoch 14/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6892 - accuracy:
0.5417 - val_loss: 0.6882 - val_accuracy: 0.5281
Epoch 15/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6911 - accuracy:
0.5306 - val_loss: 0.6893 - val_accuracy: 0.5306
Epoch 16/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6932 - accuracy:
0.5159 - val_loss: 0.6890 - val_accuracy: 0.5452
Epoch 17/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6932 - accuracy:
0.5012 - val_loss: 0.6907 - val_accuracy: 0.5281
Epoch 18/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6917 - accuracy:
0.5331 - val_loss: 0.6883 - val_accuracy: 0.5306
Epoch 19/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6881 - accuracy:
0.5368 - val_loss: 0.6852 - val_accuracy: 0.5403
Epoch 20/200
51/51 [==============================] - 9s 180ms/step - loss: 0.6902 - accuracy:
0.5466 - val_loss: 0.6876 - val_accuracy: 0.5306
Epoch 21/200
51/51 [==============================] - 8s 150ms/step - loss: 0.6855 - accuracy:
0.5453 - val_loss: 0.6901 - val_accuracy: 0.5672
Epoch 22/200
```

```
51/51 [==============================] - 7s 129ms/step - loss: 0.6959 - accuracy: 0.5135 - val_loss: 0.6887 - val_accuracy: 0.5306
Epoch 23/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6865 - accuracy: 0.5478 - val_loss: 0.6868 - val_accuracy: 0.5746
Epoch 24/200
51/51 [==============================] - 7s 132ms/step - loss: 0.6889 - accuracy: 0.5404 - val_loss: 0.6855 - val_accuracy: 0.5330
Epoch 25/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6861 - accuracy: 0.5282 - val_loss: 0.6800 - val_accuracy: 0.5452
Epoch 26/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6856 - accuracy: 0.5392 - val_loss: 0.6835 - val_accuracy: 0.5917
Epoch 27/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6869 - accuracy: 0.5368 - val_loss: 0.6819 - val_accuracy: 0.5232
Epoch 28/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6839 - accuracy: 0.5723 - val_loss: 0.6837 - val_accuracy: 0.5526
Epoch 29/200
51/51 [==============================] - 7s 147ms/step - loss: 0.6827 - accuracy: 0.5613 - val_loss: 0.6788 - val_accuracy: 0.5819
Epoch 30/200
51/51 [==============================] - 9s 168ms/step - loss: 0.6814 - accuracy: 0.5833 - val_loss: 0.6756 - val_accuracy: 0.5892
Epoch 31/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6877 - accuracy: 0.5404 - val_loss: 0.6811 - val_accuracy: 0.5966
Epoch 32/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6846 - accuracy: 0.5355 - val_loss: 0.6775 - val_accuracy: 0.5550
Epoch 33/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6829 - accuracy: 0.5502 - val_loss: 0.6769 - val_accuracy: 0.5501
Epoch 34/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6874 - accuracy: 0.5404 - val_loss: 0.6828 - val_accuracy: 0.5770
Epoch 35/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6819 - accuracy: 0.5551 - val_loss: 0.6740 - val_accuracy: 0.5941
Epoch 36/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6697 - accuracy: 0.5809 - val_loss: 0.6885 - val_accuracy: 0.5330
Epoch 37/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6916 - accuracy: 0.5221 - val_loss: 0.6942 - val_accuracy: 0.5306
Epoch 38/200
51/51 [==============================] - 7s 139ms/step - loss: 0.6822 - accuracy: 0.5625 - val_loss: 0.6840 - val_accuracy: 0.5721
Epoch 39/200
51/51 [==============================] - 7s 131ms/step - loss: 0.6810 - accuracy: 0.5674 - val_loss: 0.6801 - val_accuracy: 0.5477
Epoch 40/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6807 - accuracy: 0.5650 - val_loss: 0.6770 - val_accuracy: 0.5795
Epoch 41/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6852 - accuracy: 0.5551 - val_loss: 0.6822 - val_accuracy: 0.5844
Epoch 42/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6832 - accuracy: 0.5539 - val_loss: 0.6814 - val_accuracy: 0.5721
Epoch 43/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6842 - accuracy:
```

```
0.5490 - val_loss: 0.6784 - val_accuracy: 0.5672
Epoch 44/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6808 - accuracy: 0.5686 - val_loss: 0.6778 - val_accuracy: 0.5697
Epoch 45/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6839 - accuracy: 0.5858 - val_loss: 0.6789 - val_accuracy: 0.5721
Epoch 46/200
51/51 [==============================] - 7s 140ms/step - loss: 0.6789 - accuracy: 0.5858 - val_loss: 0.6817 - val_accuracy: 0.5672
Epoch 47/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6816 - accuracy: 0.5625 - val_loss: 0.6765 - val_accuracy: 0.5721
Epoch 48/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6690 - accuracy: 0.6115 - val_loss: 0.6845 - val_accuracy: 0.5477
Epoch 49/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6834 - accuracy: 0.5674 - val_loss: 0.6840 - val_accuracy: 0.5330
Epoch 50/200
51/51 [==============================] - 7s 140ms/step - loss: 0.6767 - accuracy: 0.5588 - val_loss: 0.6833 - val_accuracy: 0.5819
Epoch 51/200
51/51 [==============================] - 9s 187ms/step - loss: 0.6769 - accuracy: 0.5956 - val_loss: 0.6778 - val_accuracy: 0.5721
Epoch 52/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6864 - accuracy: 0.5748 - val_loss: 0.6804 - val_accuracy: 0.5746
Epoch 53/200
51/51 [==============================] - 8s 147ms/step - loss: 0.6816 - accuracy: 0.5699 - val_loss: 0.6752 - val_accuracy: 0.6064
Epoch 54/200
51/51 [==============================] - 8s 152ms/step - loss: 0.6764 - accuracy: 0.5600 - val_loss: 0.6715 - val_accuracy: 0.5966
Epoch 55/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6751 - accuracy: 0.5735 - val_loss: 0.6705 - val_accuracy: 0.6161
Epoch 56/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6686 - accuracy: 0.5858 - val_loss: 0.6729 - val_accuracy: 0.6161
Epoch 57/200
51/51 [==============================] - 7s 146ms/step - loss: 0.6769 - accuracy: 0.5686 - val_loss: 0.6743 - val_accuracy: 0.6088
Epoch 58/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6773 - accuracy: 0.5723 - val_loss: 0.6774 - val_accuracy: 0.5452
Epoch 59/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6731 - accuracy: 0.5748 - val_loss: 0.6750 - val_accuracy: 0.5990
Epoch 60/200
51/51 [==============================] - 8s 147ms/step - loss: 0.6808 - accuracy: 0.5588 - val_loss: 0.6760 - val_accuracy: 0.5501
Epoch 61/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6792 - accuracy: 0.5539 - val_loss: 0.6825 - val_accuracy: 0.5355
Epoch 62/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6849 - accuracy: 0.5429 - val_loss: 0.6744 - val_accuracy: 0.5648
Epoch 63/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6712 - accuracy: 0.5748 - val_loss: 0.6761 - val_accuracy: 0.5795
Epoch 64/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6720 - accuracy: 0.5711 - val_loss: 0.6776 - val_accuracy: 0.5892
```

```
Epoch 65/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6684 - accuracy:
0.5993 - val_loss: 0.6812 - val_accuracy: 0.5917
Epoch 66/200
51/51 [==============================] - 8s 151ms/step - loss: 0.6763 - accuracy:
0.5735 - val_loss: 0.6812 - val_accuracy: 0.5844
Epoch 67/200
51/51 [==============================] - 6s 116ms/step - loss: 0.6743 - accuracy:
0.5784 - val_loss: 0.6796 - val_accuracy: 0.5892
Epoch 68/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6738 - accuracy:
0.5907 - val_loss: 0.6743 - val_accuracy: 0.5844
Epoch 69/200
51/51 [==============================] - 7s 145ms/step - loss: 0.6761 - accuracy:
0.5784 - val_loss: 0.6840 - val_accuracy: 0.5648
Epoch 70/200
51/51 [==============================] - 6s 116ms/step - loss: 0.6728 - accuracy:
0.5711 - val_loss: 0.6750 - val_accuracy: 0.5966
Epoch 71/200
51/51 [==============================] - 8s 150ms/step - loss: 0.6706 - accuracy:
0.5858 - val_loss: 0.6737 - val_accuracy: 0.5819
Epoch 72/200
51/51 [==============================] - 8s 148ms/step - loss: 0.6787 - accuracy:
0.5956 - val_loss: 0.6786 - val_accuracy: 0.5844
Epoch 73/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6722 - accuracy:
0.5833 - val_loss: 0.6698 - val_accuracy: 0.5941
Epoch 74/200
51/51 [==============================] - 8s 148ms/step - loss: 0.6674 - accuracy:
0.5784 - val_loss: 0.6767 - val_accuracy: 0.6039
Epoch 75/200
51/51 [==============================] - 7s 131ms/step - loss: 0.6648 - accuracy:
0.5980 - val_loss: 0.6750 - val_accuracy: 0.5844
Epoch 76/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6743 - accuracy:
0.5833 - val_loss: 0.6725 - val_accuracy: 0.5966
Epoch 77/200
51/51 [==============================] - 8s 150ms/step - loss: 0.6694 - accuracy:
0.5797 - val_loss: 0.6669 - val_accuracy: 0.5941
Epoch 78/200
51/51 [==============================] - 6s 117ms/step - loss: 0.6680 - accuracy:
0.5870 - val_loss: 0.6687 - val_accuracy: 0.5966
Epoch 79/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6704 - accuracy:
0.5723 - val_loss: 0.6700 - val_accuracy: 0.5697
Epoch 80/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6563 - accuracy:
0.6189 - val_loss: 0.6736 - val_accuracy: 0.5819
Epoch 81/200
51/51 [==============================] - 7s 133ms/step - loss: 0.6586 - accuracy:
0.6127 - val_loss: 0.6686 - val_accuracy: 0.5770
Epoch 82/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6648 - accuracy:
0.5956 - val_loss: 0.6697 - val_accuracy: 0.5648
Epoch 83/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6785 - accuracy:
0.5699 - val_loss: 0.6730 - val_accuracy: 0.6064
Epoch 84/200
51/51 [==============================] - 8s 164ms/step - loss: 0.6667 - accuracy:
0.5882 - val_loss: 0.6689 - val_accuracy: 0.6015
Epoch 85/200
51/51 [==============================] - 9s 178ms/step - loss: 0.6663 - accuracy:
0.6029 - val_loss: 0.6670 - val_accuracy: 0.5868
Epoch 86/200
```

```
51/51 [==============================] - 6s 124ms/step - loss: 0.6717 - accuracy:
0.5895 - val_loss: 0.6645 - val_accuracy: 0.5868
Epoch 87/200
51/51 [==============================] - 8s 146ms/step - loss: 0.6645 - accuracy:
0.6054 - val_loss: 0.6733 - val_accuracy: 0.5746
Epoch 88/200
51/51 [==============================] - 8s 152ms/step - loss: 0.6776 - accuracy:
0.5907 - val_loss: 0.6807 - val_accuracy: 0.5941
Epoch 89/200
51/51 [==============================] - 6s 118ms/step - loss: 0.6786 - accuracy:
0.5699 - val_loss: 0.6715 - val_accuracy: 0.6088
Epoch 90/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6701 - accuracy:
0.6078 - val_loss: 0.6686 - val_accuracy: 0.5795
Epoch 91/200
51/51 [==============================] - 7s 134ms/step - loss: 0.6699 - accuracy:
0.5968 - val_loss: 0.6653 - val_accuracy: 0.5917
Epoch 92/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6760 - accuracy:
0.5833 - val_loss: 0.6649 - val_accuracy: 0.6015
Epoch 93/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6647 - accuracy:
0.6127 - val_loss: 0.6670 - val_accuracy: 0.6064
Epoch 94/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6665 - accuracy:
0.5993 - val_loss: 0.6647 - val_accuracy: 0.5844
Epoch 95/200
51/51 [==============================] - 8s 153ms/step - loss: 0.6649 - accuracy:
0.5919 - val_loss: 0.6676 - val_accuracy: 0.5917
Epoch 96/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6536 - accuracy:
0.6042 - val_loss: 0.6727 - val_accuracy: 0.5868
Epoch 97/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6673 - accuracy:
0.5748 - val_loss: 0.6672 - val_accuracy: 0.5819
Epoch 98/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6645 - accuracy:
0.5907 - val_loss: 0.6709 - val_accuracy: 0.5844
Epoch 99/200
51/51 [==============================] - 8s 153ms/step - loss: 0.6557 - accuracy:
0.6115 - val_loss: 0.6652 - val_accuracy: 0.5941
Epoch 100/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6694 - accuracy:
0.5760 - val_loss: 0.6655 - val_accuracy: 0.5868
Epoch 101/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6684 - accuracy:
0.5760 - val_loss: 0.6648 - val_accuracy: 0.6088
Epoch 102/200
51/51 [==============================] - 7s 144ms/step - loss: 0.6665 - accuracy:
0.5956 - val_loss: 0.6602 - val_accuracy: 0.5917
Epoch 103/200
51/51 [==============================] - 6s 124ms/step - loss: 0.6662 - accuracy:
0.5870 - val_loss: 0.6582 - val_accuracy: 0.5868
Epoch 104/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6496 - accuracy:
0.6189 - val_loss: 0.6596 - val_accuracy: 0.6137
Epoch 105/200
51/51 [==============================] - 8s 157ms/step - loss: 0.6562 - accuracy:
0.6152 - val_loss: 0.6727 - val_accuracy: 0.5746
Epoch 106/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6604 - accuracy:
0.5980 - val_loss: 0.6679 - val_accuracy: 0.5990
Epoch 107/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6553 - accuracy:
```

```
0.6103 - val_loss: 0.6492 - val_accuracy: 0.6308
Epoch 108/200
51/51 [==============================] - 8s 163ms/step - loss: 0.6617 - accuracy:
0.6189 - val_loss: 0.6576 - val_accuracy: 0.6039
Epoch 109/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6643 - accuracy:
0.5846 - val_loss: 0.6622 - val_accuracy: 0.6039
Epoch 110/200
51/51 [==============================] - 10s 192ms/step - loss: 0.6507 - accuracy:
0.6213 - val_loss: 0.6483 - val_accuracy: 0.6333
Epoch 111/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6644 - accuracy:
0.5968 - val_loss: 0.6574 - val_accuracy: 0.6039
Epoch 112/200
51/51 [==============================] - 7s 139ms/step - loss: 0.6603 - accuracy:
0.6078 - val_loss: 0.6585 - val_accuracy: 0.6161
Epoch 113/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6755 - accuracy:
0.5674 - val_loss: 0.6568 - val_accuracy: 0.6064
Epoch 114/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6701 - accuracy:
0.5980 - val_loss: 0.6600 - val_accuracy: 0.5844
Epoch 115/200
51/51 [==============================] - 9s 165ms/step - loss: 0.6549 - accuracy:
0.6103 - val_loss: 0.6515 - val_accuracy: 0.6088
Epoch 116/200
51/51 [==============================] - 8s 159ms/step - loss: 0.6677 - accuracy:
0.5944 - val_loss: 0.6553 - val_accuracy: 0.6235
Epoch 117/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6735 - accuracy:
0.5515 - val_loss: 0.6682 - val_accuracy: 0.5844
Epoch 118/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6720 - accuracy:
0.5846 - val_loss: 0.6601 - val_accuracy: 0.6015
Epoch 119/200
51/51 [==============================] - 7s 132ms/step - loss: 0.6505 - accuracy:
0.6029 - val_loss: 0.6595 - val_accuracy: 0.6112
Epoch 120/200
51/51 [==============================] - 7s 140ms/step - loss: 0.6751 - accuracy:
0.5809 - val_loss: 0.6722 - val_accuracy: 0.6088
Epoch 121/200
51/51 [==============================] - 7s 134ms/step - loss: 0.6561 - accuracy:
0.6091 - val_loss: 0.6607 - val_accuracy: 0.5990
Epoch 122/200
51/51 [==============================] - 7s 137ms/step - loss: 0.6531 - accuracy:
0.6324 - val_loss: 0.6563 - val_accuracy: 0.5941
Epoch 123/200
51/51 [==============================] - 7s 136ms/step - loss: 0.6589 - accuracy:
0.6189 - val_loss: 0.6580 - val_accuracy: 0.6210
Epoch 124/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6689 - accuracy:
0.5699 - val_loss: 0.6589 - val_accuracy: 0.6210
Epoch 125/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6551 - accuracy:
0.6225 - val_loss: 0.6512 - val_accuracy: 0.6137
Epoch 126/200
51/51 [==============================] - 7s 134ms/step - loss: 0.6692 - accuracy:
0.5772 - val_loss: 0.6587 - val_accuracy: 0.6161
Epoch 127/200
51/51 [==============================] - 7s 141ms/step - loss: 0.6675 - accuracy:
0.6029 - val_loss: 0.6580 - val_accuracy: 0.6015
Epoch 128/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6602 - accuracy:
0.6152 - val_loss: 0.6535 - val_accuracy: 0.6039
```

```
Epoch 129/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6478 - accuracy:
0.6189 - val_loss: 0.6565 - val_accuracy: 0.6112
Epoch 130/200
51/51 [==============================] - 6s 119ms/step - loss: 0.6499 - accuracy:
0.6189 - val_loss: 0.6606 - val_accuracy: 0.6137
Epoch 131/200
51/51 [==============================] - 8s 159ms/step - loss: 0.6571 - accuracy:
0.6042 - val_loss: 0.6750 - val_accuracy: 0.5868
Epoch 132/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6484 - accuracy:
0.6348 - val_loss: 0.6641 - val_accuracy: 0.6039
Epoch 133/200
51/51 [==============================] - 8s 165ms/step - loss: 0.6651 - accuracy:
0.5993 - val_loss: 0.6705 - val_accuracy: 0.5917
Epoch 134/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6501 - accuracy:
0.6262 - val_loss: 0.6608 - val_accuracy: 0.5795
Epoch 135/200
51/51 [==============================] - 7s 134ms/step - loss: 0.6699 - accuracy:
0.5931 - val_loss: 0.6685 - val_accuracy: 0.5746
Epoch 136/200
51/51 [==============================] - 10s 196ms/step - loss: 0.6495 - accuracy:
0.6275 - val_loss: 0.6542 - val_accuracy: 0.6112
Epoch 137/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6476 - accuracy:
0.6176 - val_loss: 0.6720 - val_accuracy: 0.6259
Epoch 138/200
51/51 [==============================] - 7s 140ms/step - loss: 0.6669 - accuracy:
0.6005 - val_loss: 0.6587 - val_accuracy: 0.5941
Epoch 139/200
51/51 [==============================] - 7s 132ms/step - loss: 0.6480 - accuracy:
0.6213 - val_loss: 0.6594 - val_accuracy: 0.6039
Epoch 140/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6620 - accuracy:
0.5944 - val_loss: 0.6568 - val_accuracy: 0.6064
Epoch 141/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6656 - accuracy:
0.6005 - val_loss: 0.6723 - val_accuracy: 0.6210
Epoch 142/200
51/51 [==============================] - 8s 147ms/step - loss: 0.6555 - accuracy:
0.5833 - val_loss: 0.6574 - val_accuracy: 0.6161
Epoch 143/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6525 - accuracy:
0.6115 - val_loss: 0.6522 - val_accuracy: 0.5990
Epoch 144/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6496 - accuracy:
0.6201 - val_loss: 0.6599 - val_accuracy: 0.5941
Epoch 145/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6594 - accuracy:
0.5944 - val_loss: 0.6599 - val_accuracy: 0.6039
Epoch 146/200
51/51 [==============================] - 7s 142ms/step - loss: 0.6482 - accuracy:
0.6189 - val_loss: 0.6433 - val_accuracy: 0.5941
Epoch 147/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6492 - accuracy:
0.6238 - val_loss: 0.6530 - val_accuracy: 0.6015
Epoch 148/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6422 - accuracy:
0.6275 - val_loss: 0.6639 - val_accuracy: 0.6235
Epoch 149/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6599 - accuracy:
0.6029 - val_loss: 0.6478 - val_accuracy: 0.6039
Epoch 150/200
```

```
51/51 [==============================] - 6s 120ms/step - loss: 0.6509 - accuracy: 
0.6127 - val_loss: 0.6613 - val_accuracy: 0.6210
Epoch 151/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6529 - accuracy: 
0.6103 - val_loss: 0.6573 - val_accuracy: 0.6088
Epoch 152/200
51/51 [==============================] - 7s 133ms/step - loss: 0.6577 - accuracy: 
0.6078 - val_loss: 0.6588 - val_accuracy: 0.5892
Epoch 153/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6467 - accuracy: 
0.6275 - val_loss: 0.6527 - val_accuracy: 0.6235
Epoch 154/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6472 - accuracy: 
0.6287 - val_loss: 0.6608 - val_accuracy: 0.5892
Epoch 155/200
51/51 [==============================] - 8s 146ms/step - loss: 0.6454 - accuracy: 
0.6336 - val_loss: 0.6597 - val_accuracy: 0.6064
Epoch 156/200
51/51 [==============================] - 8s 152ms/step - loss: 0.6551 - accuracy: 
0.6078 - val_loss: 0.6588 - val_accuracy: 0.5966
Epoch 157/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6517 - accuracy: 
0.6324 - val_loss: 0.6594 - val_accuracy: 0.5917
Epoch 158/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6456 - accuracy: 
0.6262 - val_loss: 0.6588 - val_accuracy: 0.6064
Epoch 159/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6610 - accuracy: 
0.5907 - val_loss: 0.6667 - val_accuracy: 0.5917
Epoch 160/200
51/51 [==============================] - 7s 141ms/step - loss: 0.6507 - accuracy: 
0.6115 - val_loss: 0.6593 - val_accuracy: 0.6064
Epoch 161/200
51/51 [==============================] - 7s 145ms/step - loss: 0.6418 - accuracy: 
0.6250 - val_loss: 0.6586 - val_accuracy: 0.6137
Epoch 162/200
51/51 [==============================] - 7s 128ms/step - loss: 0.6654 - accuracy: 
0.5760 - val_loss: 0.6561 - val_accuracy: 0.6015
Epoch 163/200
51/51 [==============================] - 7s 144ms/step - loss: 0.6514 - accuracy: 
0.6324 - val_loss: 0.6587 - val_accuracy: 0.6088
Epoch 164/200
51/51 [==============================] - 7s 129ms/step - loss: 0.6529 - accuracy: 
0.5895 - val_loss: 0.6516 - val_accuracy: 0.6137
Epoch 165/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6268 - accuracy: 
0.6348 - val_loss: 0.6521 - val_accuracy: 0.5917
Epoch 166/200
51/51 [==============================] - 7s 136ms/step - loss: 0.6457 - accuracy: 
0.6201 - val_loss: 0.6552 - val_accuracy: 0.6039
Epoch 167/200
51/51 [==============================] - 7s 138ms/step - loss: 0.6563 - accuracy: 
0.5956 - val_loss: 0.6519 - val_accuracy: 0.6210
Epoch 168/200
51/51 [==============================] - 8s 153ms/step - loss: 0.6293 - accuracy: 
0.6446 - val_loss: 0.6471 - val_accuracy: 0.6284
Epoch 169/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6554 - accuracy: 
0.6042 - val_loss: 0.6535 - val_accuracy: 0.6210
Epoch 170/200
51/51 [==============================] - 8s 156ms/step - loss: 0.6333 - accuracy: 
0.6164 - val_loss: 0.6390 - val_accuracy: 0.6161
Epoch 171/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6539 - accuracy: 
```

```
0.5956 - val_loss: 0.6538 - val_accuracy: 0.6112
Epoch 172/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6418 - accuracy:
0.6397 - val_loss: 0.6473 - val_accuracy: 0.6186
Epoch 173/200
51/51 [==============================] - 7s 135ms/step - loss: 0.6435 - accuracy:
0.6287 - val_loss: 0.6515 - val_accuracy: 0.6186
Epoch 174/200
51/51 [==============================] - 7s 140ms/step - loss: 0.6469 - accuracy:
0.6336 - val_loss: 0.6626 - val_accuracy: 0.5844
Epoch 175/200
51/51 [==============================] - 7s 128ms/step - loss: 0.6630 - accuracy:
0.6091 - val_loss: 0.6491 - val_accuracy: 0.5966
Epoch 176/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6323 - accuracy:
0.6483 - val_loss: 0.6479 - val_accuracy: 0.5966
Epoch 177/200
51/51 [==============================] - 7s 134ms/step - loss: 0.6346 - accuracy:
0.6348 - val_loss: 0.6520 - val_accuracy: 0.6284
Epoch 178/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6523 - accuracy:
0.6225 - val_loss: 0.6531 - val_accuracy: 0.6137
Epoch 179/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6574 - accuracy:
0.5980 - val_loss: 0.6481 - val_accuracy: 0.5917
Epoch 180/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6321 - accuracy:
0.6483 - val_loss: 0.6505 - val_accuracy: 0.6137
Epoch 181/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6504 - accuracy:
0.6066 - val_loss: 0.6496 - val_accuracy: 0.6137
Epoch 182/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6490 - accuracy:
0.6054 - val_loss: 0.6656 - val_accuracy: 0.6235
Epoch 183/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6447 - accuracy:
0.6213 - val_loss: 0.6681 - val_accuracy: 0.6210
Epoch 184/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6370 - accuracy:
0.6446 - val_loss: 0.6536 - val_accuracy: 0.6284
Epoch 185/200
51/51 [==============================] - 9s 180ms/step - loss: 0.6417 - accuracy:
0.6127 - val_loss: 0.6763 - val_accuracy: 0.5941
Epoch 186/200
51/51 [==============================] - 8s 165ms/step - loss: 0.6431 - accuracy:
0.6275 - val_loss: 0.6786 - val_accuracy: 0.5917
Epoch 187/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6412 - accuracy:
0.6287 - val_loss: 0.6611 - val_accuracy: 0.6210
Epoch 188/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6510 - accuracy:
0.6176 - val_loss: 0.6568 - val_accuracy: 0.6112
Epoch 189/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6299 - accuracy:
0.6422 - val_loss: 0.6640 - val_accuracy: 0.5941
Epoch 190/200
51/51 [==============================] - 7s 142ms/step - loss: 0.6446 - accuracy:
0.6091 - val_loss: 0.6725 - val_accuracy: 0.6308
Epoch 191/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6513 - accuracy:
0.6176 - val_loss: 0.6544 - val_accuracy: 0.6357
Epoch 192/200
51/51 [==============================] - 6s 121ms/step - loss: 0.6329 - accuracy:
0.6238 - val_loss: 0.6427 - val_accuracy: 0.6430
```

```
Epoch 193/200
51/51 [==============================] - 6s 120ms/step - loss: 0.6395 - accuracy:
0.6176 - val_loss: 0.6598 - val_accuracy: 0.5892
Epoch 194/200
51/51 [==============================] - 8s 155ms/step - loss: 0.6502 - accuracy:
0.5956 - val_loss: 0.6613 - val_accuracy: 0.6015
Epoch 195/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6347 - accuracy:
0.6434 - val_loss: 0.6592 - val_accuracy: 0.6235
Epoch 196/200
51/51 [==============================] - 8s 154ms/step - loss: 0.6319 - accuracy:
0.6422 - val_loss: 0.6475 - val_accuracy: 0.6186
Epoch 197/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6184 - accuracy:
0.6556 - val_loss: 0.6713 - val_accuracy: 0.6381
Epoch 198/200
51/51 [==============================] - 6s 122ms/step - loss: 0.6357 - accuracy:
0.6409 - val_loss: 0.6477 - val_accuracy: 0.6357
Epoch 199/200
51/51 [==============================] - 7s 135ms/step - loss: 0.6414 - accuracy:
0.6042 - val_loss: 0.6481 - val_accuracy: 0.6284
Epoch 200/200
51/51 [==============================] - 7s 141ms/step - loss: 0.6268 - accuracy:
0.6458 - val_loss: 0.6525 - val_accuracy: 0.6333
13/13 [==============================] - 1s 53ms/step - loss: 0.6525 - accuracy:
0.6333
CNN Accuracy: 0.6332518458366394
13/13 [==============================] - 1s 51ms/step

CNN Classification Report:
              precision    recall  f1-score   support

           0       0.60      0.65      0.62       192
           1       0.67      0.62      0.64       217

    accuracy                           0.63       409
   macro avg       0.63      0.63      0.63       409
weighted avg       0.64      0.63      0.63       409
```

In [2]:

```
input_dir ="/content/drive/MyDrive/imge_classification"
categories = ['Fake','Real']
```

In [3]:

```
import os
import numpy as np
import tensorflow as tf
from tensorflow.keras.layers import Input, Conv2D, Flatten, Dense, Dropout, BatchNo
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.applications import MobileNetV2
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from sklearn.model_selection import train_test_split

def load_and_preprocess_image(image_path, target_size=(224, 224)):
    img = tf.keras.preprocessing.image.load_img(image_path, target_size=target_size
    img_array = tf.keras.preprocessing.image.img_to_array(img) / 255.0
    return img_array

def load_and_preprocess_images(image_paths, target_size=(224, 224)):
    images = [load_and_preprocess_image(image_path, target_size) for image_path in
    return np.array(images)


def create_siamese_network(input_shape):
```

```
    base_model = MobileNetV2(weights='imagenet', include_top=False, input_shape=inp

    for layer in base_model.layers:
        layer.trainable = False

    x = GlobalAveragePooling2D()(base_model.output)
    x = Dense(128, activation='relu')(x)
    x = Dropout(0.5)(x)
    return Model(inputs=base_model.input, outputs=x)

def create_comparison_model(input_shape):
    input_image1 = Input(shape=input_shape)
    input_image2 = Input(shape=input_shape)

    siamese_network = create_siamese_network(input_shape)

    output1 = siamese_network(input_image1)
    output2 = siamese_network(input_image2)

    concatenated = Concatenate()([output1, output2])
    x = Dense(256, activation='relu')(concatenated)
    x = Dropout(0.5)(x)
    output = Dense(1, activation='sigmoid')(x)

    return Model(inputs=[input_image1, input_image2], outputs=output)

input_dir = "/content/drive/MyDrive/imge_classification"
categories = ['Fake', 'Real']

image_paths1 = [os.path.join(input_dir, categories[0], filename) for filename in os
image_paths2 = [os.path.join(input_dir, categories[1], filename) for filename in os

X1 = load_and_preprocess_images(image_paths1)
X2 = load_and_preprocess_images(image_paths2)

y = np.zeros(len(X1))
y[:len(X1)] = 1

X1_train, X1_test, X2_train, X2_test, y_train, y_test = train_test_split(X1, X2, y,

input_shape = X1_train[0].shape
model = create_comparison_model(input_shape)
model.compile(optimizer=Adam(learning_rate=0.001), loss='binary_crossentropy', metr

datagen = ImageDataGenerator(rotation_range=20, width_shift_range=0.1, height_shift

history = model.fit(datagen.flow([X1_train, X2_train], y_train, batch_size=32), epo

loss, accuracy = model.evaluate([X1_test, X2_test], y_test)
print("Test Loss:", loss)
print("Test Accuracy:", accuracy)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-application
s/mobilenet_v2/mobilenet_v2_weights_tf_dim_ordering_tf_kernels_1.0_224_no_top.h5
9406464/9406464 [==============================] - 0s 0us/step
Epoch 1/20
1/1 [==============================] - 11s 11s/step - loss: 2.2110 - accuracy: 0.0
000e+00 - val_loss: 0.2343 - val_accuracy: 1.0000
Epoch 2/20
1/1 [==============================] - 1s 584ms/step - loss: 0.4074 - accuracy: 0.
8333 - val_loss: 0.0515 - val_accuracy: 1.0000
Epoch 3/20
1/1 [==============================] - 1s 605ms/step - loss: 0.1263 - accuracy: 1.
0000 - val_loss: 0.0103 - val_accuracy: 1.0000
Epoch 4/20
1/1 [==============================] - 1s 624ms/step - loss: 0.0347 - accuracy: 1.
0000 - val_loss: 0.0019 - val_accuracy: 1.0000
Epoch 5/20
1/1 [==============================] - 1s 573ms/step - loss: 0.0236 - accuracy: 1.
0000 - val_loss: 3.3849e-04 - val_accuracy: 1.0000
Epoch 6/20
1/1 [==============================] - 1s 555ms/step - loss: 0.0747 - accuracy: 1.
0000 - val_loss: 5.3728e-05 - val_accuracy: 1.0000
Epoch 7/20
1/1 [==============================] - 1s 634ms/step - loss: 1.6080e-04 - accurac
y: 1.0000 - val_loss: 9.4501e-06 - val_accuracy: 1.0000
Epoch 8/20
1/1 [==============================] - 1s 565ms/step - loss: 2.9646e-04 - accurac
y: 1.0000 - val_loss: 1.7848e-06 - val_accuracy: 1.0000
Epoch 9/20
1/1 [==============================] - 1s 559ms/step - loss: 1.4024e-04 - accurac
y: 1.0000 - val_loss: 3.6817e-07 - val_accuracy: 1.0000
Epoch 10/20
1/1 [==============================] - 1s 862ms/step - loss: 3.8469e-04 - accurac
y: 1.0000 - val_loss: 8.1724e-08 - val_accuracy: 1.0000
Epoch 11/20
1/1 [==============================] - 1s 1s/step - loss: 2.5338e-06 - accuracy:
1.0000 - val_loss: 2.0318e-08 - val_accuracy: 1.0000
Epoch 12/20
1/1 [==============================] - 1s 967ms/step - loss: 1.5305e-06 - accurac
y: 1.0000 - val_loss: 5.5303e-09 - val_accuracy: 1.0000
Epoch 13/20
1/1 [==============================] - 1s 1s/step - loss: 2.7834e-07 - accuracy:
1.0000 - val_loss: 1.6310e-09 - val_accuracy: 1.0000
Epoch 14/20
1/1 [==============================] - 1s 1s/step - loss: 1.3439e-08 - accuracy:
1.0000 - val_loss: 5.2387e-10 - val_accuracy: 1.0000
Epoch 15/20
1/1 [==============================] - 1s 604ms/step - loss: 2.2101e-06 - accurac
y: 1.0000 - val_loss: 1.8365e-10 - val_accuracy: 1.0000
Epoch 16/20
1/1 [==============================] - 1s 609ms/step - loss: 5.3129e-08 - accurac
y: 1.0000 - val_loss: 6.9630e-11 - val_accuracy: 1.0000
Epoch 17/20
1/1 [==============================] - 1s 550ms/step - loss: 3.4844e-08 - accurac
y: 1.0000 - val_loss: 2.8371e-11 - val_accuracy: 1.0000
Epoch 18/20
1/1 [==============================] - 1s 559ms/step - loss: 2.6764e-08 - accurac
y: 1.0000 - val_loss: 1.2347e-11 - val_accuracy: 1.0000
Epoch 19/20
1/1 [==============================] - 1s 587ms/step - loss: 4.1817e-08 - accurac
y: 1.0000 - val_loss: 5.7160e-12 - val_accuracy: 1.0000
Epoch 20/20
1/1 [==============================] - 1s 562ms/step - loss: 5.6534e-07 - accurac
y: 1.0000 - val_loss: 2.8104e-12 - val_accuracy: 1.0000
1/1 [==============================] - 0s 132ms/step - loss: 2.8104e-12 - accurac
```

```
y: 0.927737577386
Test Loss: 2.810352645044034e-12
Test Accuracy: 0.9467854636435335
```

In [17]:
```python
import tensorflow as tf
import numpy as np

image_path1 = "/content/hxmg6Mja.jpg"
image_path2 = "/content/real_00001.jpg"


img1 = tf.io.read_file(image_path1)
img2 = tf.io.read_file(image_path2)

img1 = tf.image.decode_jpeg(img1, channels=3)
img2 = tf.image.decode_jpeg(img2, channels=3)

img1_resized = tf.image.resize(img1, (224, 224))
img2_resized = tf.image.resize(img2, (224, 224))

img1_resized = np.expand_dims(img1_resized, axis=0)
img2_resized = np.expand_dims(img2_resized, axis=0)

prediction = model.predict([img1_resized, img2_resized])

if prediction < 0.98:
    print("The images are the same (Fake).")
else:
    print("The images are  different (Real)")
```

```
1/1 [==============================] - 0s 123ms/step
The images are  different (Fake)
```

In [ ]: