```
#import all the necessary libraries
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.layers import Input, Dense, Flatten, Conv2D, MaxPooling2D, BatchNormalization,
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.models import Model


# Height and width refer to the size of the image
# Channels refers to the amount of color channels (red, green, blue)
image_dimensions = {'height':256, 'width':256, 'channels':3}


# Create a Classifier class
class Classifier:
    def __init__():
        self.model = 0

    def predict(self, x):
        return self.model.predict(x)

    def fit(self, x, y):
        return self.model.train_on_batch(x, y)

    def get_accuracy(self, x, y):
        return self.model.test_on_batch(x, y)

    def load(self, path):
        self.model.load_weights(path)


# Create a MesoNet class using the Classifier

class Meso4(Classifier):
    def __init__(self, learning_rate = 0.001):
        self.model = self.init_model()
        optimizer = Adam(lr = learning_rate)
        self.model.compile(optimizer = optimizer,
                           loss = 'mean_squared_error',
                           metrics = ['accuracy'])

    def init_model(self):
        x = Input(shape = (image_dimensions['height'],
                           image_dimensions['width'],
                           image_dimensions['channels']))

        x1 = Conv2D(8, (3, 3), padding='same', activation = 'relu')(x)
        x1 = BatchNormalization()(x1)
        x1 = MaxPooling2D(pool_size=(2, 2), padding='same')(x1)

        x2 = Conv2D(8, (5, 5), padding='same', activation = 'relu')(x1)
        x2 = BatchNormalization()(x2)
        x2 = MaxPooling2D(pool_size=(2, 2), padding='same')(x2)

        x3 = Conv2D(16, (5, 5), padding='same', activation = 'relu')(x2)
        x3 = BatchNormalization()(x3)
        x3 = MaxPooling2D(pool_size=(2, 2), padding='same')(x3)

        x4 = Conv2D(16, (5, 5), padding='same', activation = 'relu')(x3)
        x4 = BatchNormalization()(x4)
```

```
        x4 = MaxPooling2D(pool_size=(4, 4), padding='same')(x4)

        y = Flatten()(x4)
        y = Dropout(0.5)(y)
        y = Dense(16)(y)
        y = LeakyReLU(alpha=0.1)(y)
        y = Dropout(0.5)(y)
        y = Dense(1, activation = 'sigmoid')(y)

        return Model(inputs = x, outputs = y)


# Instantiate a MesoNet model with pretrained weights
meso = Meso4()
meso.load('/content/drive/MyDrive/weights/Meso4_DF.h5')
```

```
WARNING:absl:`lr` is deprecated in Keras optimizer, please use `learning_rate` or use the legacy
```

Double-click (or enter) to edit

```
# Prepare image data

# Rescaling pixel values (between 1 and 255) to a range between 0 and 1
dataGenerator = ImageDataGenerator(rescale=1./255)

# Instantiating generator to feed images through the network
generator = dataGenerator.flow_from_directory(
    '/content/drive/My Drive/dataset_fid',
    target_size=(256, 256),
    batch_size=1,
    class_mode='binary')
```

```
Found 2055 images belonging to 2 classes.
```

```
# Checking class assignment
generator.class_indices
```

```
{'fake': 0, 'real': 1}
```

```
# '.ipynb_checkpoints' is a *hidden* file Jupyter creates for autosaves
# It must be removed for flow_from_directory to work.
!rmdir /s /q c:dataset_fid\.ipynb_checkpoints
```

```
rmdir: failed to remove '/s': No such file or directory
rmdir: failed to remove '/q': No such file or directory
rmdir: failed to remove 'c:dataset_fid.ipynb_checkpoints': No such file or directory
```

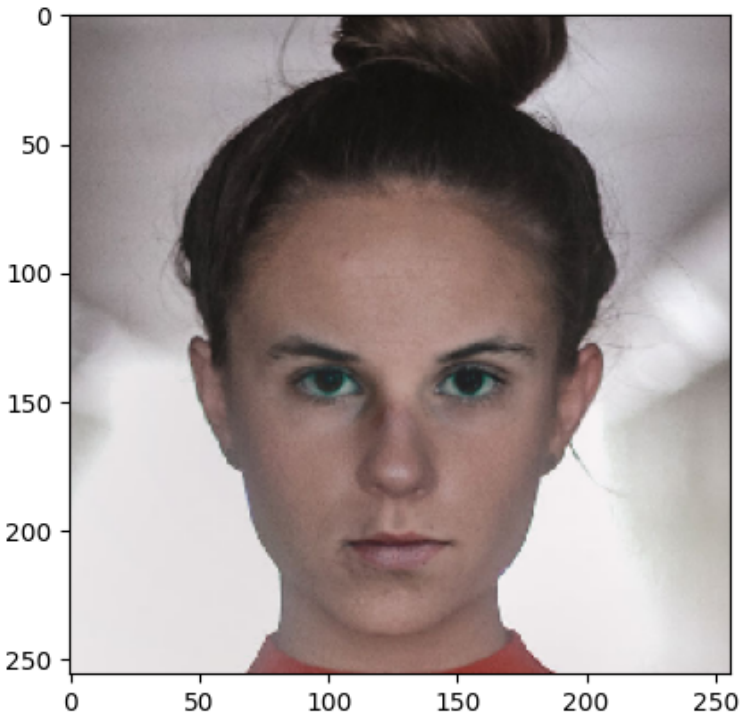
```
# Recreating generator after removing '.ipynb_checkpoints'
dataGenerator = ImageDataGenerator(rescale=1./255)

generator = dataGenerator.flow_from_directory(
    '/content/drive/My Drive/dataset_fid',
    target_size=(256, 256),
    batch_size=1,
    class_mode='binary')
```

```
# Re-checking class assignment after removing it
generator.class_indices
```

```
Found 2055 images belonging to 2 classes.
{'fake': 0, 'real': 1}
```

```
# Rendering image X with label y for MesoNet
X, y = generator.next()

# Evaluating prediction
print(f"Predicted likelihood: {meso.predict(X)[0][0]:.4f}")
print(f"Actual label: {int(y[0])}")
if(int(y[0])==1):
  print("the image is actually real")
else:
  print("the image is actually fake")

if(round(meso.predict(X)[0][0])==y[0]):
  print("model prediction is correct")
else:
  print("model prediction is wrong")
print(f"\nCorrect prediction: {round(meso.predict(X)[0][0])==y[0]}")

# Showing image
plt.imshow(np.squeeze(X));
```

```
1/1 [==============================] - 0s 22ms/step
Predicted likelihood: 0.6899
Actual label: 0
the image is actually fake
1/1 [==============================] - 0s 22ms/step
model prediction is wrong
1/1 [==============================] - 0s 21ms/step

Correct prediction: False
```




```
# Creating separate lists for correctly classified and misclassified images
correct_real = []
correct_real_pred = []
```

```
correct_deepfake = []
correct_deepfake_pred = []

misclassified_real = []
misclassified_real_pred = []

misclassified_deepfake = []
misclassified_deepfake_pred = []


# Generating predictions on validation set, storing in separate lists
for i in range(len(generator.labels)):

    # Loading next picture, generating prediction
    X, y = generator.next()
    pred = meso.predict(X)[0][0]

    # Sorting into proper category
    if round(pred)==y[0] and y[0]==1:
        correct_real.append(X)
        correct_real_pred.append(pred)
    elif round(pred)==y[0] and y[0]==0:
        correct_deepfake.append(X)
        correct_deepfake_pred.append(pred)
    elif y[0]==1:
        misclassified_real.append(X)
        misclassified_real_pred.append(pred)
    else:
        misclassified_deepfake.append(X)
        misclassified_deepfake_pred.append(pred)

    # Printing status update
    if i % 1000 == 0:
        print(i, ' predictions completed.')

    if i == len(generator.labels)-1:
        print("All", len(generator.labels), "predictions completed")
```

```
1/1 [==============================] - 0s 24ms/step
1/1 [==============================] - 0s 18ms/step
1/1 [==============================] - 0s 18ms/step
1/1 [==============================] - 0s 23ms/step
1/1 [==============================] - 0s 21ms/step
1/1 [==============================] - 0s 18ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 21ms/step
1/1 [==============================] - 0s 18ms/step
1/1 [==============================] - 0s 22ms/step
1/1 [==============================] - 0s 21ms/step
1/1 [==============================] - 0s 22ms/step
1/1 [==============================] - 0s 22ms/step
1/1 [==============================] - 0s 18ms/step
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1/1 [==============================] - 0s 21ms/step
1/1 [==============================] - 0s 20ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 18ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 20ms/step
1/1 [==============================] - 0s 25ms/step
All 2055 predictions completed
```
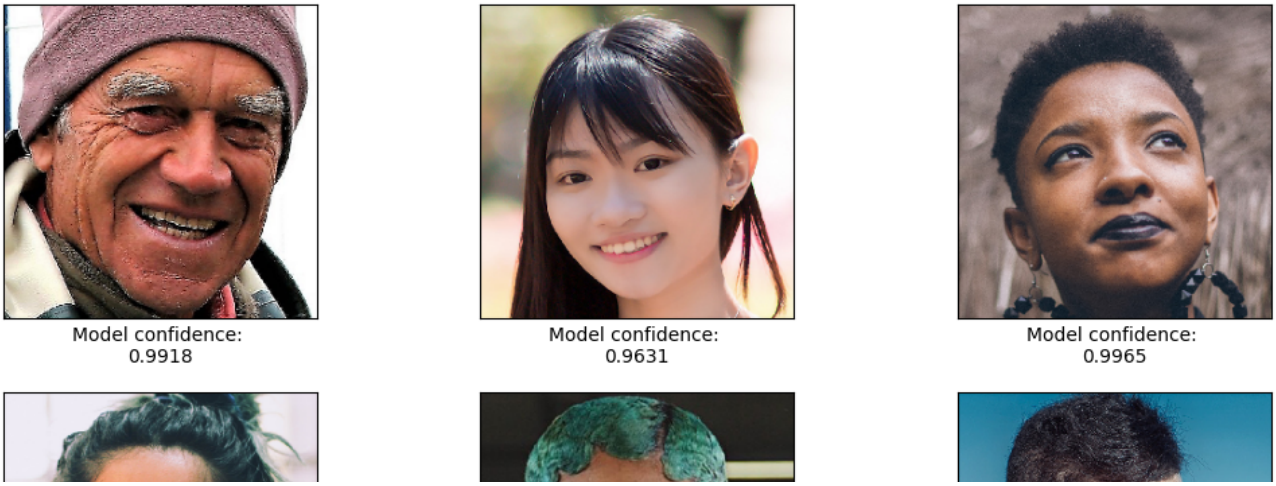
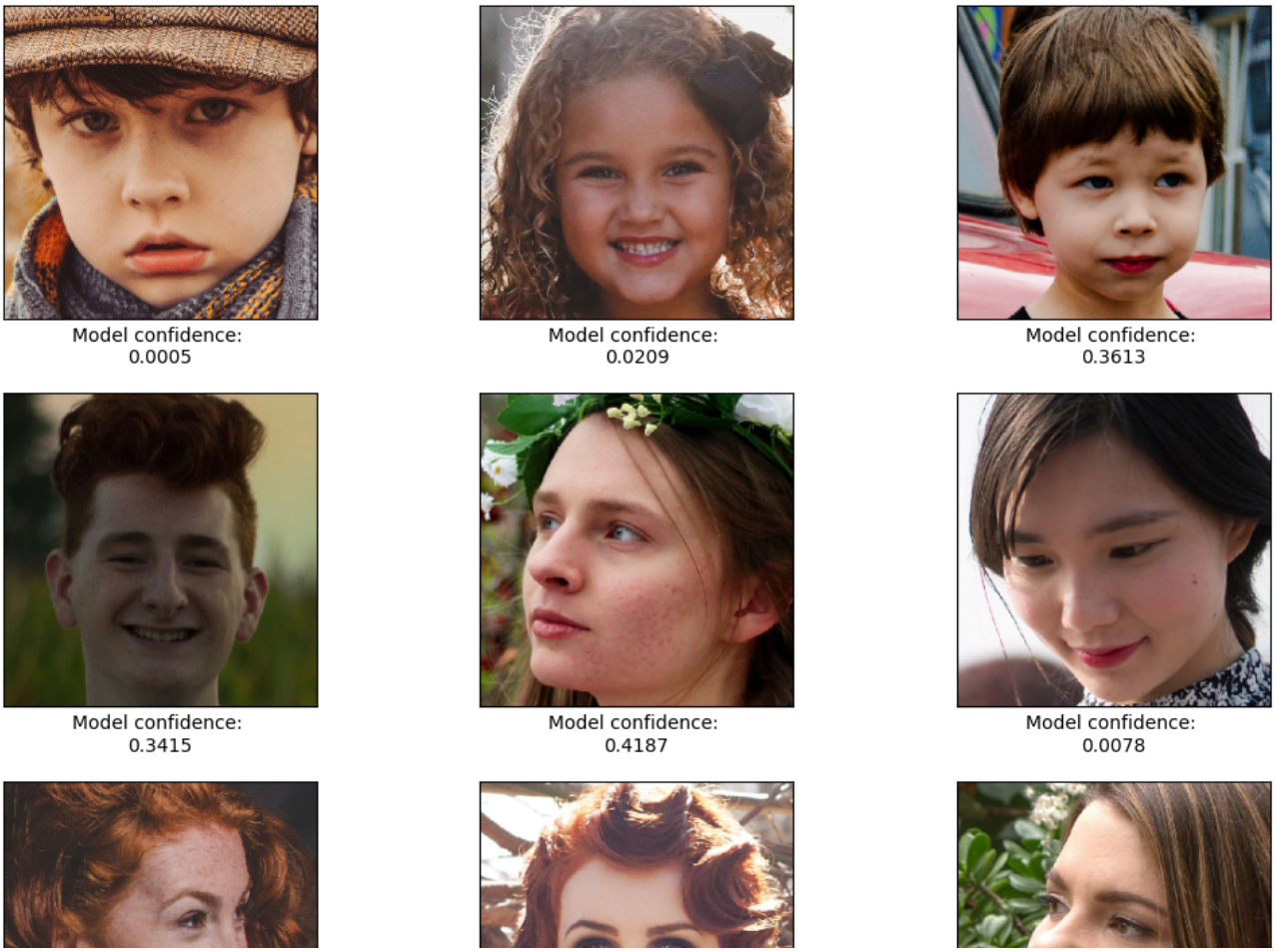

```
def plotter(images,preds):
    fig = plt.figure(figsize=(16,9))
    subset = np.random.randint(0, len(images)-1, 12)
    for i,j in enumerate(subset):
        fig.add_subplot(3,4,i+1)
        plt.imshow(np.squeeze(images[j]))
        plt.xlabel(f"Model confidence: \n{preds[j]:.4f}")
        plt.tight_layout()
        ax = plt.gca()
        ax.axes.xaxis.set_ticks([])
        ax.axes.yaxis.set_ticks([])
    plt.show;
    return
```

```
plotter(correct_real, correct_real_pred)
```



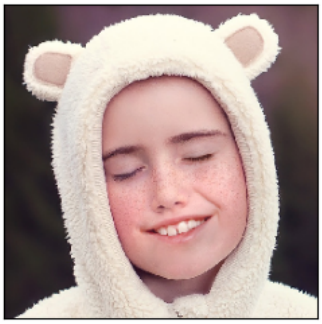

```
plotter(misclassified_real, misclassified_real_pred)
```

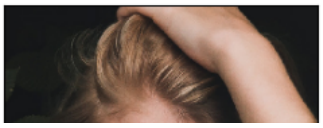



```
plotter(correct_deepfake, correct_deepfake_pred)
```


Model confidence:
0.2556


Model confidence:
0.0336


Model confidence:
0.2430

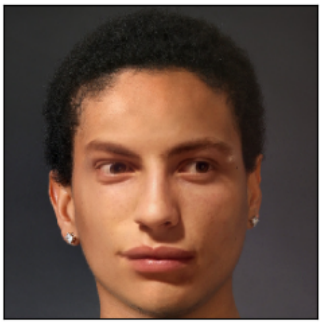


```
plotter(misclassified_deepfake, misclassified_deepfake_pred)
```


Model confidence:
0.9996


Model confidence:
0.9997


Model confidence:
0.9821


Model confidence:
0.9819


Model confidence:
0.9022


Model confidence:
0.9974