In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
np.random.seed(2)
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from keras.utils import to_categorical
from keras.models import Sequential
from keras.layers import Dense, Flatten, Conv2D, MaxPool2D, Dropout
from keras.optimizers import Adam
from keras.preprocessing.image import ImageDataGenerator
from keras.callbacks import EarlyStopping
```

In [2]:
```
from PIL import Image, ImageChops, ImageEnhance
import os
import itertools
```

In [3]:
```
def convert_to_ela_image(path, quality):
    temp_filename = 'temp_file_name.jpg'
    ela_filename = 'temp_ela.png'

    image = Image.open(path).convert('RGB')
    image.save(temp_filename, 'JPEG', quality = quality)
    temp_image = Image.open(temp_filename)

    ela_image = ImageChops.difference(image, temp_image)

    extrema = ela_image.getextrema()
    max_diff = max([ex[1] for ex in extrema])
    if max_diff == 0:
        max_diff = 1
    scale = 255.0 / max_diff

    ela_image = ImageEnhance.Brightness(ela_image).enhance(scale)

    return ela_image
```

Open a real image

In [4]:
```
real_image_path = "E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA1\Au\Au_ani_0001.jpg"
Image.open(real_image_path)
```

Out[4]:

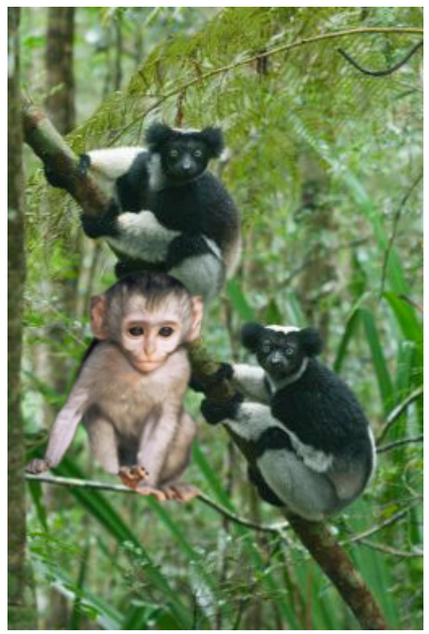
In [5]:
```
convert_to_ela_image(real_image_path, 90)
```

Out[5]:

Open a fake image

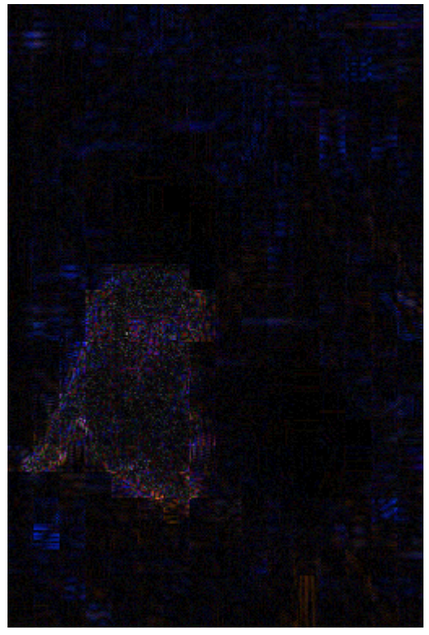
In [6]:
```
fake_image_path = "E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA2\Tp\Tp_D_CND_S_N_ani00073_ani00068_00193.tif"
Image.open(fake_image_path)
```

Out[6]:



In [7]:
```
convert_to_ela_image(fake_image_path, 90)
```

Out[7]:



In [8]:
```
image_size = (128, 128)
```

In [9]:
```
def prepare_image(image_path):
    return np.array(convert_to_ela_image(image_path, 90).resize(image_size)).flatten() / 255.0
```

In [10]:
```
X = [] # list for ELA converted images
Y = [] # output, 0 for fake, 1 for real
```

In [11]:
```
import random
path = "E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA2\Au"
for dirname, _, filenames in os.walk(path):
    for filename in filenames:
        if filename.endswith('jpg') or filename.endswith('png'):
            full_path = os.path.join(dirname, filename)
            X.append(prepare_image(full_path))
            Y.append(1)
            if len(Y) % 500 == 0:
                print(f'Processing {len(Y)} images')

random.shuffle(X)
X = X[:2100]
Y = Y[:2100]
print(len(X), len(Y))
```

```
Processing 500 images
Processing 1000 images
Processing 1500 images
Processing 2000 images
Processing 2500 images
Processing 3000 images
Processing 3500 images
Processing 4000 images
Processing 4500 images
Processing 5000 images
Processing 5500 images
Processing 6000 images
Processing 6500 images
Processing 7000 images
2100 2100
```

In [12]:
```
path = "E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA2\Tp"
for dirname, _, filenames in os.walk(path):
    for filename in filenames:
        if filename.endswith('jpg') or filename.endswith('png'):
            full_path = os.path.join(dirname, filename)
            X.append(prepare_image(full_path))
            Y.append(0)
            if len(Y) % 500 == 0:
                print(f'Processing {len(Y)} images')

print(len(X), len(Y))
```

```
Processing 2500 images
Processing 3000 images
Processing 3500 images
Processing 4000 images
4164 4164
```

In [13]:
```
X = np.array(X)
Y = to_categorical(Y, 2)
X = X.reshape(-1, 128, 128, 3)
```

In [14]:
```
X_train, X_val, Y_train, Y_val = train_test_split(X, Y, test_size = 0.2, random_state=5)
X = X.reshape(-1,1,1,1)
print(len(X_train), len(Y_train))
print(len(X_val), len(Y_val))
```

```
3331 3331
833 833
```

In [15]:
```
def build_model():
    model = Sequential()
    model.add(Conv2D(filters = 32, kernel_size = (5, 5), padding = 'valid', activation = 'relu', input_shape = (128, 128, 3)))
    model.add(Conv2D(filters = 32, kernel_size = (5, 5), padding = 'valid', activation = 'relu', input_shape = (128, 128, 3)))
    model.add(MaxPool2D(pool_size = (2, 2)))
    model.add(Dropout(0.25))
    model.add(Flatten())
    model.add(Dense(256, activation = 'relu'))
    model.add(Dropout(0.5))
    model.add(Dense(2, activation = 'softmax'))
    return model
```

In [16]:
```
model = build_model()
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 124, 124, 32)      2432

 conv2d_1 (Conv2D)           (None, 120, 120, 32)      25632

 max_pooling2d (MaxPooling2  (None, 60, 60, 32)        0
 D)

 dropout (Dropout)           (None, 60, 60, 32)        0

 flatten (Flatten)           (None, 115200)            0

 dense (Dense)               (None, 256)               29491456

 dropout_1 (Dropout)         (None, 256)               0

 dense_1 (Dense)             (None, 2)                 514

=================================================================
Total params: 29520034 (112.61 MB)
Trainable params: 29520034 (112.61 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [17]:
```
epochs = 20
batch_size = 32
```

In [18]:
```
init_lr = 1e-4
optimizer = optimizer = Adam(learning_rate=init_lr)
```

In [19]:
```
model.compile(optimizer = optimizer, loss = 'binary_crossentropy', metrics = ['accuracy'])
```

In [ ]:
```
# early_stopping = EarlyStopping(monitor = 'val_accuracy',
#                                min_delta = 0,
#                                patience = 2,
#                                verbose = 0,
#                                mode = 'auto')
```

In [22]:
```
hist = model.fit(X_train,
                 Y_train,
                 batch_size = batch_size,
                 epochs = epochs,
                validation_data = (X_val, Y_val))
#                 callbacks = [early_stopping])
```

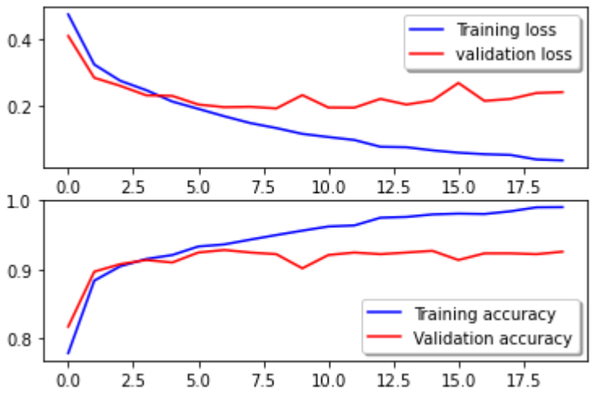
```
Epoch 1/20
105/105 [==============================] - 274s 3s/step - loss: 0.4762 - accuracy: 0.7793 - val_loss: 0.4114 - val_accuracy: 0.8175
Epoch 2/20
105/105 [==============================] - 250s 2s/step - loss: 0.3256 - accuracy: 0.8838 - val_loss: 0.2858 - val_accuracy: 0.8968
Epoch 3/20
105/105 [==============================] - 246s 2s/step - loss: 0.2768 - accuracy: 0.9045 - val_loss: 0.2616 - val_accuracy: 0.9076
Epoch 4/20
105/105 [==============================] - 263s 3s/step - loss: 0.2485 - accuracy: 0.9150 - val_loss: 0.2330 - val_accuracy: 0.9136
Epoch 5/20
105/105 [==============================] - 260s 2s/step - loss: 0.2144 - accuracy: 0.9207 - val_loss: 0.2314 - val_accuracy: 0.9100
Epoch 6/20
105/105 [==============================] - 230s 2s/step - loss: 0.1923 - accuracy: 0.9331 - val_loss: 0.2053 - val_accuracy: 0.9244
Epoch 7/20
105/105 [==============================] - 220s 2s/step - loss: 0.1701 - accuracy: 0.9361 - val_loss: 0.1975 - val_accuracy: 0.9280
Epoch 8/20
105/105 [==============================] - 220s 2s/step - loss: 0.1496 - accuracy: 0.9430 - val_loss: 0.1986 - val_accuracy: 0.9244
Epoch 9/20
105/105 [==============================] - 218s 2s/step - loss: 0.1346 - accuracy: 0.9496 - val_loss: 0.1937 - val_accuracy: 0.9220
Epoch 10/20
105/105 [==============================] - 221s 2s/step - loss: 0.1172 - accuracy: 0.9559 - val_loss: 0.2338 - val_accuracy: 0.9016
Epoch 11/20
105/105 [==============================] - 221s 2s/step - loss: 0.1077 - accuracy: 0.9619 - val_loss: 0.1964 - val_accuracy: 0.9208
Epoch 12/20
105/105 [==============================] - 219s 2s/step - loss: 0.0987 - accuracy: 0.9634 - val_loss: 0.1959 - val_accuracy: 0.9244
Epoch 13/20
105/105 [==============================] - 237s 2s/step - loss: 0.0784 - accuracy: 0.9745 - val_loss: 0.2224 - val_accuracy: 0.9220
Epoch 14/20
105/105 [==============================] - 245s 2s/step - loss: 0.0770 - accuracy: 0.9757 - val_loss: 0.2053 - val_accuracy: 0.9244
Epoch 15/20
105/105 [==============================] - 246s 2s/step - loss: 0.0676 - accuracy: 0.9793 - val_loss: 0.2174 - val_accuracy: 0.9268
Epoch 16/20
105/105 [==============================] - 249s 2s/step - loss: 0.0605 - accuracy: 0.9805 - val_loss: 0.2702 - val_accuracy: 0.9136
Epoch 17/20
105/105 [==============================] - 223s 2s/step - loss: 0.0562 - accuracy: 0.9799 - val_loss: 0.2163 - val_accuracy: 0.9232
Epoch 18/20
105/105 [==============================] - 236s 2s/step - loss: 0.0538 - accuracy: 0.9838 - val_loss: 0.2222 - val_accuracy: 0.9232
Epoch 19/20
105/105 [==============================] - 225s 2s/step - loss: 0.0403 - accuracy: 0.9895 - val_loss: 0.2399 - val_accuracy: 0.9220
Epoch 20/20
105/105 [==============================] - 224s 2s/step - loss: 0.0373 - accuracy: 0.9898 - val_loss: 0.2426 - val_accuracy: 0.9256
```

In [23]:
```
model.save('DL_Alternate_MiniProjModelCasia.h5')
```

```
D:\downloads\Anaconda\lib\site-packages\keras\src\engine\training.py:3000: UserWarning: You are saving your model as an HDF5 file via `model.save()`. This file format is conside
red legacy. We recommend using instead the native Keras format, e.g. `model.save('my_model.keras')`.
  saving_api.save_model(
```

In [24]:
```
fig, ax = plt.subplots(2,1)
ax[0].plot(hist.history['loss'], color='b', label="Training loss")
ax[0].plot(hist.history['val_loss'], color='r', label="validation loss",axes =ax[0])
legend = ax[0].legend(loc='best', shadow=True)

ax[1].plot(hist.history['accuracy'], color='b', label="Training accuracy")
ax[1].plot(hist.history['val_accuracy'], color='r',label="Validation accuracy")
legend = ax[1].legend(loc='best', shadow=True)
```



In [25]:
```
def plot_confusion_matrix(cm, classes,
                          normalize=False,
                          title='Confusion matrix',
                          cmap=plt.cm.Blues):

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes, rotation=45)
    plt.yticks(tick_marks, classes)

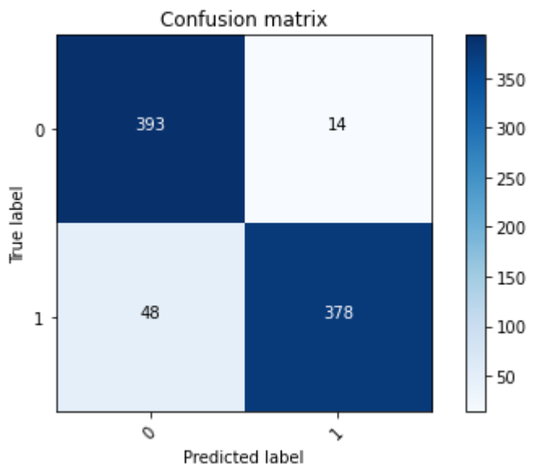
    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]

    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, cm[i, j],
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')
```

In [26]:
```
Y_pred = model.predict(X_val)
Y_pred_classes = np.argmax(Y_pred,axis = 1)
Y_true = np.argmax(Y_val,axis = 1)
confusion_mtx = confusion_matrix(Y_true, Y_pred_classes)
plot_confusion_matrix(confusion_mtx, classes = range(2))
```

```
27/27 [==============================] - 14s 131ms/step
```



In [31]:
```
class_names = ['AI-Generated', 'real']
```

In [32]:
```
real_image_path = "E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\casia\CASIA2\Au\Au_ani_00002.jpg"
image = prepare_image(real_image_path)
image = image.reshape(-1, 128, 128, 3)
y_pred = model.predict(image)
y_pred_class = np.argmax(y_pred, axis = 1)[0]
print(f'Class: {class_names[y_pred_class]} Confidence: {np.amax(y_pred) * 100:0.2f}')
```

```
1/1 [==============================] - 0s 37ms/step
Class: real Confidence: 100.00
```

In [33]:
```
fake_image_path = "E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA2\Tp\Tp_D_CRN_M_N_art00067_nat00013_11804.jpg"
image = prepare_image(fake_image_path)
image = image.reshape(-1, 128, 128, 3)
y_pred = model.predict(image)
y_pred_class = np.argmax(y_pred, axis = 1)[0]
print(f'Class: {class_names[y_pred_class]} Confidence: {np.amax(y_pred) * 100:0.2f}')
```

```
1/1 [==============================] - 0s 50ms/step
Class: AI-Generated Confidence: 100.00
```

In [36]:
```
real_image = os.listdir("E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA1\Au")
correct_r = 0
total_r = 0
for file_name in real_image:
    if file_name.endswith('jpg') or filename.endswith('png'):
        real_image_path = os.path.join("E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA1\Au", file_name)
        image = prepare_image(real_image_path)
        image = image.reshape(-1, 128, 128, 3)
        y_pred = model.predict(image)
        y_pred_class = np.argmax(y_pred, axis = 1)[0]
        total_r += 1
        if y_pred_class == 1:
            correct_r += 1
#             print(f'Class: {class_names[y_pred_class]} Confidence: {np.amax(y_pred) * 100:0.2f}')
```

```
1/1 [==============================] - 0s 55ms/step
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1/1 [==============================] - 0s 78ms/step
```

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1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 37ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 40ms/step
1/1 [==============================] - 0s 37ms/step
1/1 [==============================] - 0s 37ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 38ms/step
```

```
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 42ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 40ms/step
1/1 [==============================] - 0s 47ms/step
1/1 [==============================] - 0s 52ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 53ms/step
1/1 [==============================] - 0s 42ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 37ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 44ms/step
1/1 [==============================] - 0s 41ms/step
1/1 [==============================] - 0s 41ms/step
1/1 [==============================] - 0s 49ms/step
1/1 [==============================] - 0s 73ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 43ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 45ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 41ms/step
1/1 [==============================] - 0s 44ms/step
1/1 [==============================] - 0s 43ms/step
1/1 [==============================] - 0s 83ms/step
1/1 [==============================] - 0s 44ms/step

1/1 [==============================] - 0s 38ms/step
1/1 [==============================] - 0s 78ms/step
1/1 [==============================] - 0s 42ms/step
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 38ms/step
```

In [39]:
```
correct += correct_r
total += total_r
print(f'Total: {total_r}, Correct: {correct_r}, Acc: {correct_r / total_r * 100.0}')
print(f'Total: {total}, Correct: {correct}, Acc: {correct / total * 100.0}')
```

```
Total: 790, Correct: 750, Acc: 94.9367088607595
Total: 2854, Correct: 2800, Acc: 98.10791871058164
```

In [37]:
```
fake_image = os.listdir("E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA2\Tp")
correct = 0
total = 0
for file_name in fake_image:
    if file_name.endswith('jpg') or filename.endswith('png'):
        fake_image_path = os.path.join("E:\BTech_MIT\FourthYearBTechMIT\Semester 7\DL\extracted_images\CASIA2\Tp", file_name)
        image = prepare_image(fake_image_path)
        image = image.reshape(-1, 128, 128, 3)
        y_pred = model.predict(image)
        y_pred_class = np.argmax(y_pred, axis = 1)[0]
        total += 1
        if y_pred_class == 0:
            correct += 1
            print(f'Class: {class_names[y_pred_class]} Confidence: {np.amax(y_pred) * 100:0.2f}')
```

```
1/1 [==============================] - 0s 48ms/step
Class: AI-Generated Confidence: 100.00
1/1 [==============================] - 0s 50ms/step
Class: AI-Generated Confidence: 99.32
1/1 [==============================] - 0s 41ms/step
Class: AI-Generated Confidence: 100.00
1/1 [==============================] - 0s 41ms/step
Class: AI-Generated Confidence: 100.00
1/1 [==============================] - 0s 50ms/step
Class: AI-Generated Confidence: 100.00
1/1 [==============================] - 0s 40ms/step
Class: AI-Generated Confidence: 99.99
1/1 [==============================] - 0s 43ms/step
Class: AI-Generated Confidence: 100.00
1/1 [==============================] - 0s 58ms/step
Class: AI-Generated Confidence: 100.00
1/1 [==============================] - 0s 44ms/step
Class: AI-Generated Confidence: 100.00
1/1 [==============================] - 0s 41ms/step
Class: AI-Generated Confidence: 98.79
```

In [38]:
```
print(f'Total: {total}, Correct: {correct}, Acc: {correct / total * 100.0}')
```

```
Total: 2064, Correct: 2050, Acc: 99.32170542635659
```

In [ ]: