In [5]:

```
pip install tensorflow
```

```
Requirement already satisfied: tensorflow in c:\users\ferdi\anaconda3\lib\site-packages (2.5.0)
Requirement already satisfied: wrapt~=1.12.1 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (1.12.1)
Requirement already satisfied: grpcio~=1.34.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (1.34.1)
Requirement already satisfied: h5py~=3.1.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (3.1.0)
Requirement already satisfied: numpy~=1.19.2 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (1.19.5)
Requirement already satisfied: keras-nightly~=2.5.0.dev in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (2.
5.0.dev2021032900)
Requirement already satisfied: astunparse~=1.6.3 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers~=1.12.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (1.12)
Requirement already satisfied: wheel~=0.35 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (0.37.1)
Requirement already satisfied: termcolor~=1.1.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (1.1.0)
Requirement already satisfied: google-pasta~=0.2 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (0.2.0)
Requirement already satisfied: keras-preprocessing~=1.1.2 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow)
(1.1.2)
Requirement already satisfied: protobuf>=3.9.2 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (3.20.3)
Requirement already satisfied: absl-py~=0.10 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (0.15.0)
Requirement already satisfied: tensorflow-estimator<2.6.0,>=2.5.0rc0 in c:\users\ferdi\anaconda3\lib\site-packages (from te
nsorflow) (2.5.0)
Requirement already satisfied: six~=1.15.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (1.15.0)
Requirement already satisfied: typing-extensions~=3.7.4 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (3.
7.4.3)
Requirement already satisfied: gast==0.4.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (0.4.0)
Requirement already satisfied: opt-einsum~=3.3.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (3.3.0)
Requirement already satisfied: tensorboard~=2.5 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorflow) (2.11.0)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorboard~=2.5->
tensorflow) (2.15.0)
Requirement already satisfied: setuptools>=41.0.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorboard~=2.5->ten
sorflow) (63.4.1)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorboar
d~=2.5->tensorflow) (1.8.1)
Requirement already satisfied: werkzeug>=1.0.1 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorboard~=2.5->tensor
flow) (2.0.3)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorb
oard~=2.5->tensorflow) (0.4.6)
Requirement already satisfied: requests<3,>=2.21.0 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorboard~=2.5->te
nsorflow) (2.28.1)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in c:\users\ferdi\anaconda3\lib\site-packages (from te
nsorboard~=2.5->tensorflow) (0.6.1)
Requirement already satisfied: markdown>=2.6.8 in c:\users\ferdi\anaconda3\lib\site-packages (from tensorboard~=2.5->tensor
flow) (3.3.4)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\users\ferdi\anaconda3\lib\site-packages (from google-auth<3,>=1.
6.3->tensorboard~=2.5->tensorflow) (0.2.8)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\users\ferdi\anaconda3\lib\site-packages (from google-auth<3,>=1.6.3->ten
sorboard~=2.5->tensorflow) (4.9)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\users\ferdi\anaconda3\lib\site-packages (from google-auth<3,>=
1.6.3->tensorboard~=2.5->tensorflow) (5.2.0)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\ferdi\anaconda3\lib\site-packages (from google-auth-oau
thlib<0.5,>=0.4.1->tensorboard~=2.5->tensorflow) (1.3.1)
Requirement already satisfied: idna<4,>=2.5 in c:\users\ferdi\anaconda3\lib\site-packages (from requests<3,>=2.21.0->tensor
board~=2.5->tensorflow) (3.3)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\ferdi\anaconda3\lib\site-packages (from requests<3,>=2.21.
0->tensorboard~=2.5->tensorflow) (1.26.11)
Requirement already satisfied: charset-normalizer<3,>=2 in c:\users\ferdi\anaconda3\lib\site-packages (from requests<3,>=2.
21.0->tensorboard~=2.5->tensorflow) (2.0.4)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\ferdi\anaconda3\lib\site-packages (from requests<3,>=2.21.0->
tensorboard~=2.5->tensorflow) (2022.9.14)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\users\ferdi\anaconda3\lib\site-packages (from pyasn1-modules>=0.
2.1->google-auth<3,>=1.6.3->tensorboard~=2.5->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\ferdi\anaconda3\lib\site-packages (from requests-oauthlib>=0.7.0
->google-auth-oauthlib<0.5,>=0.4.1->tensorboard~=2.5->tensorflow) (3.2.2)
Note: you may need to restart the kernel to use updated packages.
```

In [1]:

```
pip install opencv-python
```

```
Requirement already satisfied: opencv-python in c:\users\ferdi\anaconda3\lib\site-packages (4.6.0.66)
Requirement already satisfied: numpy>=1.19.3 in c:\users\ferdi\anaconda3\lib\site-packages (from opencv-python) (1.19.5)
Note: you may need to restart the kernel to use updated packages.
```

In [2]:

```
pip install matplotlib
```

```
Requirement already satisfied: matplotlib in c:\users\ferdi\anaconda3\lib\site-packages (3.5.2)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (1.4.2)
Requirement already satisfied: pillow>=6.2.0 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (9.2.0)
Requirement already satisfied: packaging>=20.0 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (21.3)
Requirement already satisfied: pyparsing>=2.2.1 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (3.0.9)
Requirement already satisfied: numpy>=1.17 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (1.19.5)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (4.25.0)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (2.8.2)
Requirement already satisfied: cycler>=0.10 in c:\users\ferdi\anaconda3\lib\site-packages (from matplotlib) (0.11.0)
Requirement already satisfied: six>=1.5 in c:\users\ferdi\anaconda3\lib\site-packages (from python-dateutil>=2.7->matplotli
b) (1.15.0)
Note: you may need to restart the kernel to use updated packages.
```

In [3]:

```
# Import standard dependencies
import cv2
import os
import random
import numpy as np
from matplotlib import pyplot as plt
```

In [4]:

```
# Import tensorflow dependencies - Functional API
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Layer, Conv2D, Dense, MaxPooling2D, Input, Flatten
import tensorflow as tf
```

In [5]:

```
# Avoid OOM errors by setting GPU Memory Consumption Growth
gpus =   tf.config.experimental.list_physical_devices('GPU')
```

In [6]:

```
for gpu in gpus:
    tf.config.experimental.set_memory_growth(gpu, True)
```

In [7]:

```
POS_PATH = os.path.join('data', 'positive')
NEG_PATH = os.path.join('data', 'negative')
ANC_PATH = os.path.join('data', 'anchor')
```

In [8]:

```
# Make the directories
os.makedirs(POS_PATH)
os.makedirs(NEG_PATH)
os.makedirs(ANC_PATH)
```

In [9]:

```
def data_aug(img):
    data = []
    for i in range(9):
        img = tf.image.stateless_random_brightness(img, max_delta=0.02, seed=(1,2))
        img = tf.image.stateless_random_contrast(img, lower=0.6, upper=1, seed=(1,3))
        # img = tf.image.stateless_random_crop(img, size=(20,20,3), seed=(1,2))
        img = tf.image.stateless_random_flip_left_right(img, seed=(np.random.randint(100),np.random.randint(100)))
        img = tf.image.stateless_random_jpeg_quality(img, min_jpeg_quality=90, max_jpeg_quality=100, seed=(np.random.randint(100),np.rand
        img = tf.image.stateless_random_saturation(img, lower=0.9,upper=1, seed=(np.random.randint(100),np.random.randint(100)))

        data.append(img)

    return data
```

In [11]:

```
anchor = tf.data.Dataset.list_files(ANC_PATH+'\*.jpg').take(3000)
positive = tf.data.Dataset.list_files(POS_PATH+'\*.jpg').take(3000)
negative = tf.data.Dataset.list_files(NEG_PATH+'\*.jpg').take(3000)
```

In [49]:

```
dir_test = anchor.as_numpy_iterator()
```

In [50]:

```
print(dir_test.next())
```

```
b'data\\anchor\\Potato___Early_blight692.jpg'
```

In [91]:

```
def preprocess(file_path):

    # Read in image from file path
    byte_img = tf.io.read_file(file_path)
    # Load in the image
    img = tf.io.decode_jpeg(byte_img)

    # Preprocessing steps - resizing the image to be 100x100x3
    img = tf.image.resize(img, (100,100))
    # Scale image to be between 0 and 1
    img = img / 256.0

    # Return image
    return img
```

In [92]:

```
img = preprocess('data\\anchor\\Potato___Early_blight692.jpg')
```

img.numpy().max()

In [93]:

```
img.numpy().max()
```

Out[93]:

```
0.9840209
```

In [94]:

```
plt.imshow(img)
```

Out[94]:

```
<matplotlib.image.AxesImage at 0x1fd4132cc10>
```

In [95]:

```
positives = tf.data.Dataset.zip((anchor, positive, tf.data.Dataset.from_tensor_slices(tf.ones(len(anchor)))))
negatives = tf.data.Dataset.zip((anchor, negative, tf.data.Dataset.from_tensor_slices(tf.zeros(len(anchor)))))
data = positives.concatenate(negatives)
```

In [96]:

```
samples = data.as_numpy_iterator()
```

In [97]:

```
exampple = samples.next()
```

In [98]:

```
exampple
```

Out[98]:

```
(b'data\\anchor\\Potato___Early_blight235.jpg',
 b'data\\positive\\Potato_Late_blight595.jpg',
 1.0)
```

TRAIN KISMI

In [99]:

```
def preprocess_twin(input_img, validation_img, label):
    return(preprocess(input_img), preprocess(validation_img), label)
```

In [100]:

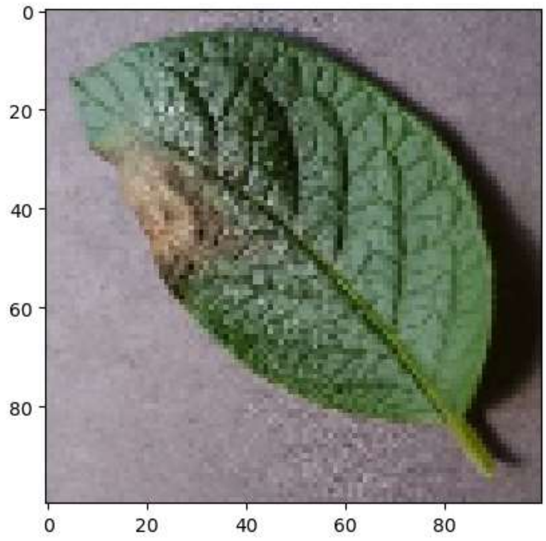
```
res = preprocess_twin(*exampple)
```

In [101]:

```
plt.imshow(res[1])
```

Out[101]:

```
<matplotlib.image.AxesImage at 0x1fd4146ed30>
```



In [102]:

```
res[2]
```

Out[102]:

```
1.0
```

In [103]:

```
# Build dataloader pipeline
data = data.map(preprocess_twin)
data = data.cache()
data = data.shuffle(buffer_size=10000)
```

In [104]:

```
# Training partition
train_data = data.take(round(len(data)*.7))
train_data = train_data.batch(16)
train_data = train_data.prefetch(8)
```

In [105]:

```
# Testing partition
test_data = data.skip(round(len(data)*.7))
test_data = test_data.take(round(len(data)*.3))
test_data = test_data.batch(16)
test_data = test_data.prefetch(8)
```

MODELLEME KISMI

In [106]:

```
inp = Input(shape=(100,100,3), name='input_image')
```

In [107]:

```
c1 = Conv2D(64, (10,10), activation='relu')(inp)
```

In [108]:

```
m1 = MaxPooling2D(64, (2,2), padding='same')(c1)
```

In [109]:

```
c2 = Conv2D(128, (7,7), activation='relu')(m1)
m2 = MaxPooling2D(64, (2,2), padding='same')(c2)
```

In [110]:

```
c3 = Conv2D(128, (4,4), activation='relu')(m2)
m3 = MaxPooling2D(64, (2,2), padding='same')(c3)
```

In [111]:

```
c4 = Conv2D(256, (4,4), activation='relu')(m3)
f1 = Flatten()(c4)
d1 = Dense(4096, activation='sigmoid')(f1)
```

In [112]:

```
mod = Model(inputs=[inp], outputs=[d1], name='embedding')
```

In [113]:

```
mod.summary()
```

```
Model: "embedding"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 input_image (InputLayer)    [(None, 100, 100, 3)]     0         
                                                                 
 conv2d (Conv2D)             (None, 91, 91, 64)        19264     
                                                                 
 max_pooling2d (MaxPooling2D) (None, 46, 46, 64)       0         
                                                                 
 conv2d_1 (Conv2D)           (None, 40, 40, 128)       401536    
                                                                 
 max_pooling2d_1 (MaxPooling2 (None, 20, 20, 128)      0         
                                                                 
 conv2d_2 (Conv2D)           (None, 17, 17, 128)       262272    
                                                                 
 max_pooling2d_2 (MaxPooling2 (None, 9, 9, 128)        0         
                                                                 
 conv2d_3 (Conv2D)           (None, 6, 6, 256)         524544    
                                                                 
 flatten (Flatten)           (None, 9216)              0         
                                                                 
 dense (Dense)               (None, 4096)              37752832  
                                                                 
=================================================================
Total params: 38,960,448
Trainable params: 38,960,448
Non-trainable params: 0
_________________________________________________________________
```

In [114]:

```
def make_embedding():
    inp = Input(shape=(100,100,3), name='input_image')

    # First block
    c1 = Conv2D(64, (10,10), activation='relu')(inp)
    m1 = MaxPooling2D(64, (2,2), padding='same')(c1)

    # Second block
    c2 = Conv2D(128, (7,7), activation='relu')(m1)
    m2 = MaxPooling2D(64, (2,2), padding='same')(c2)

    # Third block
    c3 = Conv2D(128, (4,4), activation='relu')(m2)
    m3 = MaxPooling2D(64, (2,2), padding='same')(c3)

    # Final embedding block
    c4 = Conv2D(256, (4,4), activation='relu')(m3)
    f1 = Flatten()(c4)
    d1 = Dense(4096, activation='sigmoid')(f1)


    return Model(inputs=[inp], outputs=[d1], name='embedding')
```

In [115]:

```
embedding = make_embedding()
```

In [116]:

```
embedding.summary()
```

```
Model: "embedding"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_image (InputLayer)     [(None, 100, 100, 3)]     0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 91, 91, 64)        19264
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 46, 46, 64)        0
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 40, 40, 128)       401536
_________________________________________________________________
max_pooling2d_4 (MaxPooling2 (None, 20, 20, 128)       0
_________________________________________________________________
conv2d_6 (Conv2D)            (None, 17, 17, 128)       262272
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (None, 9, 9, 128)         0
_________________________________________________________________
conv2d_7 (Conv2D)            (None, 6, 6, 256)         524544
_________________________________________________________________
flatten_1 (Flatten)          (None, 9216)              0
_________________________________________________________________
dense_1 (Dense)              (None, 4096)              37752832
=================================================================
Total params: 38,960,448
Trainable params: 38,960,448
Non-trainable params: 0
_________________________________________________________________
```

In [117]:

```
# Siamese L1 Distance class
class L1Dist(Layer):

    # Init method - inheritance
    def __init__(self, **kwargs):
        super().__init__()

    # Magic happens here - similarity calculation
    def call(self, input_embedding, validation_embedding):
        return tf.math.abs(input_embedding - validation_embedding)
```

In [118]:

```
l1 = L1Dist()
```

In [119]:

```
l1(anchor_embedding, validation_embedding)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
~\AppData\Local\Temp\ipykernel_2580\3877395630.py in <module>
----> 1 l1(anchor_embedding, validation_embedding)

NameError: name 'anchor_embedding' is not defined
```

In [ ]: