```
!pip install kaggle
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: kaggle in /usr/local/lib/python3.10/dist-packages (1.5.13)
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.8.2)
Requirement already satisfied: python-slugify in /usr/local/lib/python3.10/dist-packages (from kaggle) (8.0.1)
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.10/dist-packages (from kaggle) (1.16.0)
Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from kaggle) (2022.12.7)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from kaggle) (4.65.0)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-packages (from kaggle) (1.26.15)
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.27.1)
Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3.10/dist-packages (from python-slugify->kaggle) (1.3)
Requirement already satisfied: charset-normalizer~=2.0.0 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (2.0.12)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (3.4)
```

```
!mkdir -p ~/.kaggle
!cp kaggle.json ~/.kaggle/
```

```
!kaggle datasets download -d aryashah2k/mango-leaf-disease-dataset
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix this, you can run 'chmod 600 /root/.kaggle/kaggle.json'
Downloading mango-leaf-disease-dataset.zip to /content
 99% 102M/103M [00:04<00:00, 28.8MB/s]
100% 103M/103M [00:04<00:00, 23.8MB/s]
```

```
from zipfile import ZipFile

with ZipFile('mango-leaf-disease-dataset.zip', 'r') as f:

 #extracting in directory 'images'
 f.extractall('images')
```

```
import os
import shutil
import random

root_folder = "/content/images"
train_ratio = 0.7
val_ratio = 0.15
test_ratio = 0.15

#list of subfolders (labels)
subfolders = [f.name for f in os.scandir(root_folder) if f.is_dir()]

for subfolder in subfolders:
    subfolder_path = os.path.join(root_folder, subfolder)
    images = [f.name for f in os.scandir(subfolder_path) if f.is_file()]

    random.shuffle(images)

    num_images = len(images)
    num_train = int(num_images * train_ratio)
    num_val = int(num_images * val_ratio)
    num_test = num_images - num_train - num_val

    train_images = images[:num_train]
    val_images = images[num_train:num_train + num_val]
    test_images = images[num_train + num_val:]

    train_dir = os.path.join(root_folder, 'train', subfolder)
    val_dir = os.path.join(root_folder, 'val', subfolder)
    test_dir = os.path.join(root_folder, 'test', subfolder)
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)
    os.makedirs(test_dir, exist_ok=True)

    for image in train_images:
        src = os.path.join(subfolder_path, image)
        dst = os.path.join(train_dir, image)
        shutil.move(src, dst)

    for image in val_images:
        src = os.path.join(subfolder_path, image)
        dst = os.path.join(val_dir, image)
        shutil.move(src, dst)

    for image in test_images:
        src = os.path.join(subfolder_path, image)
        dst = os.path.join(test_dir, image)
        shutil.move(src, dst)

    os.rmdir(subfolder_path)
```

```
import·tensorflow·as·tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
# Preprocessing the Training dataset
train_datagen = ImageDataGenerator(rescale=1./255)
training_set = train_datagen.flow_from_directory('/content/images/train',
                                                 target_size = (64, 64),
                                                 batch_size = 32,
                                                 class_mode = 'binary')
```

```
Found 2800 images belonging to 8 classes.
```

```
# Preprocessing the Test set
test_datagen = ImageDataGenerator(rescale=1./255)
test_set = test_datagen.flow_from_directory('/content/images/test',
                                            target_size = (64, 64),
                                            batch_size = 32,
                                            class_mode = 'binary')
```

```
Found 600 images belonging to 8 classes.
```

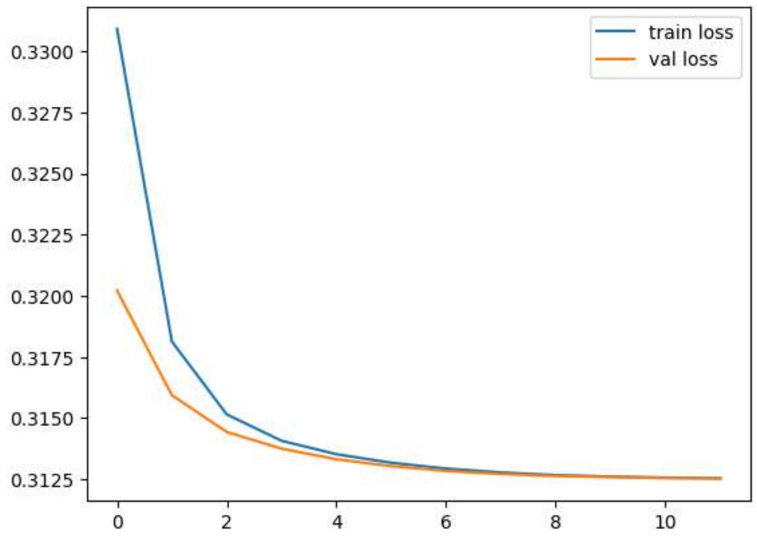
```
from tensorflow.keras.layers import Flatten
from keras.layers.pooling.max_pooling2d import MaxPool2D
from tensorflow.keras.layers import LeakyReLU
import tensorflow as tf
from keras.api._v2.keras.layers import BatchNormalization
from tensorflow.keras.layers import Conv2D
from tensorflow.keras.layers import Dense
from tensorflow.keras.regularizers import l2

cnn = tf.keras.models.Sequential()

#  Convolution
cnn.add(tf.keras.layers.Conv2D(filters=32,padding="same",kernel_size=3, activation='relu', strides=2, input_shape=[64, 64, 3]))
cnn.add(LeakyReLU(alpha=0.2))

cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))


cnn.add(Conv2D(filters=64, kernel_size=3, padding='same', strides=1))
cnn.add(LeakyReLU(alpha=0.2))
cnn.add(MaxPool2D(pool_size=2, strides=2))

cnn.add(Conv2D(filters=128, kernel_size=3, padding='same', strides=1))
cnn.add(LeakyReLU(alpha=0.2))
cnn.add(MaxPool2D(pool_size=2, strides=2))

cnn.add(Flatten())

cnn.add(Dense(units=256))
cnn.add(LeakyReLU(alpha=0.2))
cnn.add(BatchNormalization())

cnn.add(Dense(units=1, activation='linear', kernel_regularizer=l2(0.01)))


cnn.add(Dense(4, kernel_regularizer=tf.keras.regularizers.l2(0.01),activation
             ='softmax'))
cnn.compile(optimizer = 'adam', loss = 'squared_hinge', metrics = ['accuracy'])
cnn.summary()
```

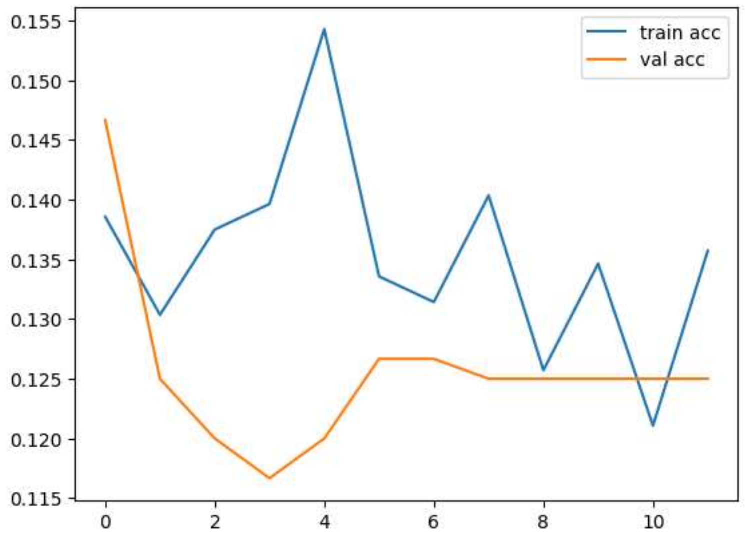
```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_4 (Conv2D)           (None, 32, 32, 32)        896
 leaky_re_lu_2 (LeakyReLU)   (None, 32, 32, 32)        0

 max_pooling2d_3 (MaxPooling  (None, 16, 16, 32)       0
 2D)

 conv2d_5 (Conv2D)           (None, 16, 16, 64)        18496

 leaky_re_lu_3 (LeakyReLU)   (None, 16, 16, 64)        0

 max_pooling2d_4 (MaxPooling  (None, 8, 8, 64)         0
 2D)

 conv2d_6 (Conv2D)           (None, 8, 8, 128)         73856

 leaky_re_lu_4 (LeakyReLU)   (None, 8, 8, 128)         0

 max_pooling2d_5 (MaxPooling  (None, 4, 4, 128)        0
 2D)

 flatten_1 (Flatten)         (None, 2048)              0

 dense_2 (Dense)             (None, 256)               524544

 leaky_re_lu_5 (LeakyReLU)   (None, 256)               0

 batch_normalization (BatchN  (None, 256)              1024
 ormalization)

 dense_3 (Dense)             (None, 1)                 257

 dense_4 (Dense)             (None, 4)                 8

=================================================================
Total params: 619,081
Trainable params: 618,569
Non-trainable params: 512
_________________________________________________________________
```

```
# Part 3 - Training the CNN

# Compiling the CNN
cnn.compile(optimizer = 'adam', loss = 'hinge', metrics = ['accuracy'])

# Training the CNN on the Training set and evaluating it on the Test set
r=cnn.fit(x = training_set, validation_data = test_set, epochs = 12)
```

```
Epoch 1/12
88/88 [==============================] - 18s 189ms/step - loss: 0.3309 - accuracy: 0.1386 - val_loss: 0.3202 - val_accuracy: 0.1467
Epoch 2/12
88/88 [==============================] - 16s 177ms/step - loss: 0.3181 - accuracy: 0.1304 - val_loss: 0.3159 - val_accuracy: 0.1250
Epoch 3/12
88/88 [==============================] - 17s 189ms/step - loss: 0.3152 - accuracy: 0.1375 - val_loss: 0.3144 - val_accuracy: 0.1200
Epoch 4/12
88/88 [==============================] - 16s 178ms/step - loss: 0.3141 - accuracy: 0.1396 - val_loss: 0.3138 - val_accuracy: 0.1167
Epoch 5/12
88/88 [==============================] - 15s 170ms/step - loss: 0.3135 - accuracy: 0.1543 - val_loss: 0.3133 - val_accuracy: 0.1200
Epoch 6/12
88/88 [==============================] - 14s 162ms/step - loss: 0.3132 - accuracy: 0.1336 - val_loss: 0.3130 - val_accuracy: 0.1267
Epoch 7/12
88/88 [==============================] - 14s 163ms/step - loss: 0.3129 - accuracy: 0.1314 - val_loss: 0.3128 - val_accuracy: 0.1267
Epoch 8/12
88/88 [==============================] - 17s 195ms/step - loss: 0.3128 - accuracy: 0.1404 - val_loss: 0.3127 - val_accuracy: 0.1250
Epoch 9/12
88/88 [==============================] - 15s 175ms/step - loss: 0.3127 - accuracy: 0.1257 - val_loss: 0.3126 - val_accuracy: 0.1250
Epoch 10/12
88/88 [==============================] - 16s 178ms/step - loss: 0.3126 - accuracy: 0.1346 - val_loss: 0.3126 - val_accuracy: 0.1250
Epoch 11/12
88/88 [==============================] - 14s 164ms/step - loss: 0.3126 - accuracy: 0.1211 - val_loss: 0.3125 - val_accuracy: 0.1250
Epoch 12/12
88/88 [==============================] - 15s 174ms/step - loss: 0.3125 - accuracy: 0.1357 - val_loss: 0.3125 - val_accuracy: 0.1250
```

```
import matplotlib.pyplot as plt
plt.plot(r.history['loss'], label='train loss')
plt.plot(r.history['val_loss'], label='val loss')
plt.legend()
plt.show()
plt.savefig('LossVal_loss')

# ploting the model accuracy
plt.plot(r.history['accuracy'], label='train acc')
plt.plot(r.history['val_accuracy'], label='val acc')
plt.legend()
plt.show()
plt.savefig('AccVal_acc')
```





```
<Figure size 640x480 with 0 Axes>
```

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