```
!pip3 install opencv-python
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: opencv-python in /usr/local/lib/python3.10/dist-packages (4.7.0.72)
Requirement already satisfied: numpy>=1.21.2 in /usr/local/lib/python3.10/dist-packages (from opencv-python) (1.22.4)
```

```
!pip install numpy
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages (1.22.4)
```

```
!pip install matplotlib
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/dist-packages (3.7.1)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (1.0.7)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (4.39.3)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (1.4.4)
Requirement already satisfied: numpy>=1.20 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (1.22.4)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (23.1)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (8.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (2.8.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.7->matplotlib) (1.16.0)
```

```
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
import os                                       #to access files in the folder
import cv2
# from google.colab.patches import cv2_imshow    #to open image in another window
from PIL import Image                           #Pillow remains an important tool for understanding and dealing with images like image
from sklearn.model_selection import train_test_split
```

```
raveling_files = os.listdir('/content/drive/MyDrive/classification_problem/train/Raveling')          #Return a list containing the name
non_raveling_files = os.listdir('/content/drive/MyDrive/classification_problem/train/Non_raveling')    #os.listdir() method in python is
```

```
print(raveling_files[0:10])
print(non_raveling_files[0:10])
```

```
['image671.jpg', 'image672.jpg', 'image670.jpg', 'image661.jpg', 'image673.jpg', 'image669.jpg', 'image682.jpg', 'image658.jpg', 'i
['image96.jpg', 'image99.jpg', 'image71.jpg', 'image90.jpg', 'image95.jpg', 'image82.jpg', 'image7.jpg', 'image660.jpg', 'image687
```

```
working_directory_path = os.getcwd()        #current working directory
```

```
print(working_directory_path)
```

```
/content
```

```
pwd #present working directory
```

```
'/content'
```

```
len(raveling_files)
```

```
300
```

```
len(non_raveling_files)
```

```
300
```

```
raveling_lebels = [1]*300
non_raveling_lebels = [0]*300
```

```
print(raveling_lebels)
```

```
[1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
```

```
print(non_raveling_lebels)
```

```
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, (
```

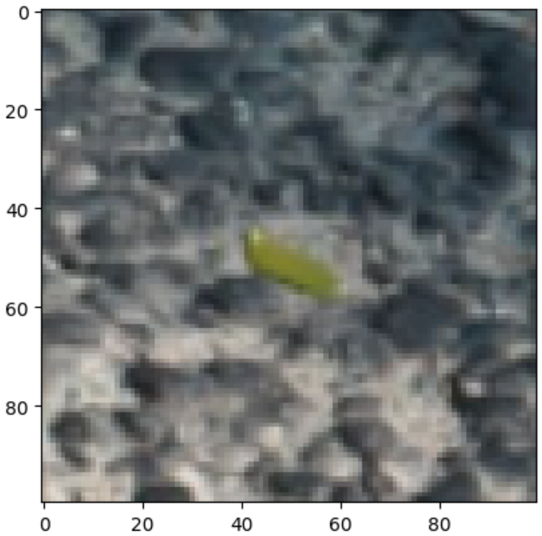
```
lebels = raveling_lebels+non_raveling_lebels
```

```
print(lebels)
```

```
[1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
```

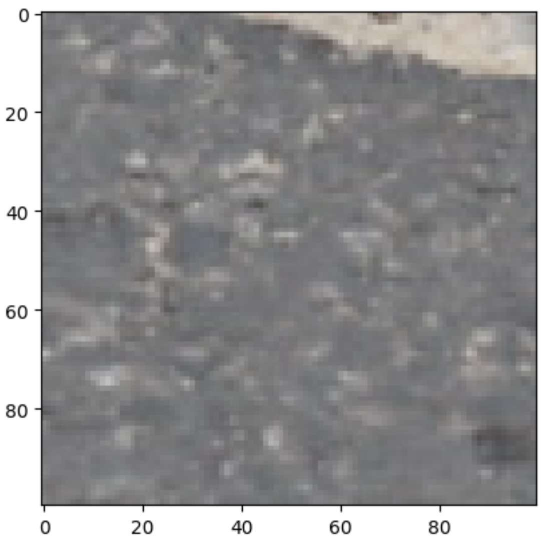
```
img = mpimg.imread('/content/drive/MyDrive/classification_problem/train/Raveling/image11.jpg') #reading image as a numpy array
plt.imshow(img)   #Display data as an image
```

```
<matplotlib.image.AxesImage at 0x7fc7d8ebe080>
```




```
img2 = mpimg.imread('/content/drive/MyDrive/classification_problem/train/Non_raveling/image179.jpg')
plt.imshow(img2)
```

```
<matplotlib.image.AxesImage at 0x7fc7d8f5e140>
```




```
raveling_path = '/content/drive/MyDrive/classification_problem/train/Raveling/'
```

```
for i in range(0,10):
    raveling_file_name = raveling_files[i]
    image = Image.open(raveling_path+raveling_file_name)
    width,height = image.size
    print(width,height)
```

```
100 100
100 100
100 100
100 100
100 100
```

```
100 100
100 100
100 100
100 100
100 100
```

```
data= []
```

```
raveling_path = '/content/drive/MyDrive/classification_problem/train/Raveling/'
for raveling in raveling_files:
    image = Image.open(raveling_path+raveling)
    image = np.array(image)
    image = image.flatten() / 255.0
    data.append(image)
```

```
len(data)
```

```
300
```

```
non_raveling_path  = '/content/drive/MyDrive/classification_problem/train/Non_raveling/'
for non_raveling in non_raveling_files:
    image = Image.open(non_raveling_path+non_raveling)
    image = np.array(image)
    image = image.flatten() / 255.0
    data.append(image)
```

```
len(data)
```

```
600
```

```
len(lebels)
```

```
600
```

```
print(data[0])   #each image has now been converted into a numpy array
```

```
[0.40784314 0.42352941 0.42745098 ... 0.67843137 0.65490196 0.6       ]
```

```
data[0].shape  #shape of each image
```

```
(30000,)
```

```
X = np.array(data)              #since data was list, we need to convert it into a numpy array
Y = np.array(lebels)            #same for the lebels
```

```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size = .2,random_state = 2)
```

```
X_train.shape
```

```
(480, 30000)
```

```
X_test.shape
```

```
(120, 30000)
```

```
Y_train.shape
```

```
(480,)
```

```
Y_test.shape
```

```
(120,)
```

```
X_train[0]
```

```
array([0.38039216, 0.36470588, 0.35294118, ..., 0.55294118, 0.55294118,
       0.55294118])
```

```
from sklearn.linear_model import LogisticRegression
```

```
logisticRegr = LogisticRegression()



logisticRegr.fit(X_train, Y_train)
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
lr_model = LogisticRegression(max_iter=100)
lr_model.fit(X_train, Y_train)

ann_model = MLPClassifier(hidden_layer_sizes=(128, 64), max_iter=500)
ann_model.fit(X_train, Y_train)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfg
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
MLPClassifier(hidden_layer_sizes=(128, 64), max_iter=500)
```

```
# Evaluate the models

y_train_pred_lr = lr_model.predict(X_train)
y_train_pred_ann = ann_model.predict(X_train)

train_accuracy_lr = accuracy_score(Y_train, y_train_pred_lr)
train_accuracy_ann = accuracy_score(Y_train, y_train_pred_ann)

y_val_pred_lr = lr_model.predict(X_test)
y_val_pred_ann = ann_model.predict(X_test)

val_accuracy_lr = accuracy_score(Y_test, y_val_pred_lr)
val_accuracy_ann = accuracy_score(Y_test, y_val_pred_ann)

print(f"LR Training Accuracy: {train_accuracy_lr:.4f}")
print(f"ANN Training Accuracy: {train_accuracy_ann:.4f}")
print(f"LR Test Accuracy: {val_accuracy_lr:.4f}")
print(f"ANN Test Accuracy: {val_accuracy_ann:.4f}")
```

```
LR Training Accuracy: 1.0000
ANN Training Accuracy: 0.7479
LR Test Accuracy: 0.6333
ANN Test Accuracy: 0.6583
```

```
final_image_files = os.listdir('/content/drive/MyDrive/classification_problem/test')


final_image_files[1]
```

```
'10.jpg'
```

```
test_data =[]
final_file_path = '/content/drive/MyDrive/classification_problem/test/'
for final in final_image_files:
    image = Image.open(final_file_path+final)
    image = np.array(image)
    image = image.flatten() / 255.0
    test_data.append(image)


test_data[0]
```

```
array([0.58039216, 0.58039216, 0.57254902, ..., 0.55686275, 0.55294118,
       0.54509804])
```

```
#Predict the classes for the test dataset

test_predictions_lr = lr_model.predict(test_data)
test_predictions_ann = ann_model.predict(test_data)
```

```
print(test_predictions_lr)
```

```
[0 1 0 0 0 0 1 0 0 1]
```

```
print(test_predictions_ann)
```

```
[1 1 0 1 1 1 1 1 1 1]
```

✓ 0s completed at 22:22