In [1]:

```
from PIL import Image
import cv2
import pandas as pd
import numpy as np
# import tensorflow_hub as hub
import numpy.random as npr
import matplotlib.pyplot as plt
%matplotlib inline
plt.style.use('bmh')

import tensorflow as tf
from tensorflow import keras

from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_sc
```

```
2023-12-06 23:36:51.632388: E tensorflow/compiler/xla/stream_executor/cuda/cuda_d
nn.cc:9342] Unable to register cuDNN factory: Attempting to register factory for
plugin cuDNN when one has already been registered
2023-12-06 23:36:51.632454: E tensorflow/compiler/xla/stream_executor/cuda/cuda_f
ft.cc:609] Unable to register cuFFT factory: Attempting to register factory for p
lugin cuFFT when one has already been registered
2023-12-06 23:36:51.632460: E tensorflow/compiler/xla/stream_executor/cuda/cuda_b
las.cc:1518] Unable to register cuBLAS factory: Attempting to register factory fo
r plugin cuBLAS when one has already been registered
2023-12-06 23:36:51.638109: I tensorflow/core/platform/cpu_feature_guard.cc:182]
This TensorFlow binary is optimized to use available CPU instructions in performa
nce-critical operations.
To enable the following instructions: SSE4.1 SSE4.2 AVX AVX2 FMA, in other operat
ions, rebuild TensorFlow with the appropriate compiler flags.
```

In [ ]:

1.Flowers Dataset

In [2]:

```
flowers = tf.keras.models.load_model('Models/Flowers.h5')
```

```
2023-12-06 22:29:13.170192: I tensorflow/core/common_runtime/gpu/gpu_device.cc:18
86] Created device /job:localhost/replica:0/task:0/device:GPU:0 with 79087 MB mem
ory:  -> device: 0, name: NVIDIA A100-SXM4-80GB, pci bus id: 0000:47:00.0, comput
e capability: 8.0
2023-12-06 22:29:13.172006: I tensorflow/core/common_runtime/gpu/gpu_device.cc:18
86] Created device /job:localhost/replica:0/task:0/device:GPU:1 with 79087 MB mem
ory:  -> device: 1, name: NVIDIA A100-SXM4-80GB, pci bus id: 0000:4e:00.0, comput
e capability: 8.0
```

In [3]:

```
X_test = np.load('flower_species_classification/data_test.npy').T
t_test = np.load('flower_species_classification/labels_test.npy')

#Resizing test images
NEW_SIZE = (224,224)
INTERPOLATION = cv2.INTER_CUBIC
data = []

for i in range(415):
    img = X_test[i,:].reshape(300,300,3)
    # img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
    # img = tf.image.convert_image_dtype(img, tf.float32)
    # img = tf.image.resize(img, NEW_SIZE)
    img = cv2.resize(img, NEW_SIZE, interpolation=INTERPOLATION)
    img = np.array(img)
    data.append(img)

X_test_resized = np.array(data)

# flowers.evaluate(X_test_resized, t_test)
```

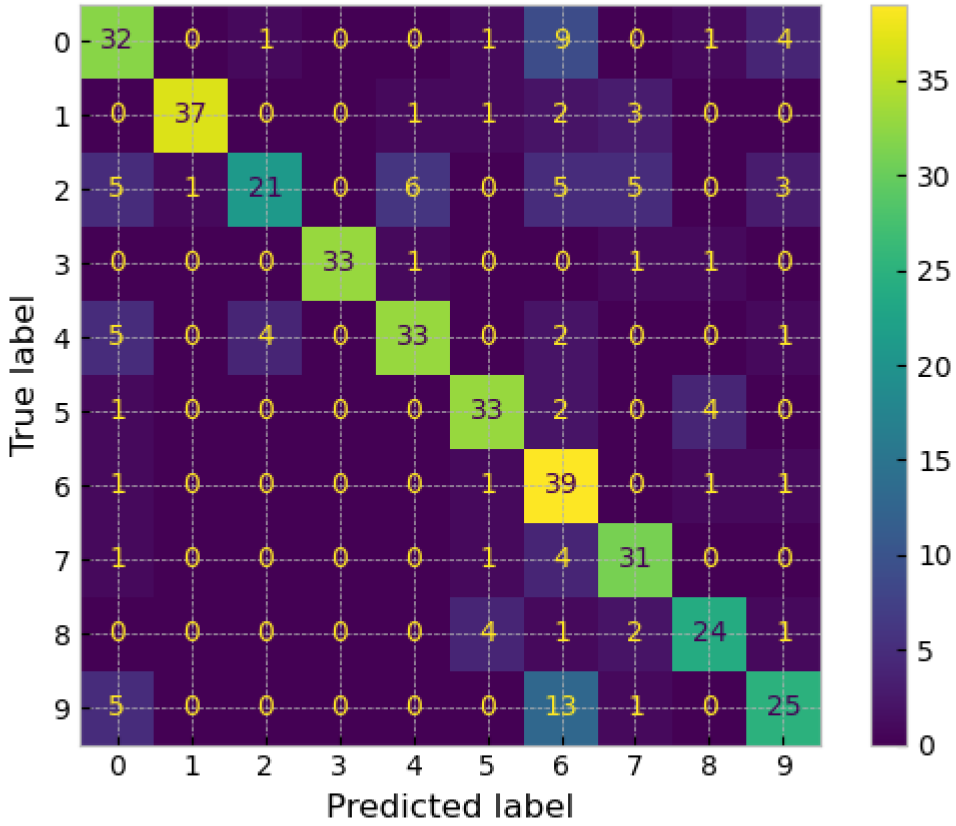
In [4]:

```
y_proba = flowers.predict(X_test_resized)
y_test = np.argmax(y_proba, axis=1)

class_names = ['Roses', 'Magnolias', 'Lilies', 'Sunflowers', 'Orchids',
               'Marigold', 'Hibiscus', 'Firebush', 'Pentas', 'Bougainvillea']

cm = confusion_matrix(t_test, y_test)

print("Classification Report:\n", classification_report(t_test, y_test))
print("Confusion Matrix:\n", cm)
```

```
2023-12-06 22:29:20.259126: I tensorflow/compiler/xla/stream_executor/cuda/cuda_d
nn.cc:442] Loaded cuDNN version 8800
13/13 [==============================] - 2s 79ms/step
Classification Report:
               precision    recall  f1-score   support

         0.0       0.64      0.67      0.65        48
         1.0       0.97      0.84      0.90        44
         2.0       0.81      0.46      0.58        46
         3.0       1.00      0.92      0.96        36
         4.0       0.80      0.73      0.77        45
         5.0       0.80      0.82      0.81        40
         6.0       0.51      0.91      0.65        43
         7.0       0.72      0.84      0.77        37
         8.0       0.77      0.75      0.76        32
         9.0       0.71      0.57      0.63        44

    accuracy                           0.74       415
   macro avg       0.77      0.75      0.75       415
weighted avg       0.77      0.74      0.74       415

Confusion Matrix:
 [[32  0  1  0  0  1  9  0  1  4]
 [ 0 37  0  0  1  1  2  3  0  0]
 [ 5  1 21  0  6  0  5  5  0  3]
 [ 0  0  0 33  1  0  0  1  1  0]
 [ 5  0  4  0 33  0  2  0  0  1]
 [ 1  0  0  0  0 33  2  0  4  0]
 [ 1  0  0  0  0  1 39  0  1  1]
 [ 1  0  0  0  0  1  4 31  0  0]
 [ 0  0  0  0  0  4  1  2 24  1]
 [ 5  0  0  0  0  0 13  1  0 25]]
```

In [5]:

```
disp = ConfusionMatrixDisplay(confusion_matrix=cm)
disp.plot()
plt.figure(figsize = (10,7))
plt.show()
```



	0	1	2	3	4	5	6	7	8	9
0	32	0	1	0	0	1	9	0	1	4
1	0	37	0	0	1	1	2	3	0	0
2	5	1	21	0	6	0	5	5	0	3
3	0	0	0	33	1	0	0	1	1	0
4	5	0	4	0	33	0	2	0	0	1
5	1	0	0	0	0	33	2	0	4	0
6	1	0	0	0	0	1	39	0	1	1
7	1	0	0	0	0	1	4	31	0	0
8	0	0	0	0	0	4	1	2	24	1
9	5	0	0	0	0	0	13	1	0	25

```
<Figure size 1000x700 with 0 Axes>
```

In [ ]:

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In [ ]:

In [ ]:

2.Vehicle object detection

In [2]:

```
cars = tf.keras.models.load_model('Models/Car_detection_380_nocars.h5')
```

```
2023-12-06 23:36:58.971798: I tensorflow/core/common_runtime/gpu/gpu_device.cc:18
86] Created device /job:localhost/replica:0/task:0/device:GPU:0 with 79087 MB mem
ory:  -> device: 0, name: NVIDIA A100-SXM4-80GB, pci bus id: 0000:47:00.0, comput
e capability: 8.0
2023-12-06 23:36:58.975693: I tensorflow/core/common_runtime/gpu/gpu_device.cc:18
86] Created device /job:localhost/replica:0/task:0/device:GPU:1 with 79087 MB mem
ory:  -> device: 1, name: NVIDIA A100-SXM4-80GB, pci bus id: 0000:4e:00.0, comput
e capability: 8.0
```

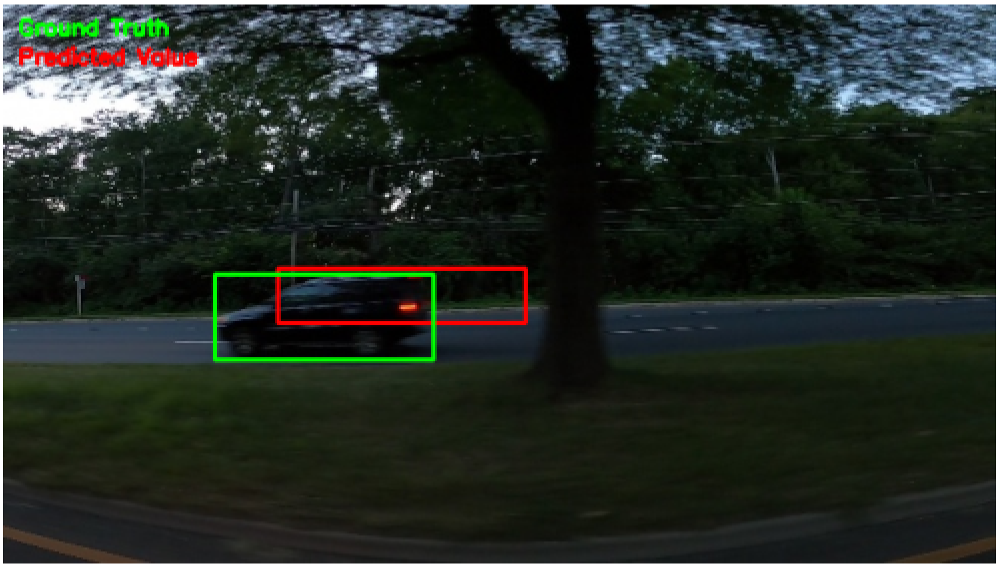
In [3]:

```
#Function to compute Intersection over union.
def IOU(box1, box2):
    x1, y1, w1, h1 = box1
    x2, y2, w2, h2 = box2

    w_intersection = min(x1 + w1, x2 + w2) - max(x1, x2)
    h_intersection = min(y1 + h1, y2 + h2) - max(y1, y2)

    if w_intersection <= 0 or h_intersection <= 0:
        return 0

    Intersection = w_intersection * h_intersection
    Union = w1 * h1 + w2 * h2 - Intersection
    return Intersection / Union
```

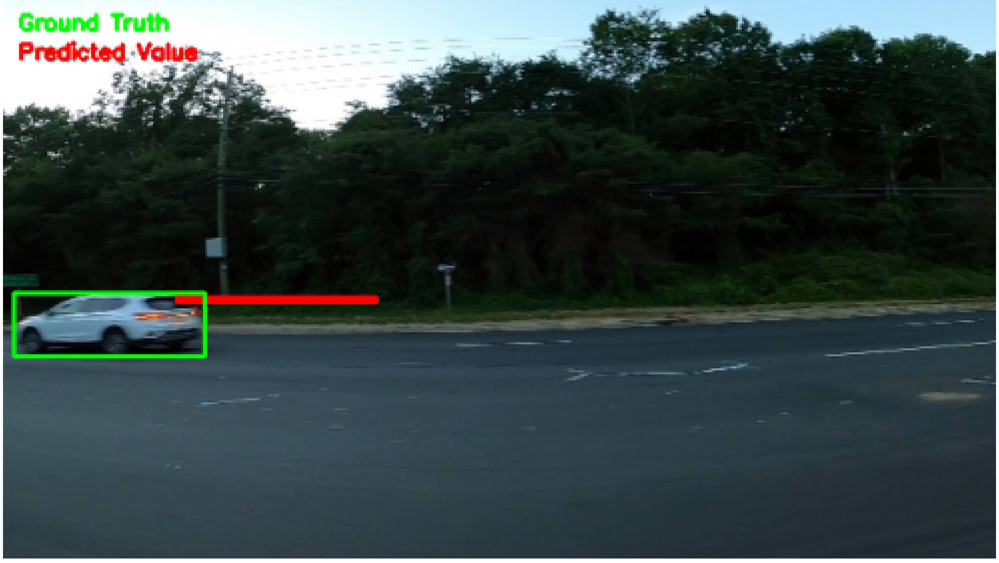
In [6]:

```
#Displaying bounding box

bbox = pd.read_csv('car_detection_dataset/makesense_test.csv')

images = list(bbox['image_name'])

t_test = bbox.drop('image_name', axis=1).round().to_numpy().astype(int)
t_test = t_test.astype(float)

#Printing IOU for Region of Interest
i = 1

for image in images[:3]:
    filename='car_detection_dataset/testing_images/'+image
    img = np.array(Image.open(filename))
    (h,w,c) = img.shape
    img = np.array(img)
    index = (bbox.index[bbox['image_name']==image][0])
    predicted_bbox = cars.predict(np.expand_dims(img, axis=0))
    ground_truth = t_test[index]
    ground_truth = ground_truth.astype(int)

    predicted_bbox = predicted_bbox*(w,h,w,h)
    predicted_bbox = predicted_bbox.astype(int)

    cv2.putText(img, f"Ground Truth", (10, 20), cv2.FONT_HERSHEY_SIMPLEX, 0.5, (
    cv2.putText(img, f"Predicted Value", (10, 40), cv2.FONT_HERSHEY_SIMPLEX, 0.5

    cv2.rectangle(img, (predicted_bbox[0][0],  predicted_bbox[0][1]),
              ( predicted_bbox[0][2],  predicted_bbox[0][3]),
              (255, 0, 0), 2);

    cv2.rectangle(img, (ground_truth[0],  ground_truth[1]),
              (ground_truth[2],  ground_truth[3]),
              (0, 255, 0), 2);

    # Display the image on the corresponding subplot
    plt.imshow(img)
    plt.axis('off')

    plt.show()


    i = i+1

    # Show the plot
    # plt.show()

    iou = IOU(ground_truth, predicted_bbox[0])
    print('IOU for image' +image+': ', iou)
```

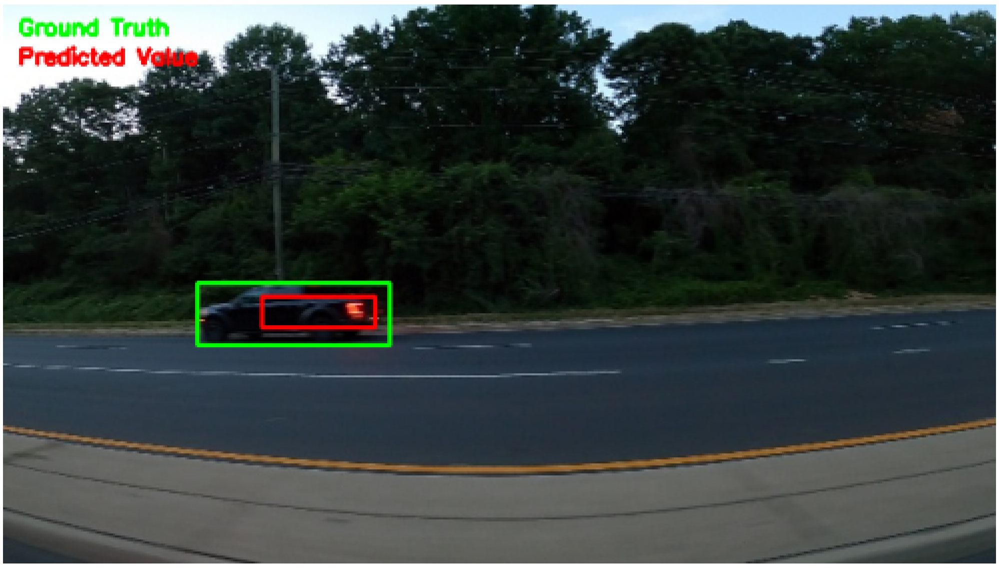
```
1/1 [==============================] - 0s 27ms/step
```



```
IOU for imagevid_5_27920.jpg:  0.5620777788383019
1/1 [==============================] - 0s 25ms/step
```



```
IOU for imagevid_5_28260.jpg:  0.06671339524870454
1/1 [==============================] - 0s 27ms/step
```



```
IOU for imagevid_5_28420.jpg:  0.7032507808032376
```

In [ ]: