Day 01

```
from google.colab import drive
drive.mount('/content/drive')

data_path = '/content/drive/MyDrive/F1CarsDataset/Formula One Cars'

```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remoun
```

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator

IMG_SIZE = (224, 224)
BATCH_SIZE = 32

datagen = ImageDataGenerator(
    rescale=1./255,       # Normalize pixel values
    validation_split=0.2  # 20% validation split
)

train_generator = datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='training',
    color_mode='rgb' # Add this to ensure images are converted to RGB
)

val_generator = datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='validation',
    color_mode='rgb' # Add this to ensure images are converted to RGB
)
```

```
Found 1928 images belonging to 8 classes.
Found 479 images belonging to 8 classes.
```

```
import matplotlib.pyplot as plt
import numpy as np

class_labels = list(train_generator.class_indices.keys())

images, labels = next(train_generator)  # get a batch
plt.figure(figsize=(10,10))
for i in range(9):
```

```
    plt.subplot(3,3,i+1)
    plt.imshow(images[i])
    plt.title(class_labels[np.argmax(labels[i])])
    plt.axis('off')
plt.show()

```

```
print(f"Classes found: {train_generator.class_indices}")
print(f"Number of training samples: {train_generator.samples}")
print(f"Number of validation samples: {val_generator.samples}")

```

```
Classes found: {'AlphaTauri F1 car': 0, 'Ferrari F1 car': 1, 'McLaren F1 car': 2, 'Mercedes F1 car': 3, 'Racing Point F1 car
Number of training samples: 1928
Number of validation samples: 479
```

Day 02

```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense, Dropout
import matplotlib.pyplot as plt

```

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator

data_path = '/content/drive/MyDrive/F1CarsDataset/Formula One Cars'

IMG_SIZE = (224, 224)
BATCH_SIZE = 32

datagen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.2
)

train_generator = datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='training'
)

val_generator = datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='validation'
)

```

```
Found 1928 images belonging to 8 classes.
Found 479 images belonging to 8 classes.
```

```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense, Dropout

num_classes = train_generator.num_classes
input_shape = (224, 224, 3)

model = Sequential([
    Conv2D(32, (3,3), activation='relu', input_shape=input_shape),
    MaxPooling2D(2, 2),

    Conv2D(64, (3,3), activation='relu'),
    MaxPooling2D(2, 2),

    Conv2D(128, (3,3), activation='relu'),
    MaxPooling2D(2, 2),

    Flatten(),
    Dense(256, activation='relu'),
    Dropout(0.5),
    Dense(num_classes, activation='softmax')
])

model.compile(
    optimizer='adam',
    loss='categorical_crossentropy',
    metrics=['accuracy']
)

model.summary()

```

```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/convolutional/base_conv
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 222, 222, 32)	896
max_pooling2d (MaxPooling2D)	(None, 111, 111, 32)	0
conv2d_1 (Conv2D)	(None, 109, 109, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(None, 54, 54, 64)	0
conv2d_2 (Conv2D)	(None, 52, 52, 128)	73,856
max_pooling2d_2 (MaxPooling2D)	(None, 26, 26, 128)	0
flatten (Flatten)	(None, 86528)	0
dense (Dense)	(None, 256)	22,151,424
dropout (Dropout)	(None, 256)	0
dense_1 (Dense)	(None, 8)	2,056

Total params: 22,246,728 (84.86 MB)
Trainable params: 22,246,728 (84.86 MB)
Non-trainable params: 0 (0.00 B)

```python
from PIL import Image
import os

data_path = '/content/drive/MyDrive/F1CarsDataset/Formula One Cars'

for root, dirs, files in os.walk(data_path):
    for fname in files:
        fpath = os.path.join(root, fname)
        try:
            img = Image.open(fpath)
            img.verify()  # verify if image file is broken
        except (IOError, SyntaxError) as e:
            print(f"Bad file detected: {fpath} - {e}")

```

```python
import os
from PIL import Image

# Path to your dataset folder
data_path = '/content/drive/MyDrive/F1CarsDataset/Formula One Cars'

# Allowed image extensions
valid_extensions = {'.jpg', '.jpeg', '.png', '.bmp', '.gif'}

```

```
deleted_files = []

for root, dirs, files in os.walk(data_path):
    for fname in files:
        fpath = os.path.join(root, fname)
        ext = os.path.splitext(fname)[1].lower()

        # Remove files with invalid extensions
        if ext not in valid_extensions:
            os.remove(fpath)
            deleted_files.append(f"Removed non-image file: {fpath}")
            continue

        # Check if image is corrupted
        try:
            img = Image.open(fpath)
            img.verify()  # Verify image integrity
        except Exception as e:
            os.remove(fpath)
            deleted_files.append(f"Removed corrupted image: {fpath}")

print(f"Total files removed: {len(deleted_files)}")
for msg in deleted_files:
    print(msg)

```

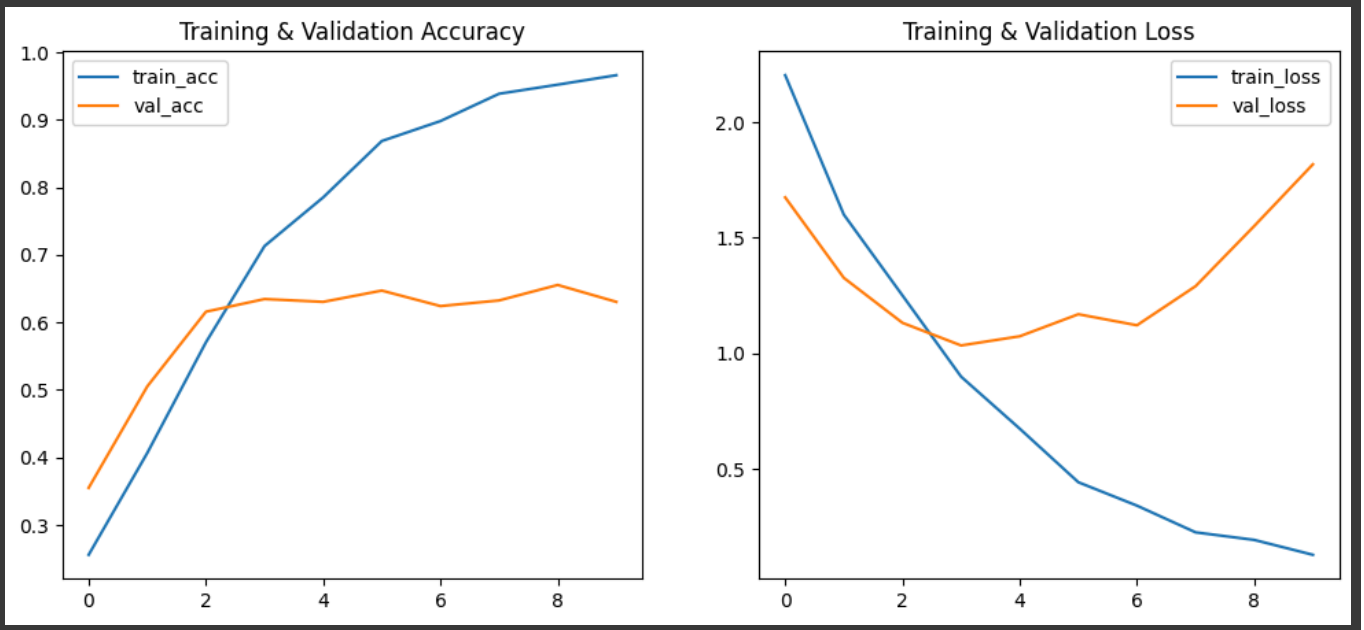
```
Total files removed: 0
```

```
epochs = 10  # start with 10, adjust as needed

history = model.fit(
    train_generator,
    validation_data=val_generator,
    epochs=epochs
)

```

```
/usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:121: UserWarning: Your `
  self._warn_if_super_not_called()
/usr/local/lib/python3.11/dist-packages/PIL/Image.py:1047: UserWarning: Palette images with Transparency expressed i
  warnings.warn(
Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 309s 5s/step - accuracy: 0.1765 - loss: 3.0811 - val_accuracy: 0.3549 - val_loss: 1.6
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 261s 4s/step - accuracy: 0.3839 - loss: 1.6410 - val_accuracy: 0.5052 - val_loss: 1.3
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 263s 4s/step - accuracy: 0.5592 - loss: 1.2820 - val_accuracy: 0.6159 - val_loss: 1.1
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 261s 4s/step - accuracy: 0.7010 - loss: 0.9136 - val_accuracy: 0.6347 - val_loss: 1.0
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 262s 4s/step - accuracy: 0.8039 - loss: 0.6301 - val_accuracy: 0.6305 - val_loss: 1.0
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 262s 4s/step - accuracy: 0.8715 - loss: 0.4415 - val_accuracy: 0.6472 - val_loss: 1.1
Epoch 7/10
```

```
61/61 ━━━━━━━━━━━━━━━━━━━━ 262s 4s/step - accuracy: 0.9035 - loss: 0.3329 - val_accuracy: 0.6242 - val_loss: 1.1
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 262s 4s/step - accuracy: 0.9334 - loss: 0.2337 - val_accuracy: 0.6326 - val_loss: 1.2
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 262s 4s/step - accuracy: 0.9487 - loss: 0.1947 - val_accuracy: 0.6555 - val_loss: 1.5
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 279s 5s/step - accuracy: 0.9689 - loss: 0.1177 - val_accuracy: 0.6305 - val_loss: 1.8
```

```
plt.figure(figsize=(12,5))

plt.subplot(1,2,1)
plt.plot(history.history['accuracy'], label='train_acc')
plt.plot(history.history['val_accuracy'], label='val_acc')
plt.title('Training & Validation Accuracy')
plt.legend()

plt.subplot(1,2,2)
plt.plot(history.history['loss'], label='train_loss')
plt.plot(history.history['val_loss'], label='val_loss')
plt.title('Training & Validation Loss')
plt.legend()

plt.show()
```



```
model.save('/content/drive/MyDrive/F1CarsDataset/f1cars_cnn_model.h5')

```

```
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. T
```

Day 03

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator

data_path = '/content/drive/MyDrive/F1CarsDataset/Formula One Cars'
IMG_SIZE = (224, 224)
BATCH_SIZE = 32

train_datagen = ImageDataGenerator(
    rescale=1./255,
    rotation_range=20,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.15,
    zoom_range=0.15,
    horizontal_flip=True,
    fill_mode='nearest',
    validation_split=0.2
)

val_datagen = ImageDataGenerator(rescale=1./255, validation_split=0.2)

train_generator = train_datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='training',
    shuffle=True
)

val_generator = val_datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='validation',
    shuffle=False
)

```

```
Found 1928 images belonging to 8 classes.
Found 479 images belonging to 8 classes.
```

```
import tensorflow as tf

```

```
base_model = tf.keras.applications.MobileNetV2(
    input_shape=(224, 224, 3),
    include_top=False,
    weights='imagenet'
)

base_model.trainable = False  # freeze base layers initially

model = tf.keras.Sequential([
    base_model,
    tf.keras.layers.GlobalAveragePooling2D(),
    tf.keras.layers.Dropout(0.3),
    tf.keras.layers.Dense(train_generator.num_classes, activation='softmax')
])

model.compile(
    optimizer='adam',
    loss='categorical_crossentropy',
    metrics=['accuracy']
)

model.summary()

```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applicatio
9406464/9406464 ━━━━━━━━━━━━━━━━━━━━ 0s 0us/step
Model: "sequential_1"
```

Layer (type)	Output Shape	Param #
mobilenetv2_1.00_224 (Functional)	(None, 7, 7, 1280)	2,257,984
global_average_pooling2d (GlobalAveragePooling2D)	(None, 1280)	0
dropout_1 (Dropout)	(None, 1280)	0
dense_2 (Dense)	(None, 8)	10,248

```
Total params: 2,268,232 (8.65 MB)
Trainable params: 10,248 (40.03 KB)
Non-trainable params: 2,257,984 (8.61 MB)
```

```
epochs = 10

history = model.fit(
    train_generator,
    validation_data=val_generator,
    epochs=epochs
)

```

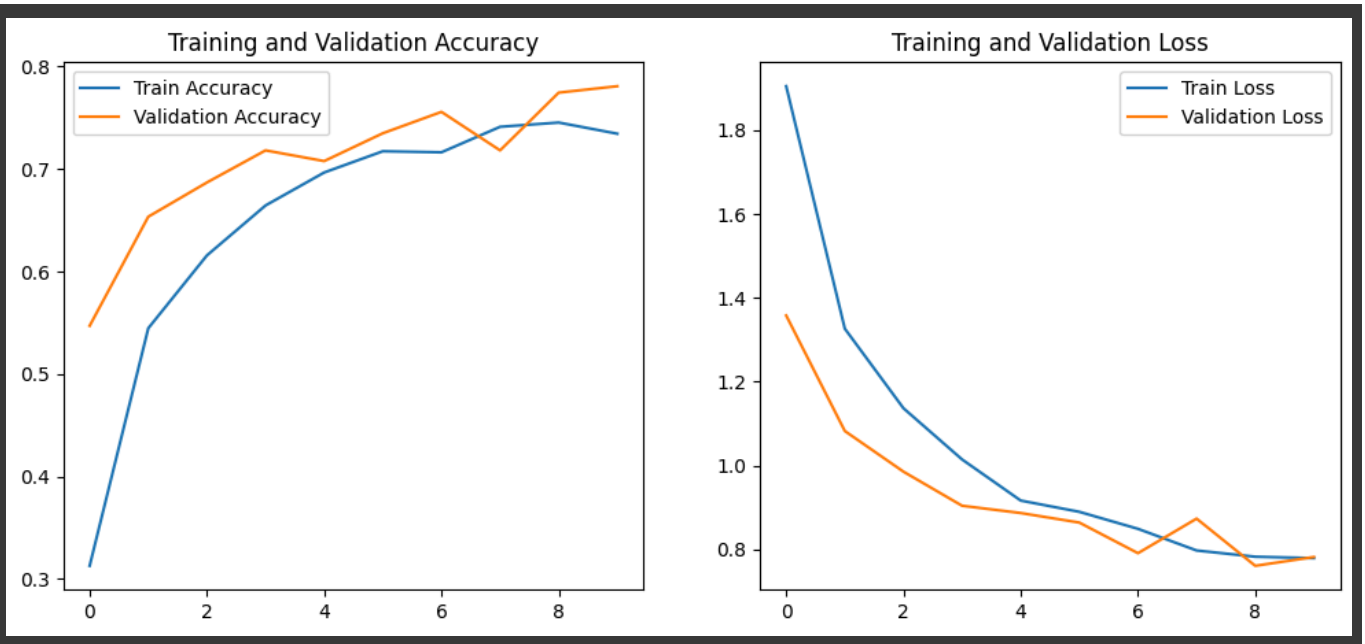
```
Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 178s 3s/step - accuracy: 0.2357 - loss: 2.1375 - val_accuracy: 0.5470 - val_loss: 1.3
```

```
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 157s 3s/step - accuracy: 0.5218 - loss: 1.3816 - val_accuracy: 0.6534 - val_loss: 1.(
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 169s 3s/step - accuracy: 0.6169 - loss: 1.1148 - val_accuracy: 0.6868 - val_loss: 0.9
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 170s 3s/step - accuracy: 0.6483 - loss: 1.0352 - val_accuracy: 0.7182 - val_loss: 0.9
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 168s 3s/step - accuracy: 0.6942 - loss: 0.9081 - val_accuracy: 0.7077 - val_loss: 0.8
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 152s 2s/step - accuracy: 0.7059 - loss: 0.9053 - val_accuracy: 0.7349 - val_loss: 0.8
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 154s 3s/step - accuracy: 0.7114 - loss: 0.8527 - val_accuracy: 0.7557 - val_loss: 0.7
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 154s 3s/step - accuracy: 0.7465 - loss: 0.8075 - val_accuracy: 0.7182 - val_loss: 0.8
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 153s 2s/step - accuracy: 0.7372 - loss: 0.7930 - val_accuracy: 0.7745 - val_loss: 0.7
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 170s 3s/step - accuracy: 0.7309 - loss: 0.7612 - val_accuracy: 0.7808 - val_loss: 0.7
```

```
model.save('/content/drive/MyDrive/F1CarsDataset/f1cars_mobilenetv2_augmented.h5')

```

```
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. T
```

```
import matplotlib.pyplot as plt

acc = history.history['accuracy'] + history_fine.history['accuracy'] if 'history_fine' in globals() else history.history['accuracy']
val_acc = history.history['val_accuracy'] + history_fine.history['val_accuracy'] if 'history_fine' in globals() else history.history['val_a
loss = history.history['loss'] + history_fine.history['loss'] if 'history_fine' in globals() else history.history['loss']
val_loss = history.history['val_loss'] + history_fine.history['val_loss'] if 'history_fine' in globals() else history.history['val_loss']

plt.figure(figsize=(12,5))
plt.subplot(1,2,1)
plt.plot(acc, label='Train Accuracy')
plt.plot(val_acc, label='Validation Accuracy')
plt.title('Training and Validation Accuracy')
plt.legend()

plt.subplot(1,2,2)
plt.plot(loss, label='Train Loss')
plt.plot(val_loss, label='Validation Loss')
plt.title('Training and Validation Loss')
plt.legend()

plt.show()

```



Day 04

```
import tensorflow as tf

model_path = '/content/drive/MyDrive/F1CarsDataset/f1cars_mobilenetv2_augmented.h5'  # Adjust path/filename
model = tf.keras.models.load_model(model_path)

```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have yet to be built. `model.compile_metrics` wi
```

```
import numpy as np

# Reset the validation generator for consistent batch order
val_generator.reset()

# Predict probabilities for all validation images
pred_probs = model.predict(val_generator)

# Predicted class labels
pred_labels = np.argmax(pred_probs, axis=1)

# True class labels
true_labels = val_generator.classes

```

```
# Class label names
class_names = list(val_generator.class_indices.keys())

```

15/15 **29s** 2s/step

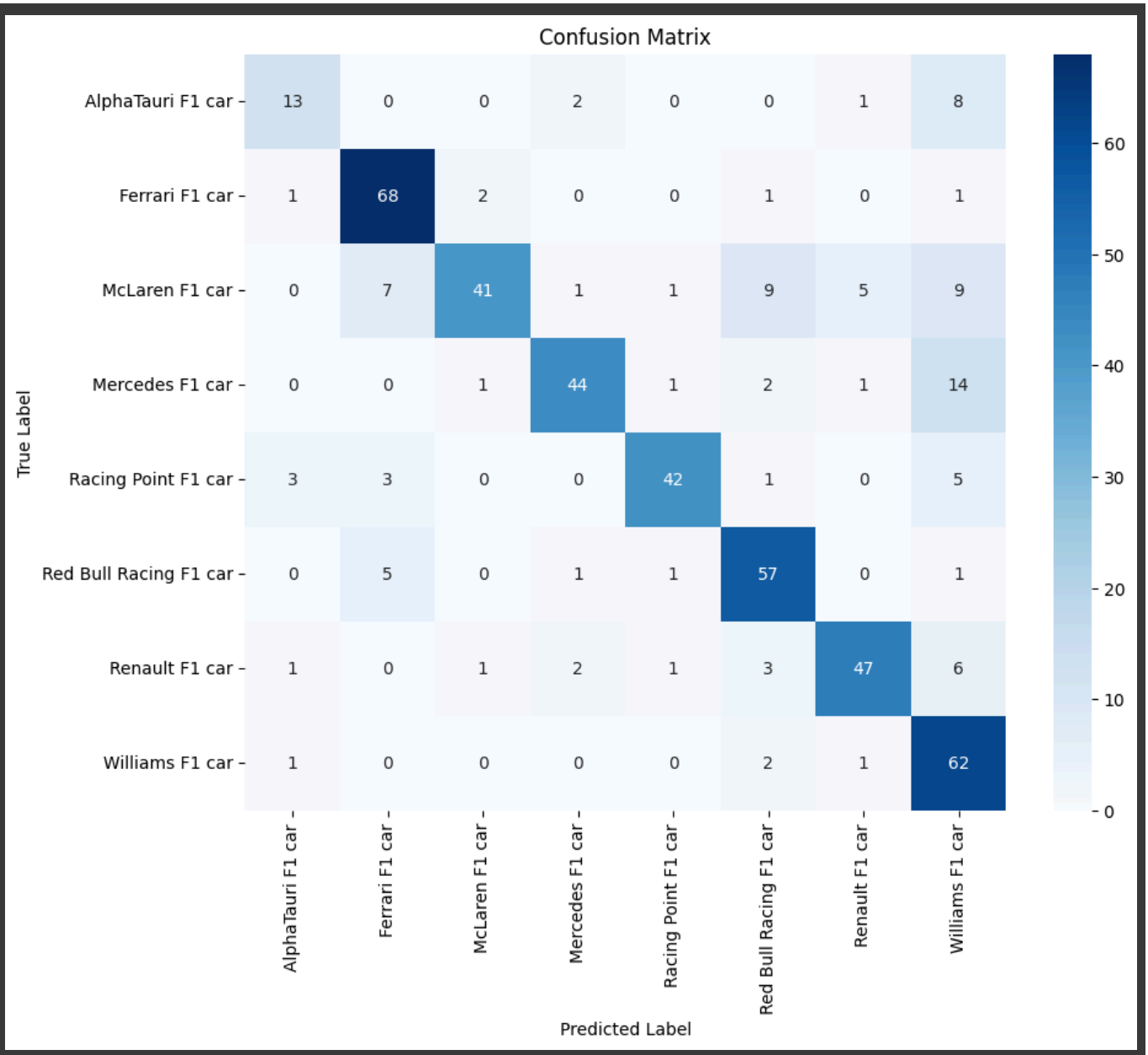
```
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

print("Validation Accuracy:", accuracy_score(true_labels, pred_labels))
print("\nClassification Report:\n")
print(classification_report(true_labels, pred_labels, target_names=class_names))

```

Validation Accuracy: 0.7807933194154488

Classification Report:

	precision	recall	f1-score	support
AlphaTauri F1 car	0.68	0.54	0.60	24
Ferrari F1 car	0.82	0.93	0.87	73
McLaren F1 car	0.91	0.56	0.69	73
Mercedes F1 car	0.88	0.70	0.78	63
Racing Point F1 car	0.91	0.78	0.84	54
Red Bull Racing F1 car	0.76	0.88	0.81	65
Renault F1 car	0.85	0.77	0.81	61
Williams F1 car	0.58	0.94	0.72	66
accuracy			0.78	479
macro avg	0.80	0.76	0.77	479
weighted avg	0.81	0.78	0.78	479

```
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import ConfusionMatrixDisplay

cm = confusion_matrix(true_labels, pred_labels)
plt.figure(figsize=(10,8))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=class_names, yticklabels=class_names)
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.title('Confusion Matrix')
plt.show()

```




```
with open('/content/drive/MyDrive/F1CarsDataset/classification_report.txt', 'w') as f:
    f.write(classification_report(true_labels, pred_labels, target_names=class_names))

```

Day 05

```
import tensorflow as tf
import tensorflow_model_optimization as tfmot
import numpy as np

```

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator

data_path = '/content/drive/MyDrive/F1CarsDataset/Formula One Cars'
IMG_SIZE = (224, 224)
BATCH_SIZE = 32

datagen = ImageDataGenerator(rescale=1./255, validation_split=0.2)

train_generator = datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='training'
)

val_generator = datagen.flow_from_directory(
    data_path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='validation'
)

```

```
Found 1928 images belonging to 8 classes.
Found 479 images belonging to 8 classes.
```

```
num_classes = train_generator.num_classes
input_shape = (224, 224, 3)

model = tf.keras.Sequential([
    tf.keras.layers.Conv2D(32, (3,3), activation='relu', input_shape=input_shape
    tf.keras.layers.MaxPooling2D(2, 2),
    tf.keras.layers.Conv2D(64, (3,3), activation='relu'),
    tf.keras.layers.MaxPooling2D(2, 2),
    tf.keras.layers.Flatten(),
    tf.keras.layers.Dense(256, activation='relu'),
    tf.keras.layers.Dropout(0.5),
    tf.keras.layers.Dense(num_classes, activation='softmax'),
])

model.compile(optimizer='adam',
              loss='categorical_crossentropy',
```

```
17             metrics=['accuracy'])
18
```

```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/convolutional/base_conv.py:113: UserWarning: Do not pass an `
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```
epochs = 10
batch_size = train_generator.batch_size
num_training_samples = train_generator.samples

steps_per_epoch = np.ceil(num_training_samples / batch_size).astype(np.int32)
end_step = steps_per_epoch * epochs

```

```
import numpy as np

# Assuming you have your train_generator and epochs set
batch_size = train_generator.batch_size              # e.g., 32
epochs = 10                                          # number of epochs to train
num_training_samples = train_generator.samples       # total training images

steps_per_epoch = np.ceil(num_training_samples / batch_size).astype(np.int32)
end_step = steps_per_epoch * epochs

```

```
import tensorflow_model_optimization as tfmot

pruning_params = {
    'pruning_schedule': tfmot.sparsity.keras.PolynomialDecay(
        initial_sparsity=0.0,
        final_sparsity=0.5,
        begin_step=0,
        end_step=end_step
    )
}

```