```
import os

# Create a directory for Kaggle config
os.makedirs("/root/.kaggle", exist_ok=True)

# Upload `kaggle.json`
from google.colab import files
files.upload()  # Select and upload the downloaded kaggle.json file

# Move `kaggle.json` to the correct directory
!mv kaggle.json /root/.kaggle/

# Set permissions
!chmod 600 /root/.kaggle/kaggle.json

# Verify Kaggle API works
!kaggle datasets list
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving kaggle.json to kaggle.json
Warning: Looks like you're using an outdated API Version, please consider updating (server 1.7.4.2 / client 1.6.17)
ref                                                                    title                                              size  las
---------------------------------------------------------------------  -------------------------------------------------  -----  --
atharvasoundankar/chocolate-sales                                      Chocolate Sales Data 📊🍫                            14KB
atharvasoundankar/global-food-wastage-dataset-2018-2024                🌍 Global Food Wastage Dataset (2018-2024) 🍽️        106KB  :
abdulmalik1518/mobiles-dataset-2025                                    Mobiles Dataset (2025)                              20KB  202
adilshamim8/student-depression-dataset                                 Student Depression Dataset                         456KB  202
mahmoudelhemaly/students-grading-dataset                               Student Performance & Behavior Dataset             508KB  202
atharvasoundankar/global-water-consumption-dataset-2000-2024           Global Water Consumption Dataset (2000-2024) 🌍💧      17KB
atharvasoundankar/global-energy-consumption-2000-2024                  Global Energy Consumption (2000-2024) 🔥⚡             252KB
aniruddhawankhede/mental-heath-analysis-among-teenagers                Mental_Heath_Analysis_Among_Teenagers              173KB  202
salahuddinahmedshuvo/ecommerce-consumer-behavior-analysis-data         Ecommerce Consumer Behavior Analysis Data           43KB  202
smayanj/netflix-users-database                                         Netflix Users Database                             354KB  202
willianoliveiragibin/grocery-inventory                                 Grocery Inventory                                   50KB  202
alikalwar/heart-attack-risk-prediction-cleaned-dataset                 Heart Attack Risk Prediction Cleaned Dataset       671KB  202
atharvasoundankar/global-music-streaming-trends-and-listener-insights  Global Music Streaming Trends & Listener Insights   95KB  202
atharvasoundankar/viral-social-media-trends-and-engagement-analysis    🚀 Viral Social Media Trends & Engagement Analysis  105KB  2
brsahan/genomic-data-for-cancer                                        Genomic Data for Cancer                              9KB  202
amanrajput16/olympics-medal-list-1896-2024                             Olympic Medal List (1896-2024)                      11KB  202
miadul/brain-tumor-dataset                                             Brain Tumor Dataset                                852KB  202
adilshamim8/student-performance-on-an-entrance-examination             Student Performance on an Entrance Examination       4KB  202
anandshaw2001/video-game-sales                                         Video Game Sales                                   381KB  202
atharvasoundankar/big-4-financial-risk-insights-2020-2025              Big 4 Financial Risk  Insights (2020-2025)           3KB  202
```

```
!kaggle datasets download -d preetishah/waste-classificationorganic-and-recyclable
```

```
Warning: Looks like you're using an outdated API Version, please consider updating (server 1.7.4.2 / client 1.6.17)
Dataset URL: https://www.kaggle.com/datasets/preetishah/waste-classificationorganic-and-recyclable
License(s): apache-2.0
Downloading waste-classificationorganic-and-recyclable.zip to /content
 92% 23.0M/25.0M [00:00<00:00, 60.3MB/s]
100% 25.0M/25.0M [00:00<00:00, 55.6MB/s]
```

```
import zipfile

with zipfile.ZipFile("waste-classificationorganic-and-recyclable.zip", 'r') as zip_ref:
    zip_ref.extractall("waste_classification")
```

```
import os
print(os.listdir("/content/"))
```

```
['.config', 'waste-classificationorganic-and-recyclable.zip', 'waste_classification', 'sample_data']
```

```
train_folder = "/content/waste_classification/wasteclassification/train"
test_folder = "/content/waste_classification/wasteclassification/test"
```

```
import pandas as pd
import numpy as np
import glob
import os
from datetime import datetime
from packaging import version

import tensorflow as tf
```

```
from tensorflow import keras
from tensorflow.keras.applications import ResNet50
from tensorflow.keras.preprocessing import image_dataset_from_directory
from tensorflow.keras.preprocessing.image import load_img, img_to_array
from tensorflow.keras.callbacks import ModelCheckpoint, History

from tensorflow.keras.models import Sequential, load_model
from tensorflow.keras.layers import Conv2D, Lambda, MaxPooling2D, Dense, Dropout, Flatten
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.utils import to_categorical

from skimage.io import imread, imshow
from skimage.transform import resize
from IPython import display
import matplotlib.pyplot as plt
import seaborn as sns
from seaborn import heatmap
from sklearn.metrics import confusion_matrix
```

```
# Data augmentation for training
train_datagen = ImageDataGenerator(
    rescale=1./255,
    rotation_range=30,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    fill_mode='nearest')
```

```
# No augmentation for validation/test
test_datagen = ImageDataGenerator(rescale=1./255)
```

```
# Load dataset
train_generator = train_datagen.flow_from_directory(
    train_folder,
    target_size=(224, 224),
    batch_size=32,
    class_mode='binary')
```

```
Found 666 images belonging to 2 classes.
```

```
test_generator = test_datagen.flow_from_directory(
    test_folder,
    target_size=(224, 224),
    batch_size=32,
    class_mode='binary',
    shuffle=False)
```

```
Found 32 images belonging to 2 classes.
```

```
from sklearn.utils.class_weight import compute_class_weight
# Compute class weights to address imbalance
class_labels = np.array(train_generator.classes)
class_weights = compute_class_weight(class_weight='balanced', classes=np.unique(class_labels), y=class_labels)
class_weight_dict = {i: class_weights[i] for i in range(len(class_weights))}
```

```
# Define ResNet model
base_model = ResNet50(weights='imagenet', include_top=False, input_shape=(224, 224, 3))
base_model.trainable = False
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/resnet/resnet50_weights_tf_dim_ordering_tf_kerne
94765736/94765736 ━━━━━━━━━━━━━━━━━━━━ 1s 0us/step
```

```
model = keras.Sequential([
    base_model,
    keras.layers.GlobalAveragePooling2D(),
    keras.layers.Dense(128, activation='relu'),
    keras.layers.Dropout(0.5),
    keras.layers.Dense(1, activation='sigmoid')
])
```

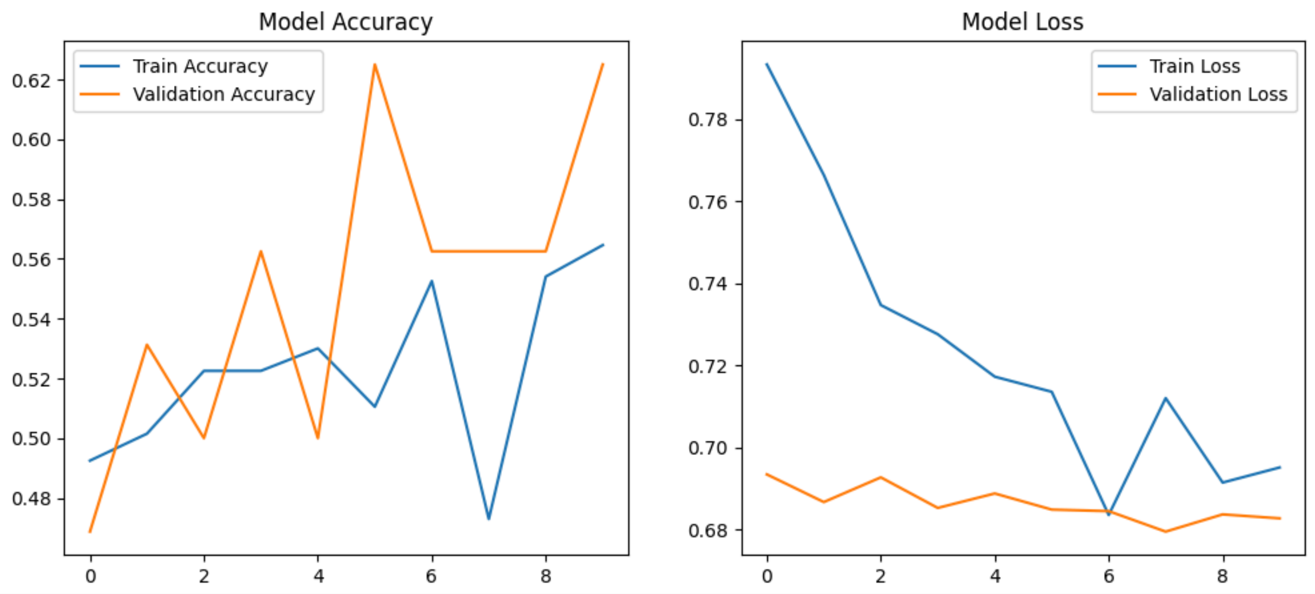
```
from tensorflow.keras.optimizers import Adam
#Compile the model
```

```
model.compile(optimizer=Adam(learning_rate=0.0001), loss='binary_crossentropy', metrics=['accuracy'])


# Train model
history = model.fit(
    train_generator,
    epochs=10,
    validation_data=test_generator,
    class_weight=class_weight_dict)
```

```
/usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:121: UserWarning: Your `PyDataset` cl
  self._warn_if_super_not_called()
Epoch 1/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 131s 6s/step - accuracy: 0.5073 - loss: 0.7618 - val_accuracy: 0.4688 - val_loss: 0.6935
Epoch 2/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 117s 6s/step - accuracy: 0.4872 - loss: 0.7864 - val_accuracy: 0.5312 - val_loss: 0.6867
Epoch 3/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 141s 6s/step - accuracy: 0.5271 - loss: 0.7417 - val_accuracy: 0.5000 - val_loss: 0.6928
Epoch 4/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 123s 6s/step - accuracy: 0.4846 - loss: 0.7501 - val_accuracy: 0.5625 - val_loss: 0.6853
Epoch 5/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 118s 6s/step - accuracy: 0.5133 - loss: 0.7328 - val_accuracy: 0.5000 - val_loss: 0.6888
Epoch 6/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 118s 6s/step - accuracy: 0.5156 - loss: 0.7211 - val_accuracy: 0.6250 - val_loss: 0.6849
Epoch 7/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 118s 6s/step - accuracy: 0.5501 - loss: 0.6834 - val_accuracy: 0.5625 - val_loss: 0.6845
Epoch 8/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 142s 6s/step - accuracy: 0.4633 - loss: 0.7186 - val_accuracy: 0.5625 - val_loss: 0.6795
Epoch 9/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 144s 6s/step - accuracy: 0.5623 - loss: 0.6902 - val_accuracy: 0.5625 - val_loss: 0.6837
Epoch 10/10
21/21 ━━━━━━━━━━━━━━━━━━━━ 123s 6s/step - accuracy: 0.5480 - loss: 0.7046 - val_accuracy: 0.6250 - val_loss: 0.6828
```

```
# Plot accuracy and loss
fig, axes = plt.subplots(1, 2, figsize=(12, 5))
axes[0].plot(history.history['accuracy'], label='Train Accuracy')
axes[0].plot(history.history['val_accuracy'], label='Validation Accuracy')
axes[0].set_title('Model Accuracy')
axes[0].legend()
axes[1].plot(history.history['loss'], label='Train Loss')
axes[1].plot(history.history['val_loss'], label='Validation Loss')
axes[1].set_title('Model Loss')
axes[1].legend()
plt.show()
```



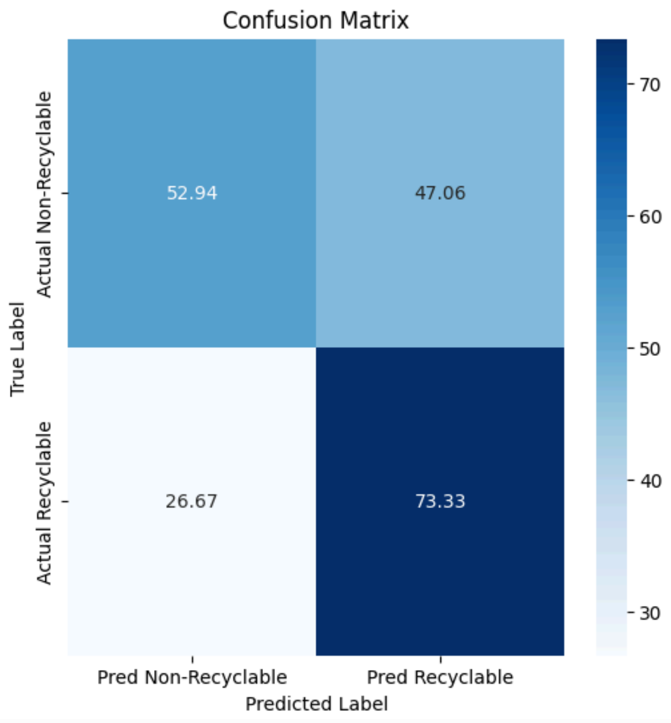
```
# Confusion matrix
y_true = test_generator.classes
y_pred = model.predict(test_generator) > 0.5
cm = confusion_matrix(y_true, y_pred)
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 8s 8s/step
```

```
# Display confusion matrix with labels and percentages
fig, ax = plt.subplots(figsize=(6, 6))
cm_percent = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis] * 100
sns.heatmap(cm_percent, annot=True, fmt='.2f', cmap='Blues', xticklabels=['Pred Non-Recyclable', 'Pred Recyclable'],
            yticklabels=['Actual Non-Recyclable', 'Actual Recyclable'])
plt.xlabel('Predicted Label')
```

```
    plt.ylabel('True Label')
    plt.title('Confusion Matrix')
```

```
Text(0.5, 1.0, 'Confusion Matrix')
```



```
from sklearn.metrics import classification_report
# Classification report
print("Classification Report:")
print(classification_report(y_true, y_pred, target_names=['Non-Recyclable', 'Recyclable']))
```

```
Classification Report:
                precision    recall  f1-score   support

Non-Recyclable       0.69      0.53      0.60        17
    Recyclable       0.58      0.73      0.65        15

      accuracy                           0.62        32
     macro avg       0.64      0.63      0.62        32
  weighted avg       0.64      0.62      0.62        32
```

```
# Convert accuracy and loss to percentage
train_acc = [x * 100 for x in history.history['accuracy']]
val_acc = [x * 100 for x in history.history['val_accuracy']]
train_loss = [x * 100 for x in history.history['loss']]
val_loss = [x * 100 for x in history.history['val_loss']]
# Print accuracy and loss values
print("Final Training Accuracy: {:.2f}%".format(train_acc[-1]))
print("Final Validation Accuracy: {:.2f}%".format(val_acc[-1]))
print("Final Training Loss: {:.2f}%".format(train_loss[-1]))
print("Final Validation Loss: {:.2f}%".format(val_loss[-1]))
```

```
Final Training Accuracy: 56.46%
Final Validation Accuracy: 62.50%
Final Training Loss: 69.52%
Final Validation Loss: 68.28%
```