```
from google.colab import drive
drive.mount('/content/drive', force_remount=True)
```

```
Mounted at /content/drive
```

```
import pandas as pd
import numpy as np
import tensorflow as tf
from tensorflow import keras
from keras import Sequential
import matplotlib.pyplot as plt
from PIL import Image
import os
import pathlib
import random
import glob
```

```
# Create data directory in your google MyDrive folder.
# Copy all three folders in your data directory to MyDrive->data folder in your google drive
# Then Execute below code
def get_data_dir_path():
  path = '/content/drive/MyDrive/data/'
  data_dir_path= pathlib.Path(path)
  data_dir_file = str(pathlib.Path(path)) + "/*.*"
  return data_dir_path
```

```
# Create filter path to retive all the png files
def filter_path():
  data_dir_path_benign = str(pathlib.Path(os.path.join(get_data_dir_path(),'benign'))) + "/*.png"
  data_dir_path_normal = str(pathlib.Path(os.path.join(get_data_dir_path(),'normal'))) + "/*.png"
  data_dir_path_malignant = str(pathlib.Path(os.path.join(get_data_dir_path(),'malignant'))) + "/*.png"
  return data_dir_path_benign,data_dir_path_normal,data_dir_path_malignant
```

```
# Use the filter to retrieve the corresponsing image counts
def image_count():
  data_dir_path_benign,data_dir_path_normal,data_dir_path_malignant = filter_path()
  img_count_benign = glob.glob(data_dir_path_benign,recursive=True)
  img_count_normal = glob.glob(data_dir_path_normal,recursive=True)
  img_count_malignant = glob.glob(data_dir_path_malignant,recursive=True)
  img_total_count = len(img_count_benign) + len(img_count_normal) + len(img_count_malignant)
  print("Total  Images: ", img_total_count)
  print("Benign (non-dangerous) Images: {}({})".format(len(img_count_benign), round(len(img_count_benign)*1
  print("Malignant (dangerous) Images: {}({})".format(len(img_count_normal), round(len(img_count_normal)*10
  print("Normal (No Traces) Images: {}({})".format(len(img_count_malignant), round(len(img_count_malignant)
  #return img_total_count,len(img_count_benign),len(img_count_normal),len(img_count_malignant)
```

```
#Display the image totals and respective class image counts
image_count()
```

```
Total  Images:  1587
Benign (non-dangerous) Images: 900(56.71)
Malignant (dangerous) Images: 266(16.76)
```

```
      Normal (No Traces) Images: 421(26.53)
```

```
# Configure batch size,img size and create train, validation split use function call configure_for_performa
def create_data_sets():
  batch_size = 40
  img_height = 224
  img_width = 224
  train_ds = tf.keras.utils.image_dataset_from_directory(get_data_dir_path(),validation_split=0.3,subset="t
  val_ds = tf.keras.utils.image_dataset_from_directory(get_data_dir_path(),validation_split=0.3,subset="val
  val_ds.class_names
  return train_ds,val_ds


train_ds,val_ds = create_data_sets()
```

```
Found 1587 files belonging to 3 classes.
Using 1111 files for training.
Found 1587 files belonging to 3 classes.
Using 476 files for validation.
```

```
def create_model(img_height=224,img_width=224):
  model = tf.keras.Sequential([
    tf.keras.layers.Rescaling(1./255, input_shape=(img_height, img_width, 3)),

    tf.keras.layers.Conv2D(16, 3, padding='same', activation='relu'),
    tf.keras.layers.MaxPooling2D(),

    tf.keras.layers.Conv2D(32, 3, padding='same', activation='relu'),
    tf.keras.layers.MaxPooling2D(),

    tf.keras.layers.Conv2D(64, 3, padding='same', activation='relu'),
    tf.keras.layers.MaxPooling2D(),

    tf.keras.layers.Conv2D(128, 3, padding='same', activation='relu'),
    tf.keras.layers.MaxPooling2D(),

    tf.keras.layers.Dropout(0.3),
    tf.keras.layers.Flatten(),
    tf.keras.layers.Dense(64, activation='relu'),
    tf.keras.layers.Dense(3,activation="softmax")
  ])
  return model



model = create_model()
model.summary()
```

Model: "sequential_7"

Layer (type)	Output Shape	Param #
rescaling_7 (Rescaling)	(None, 224, 224, 3)	0
conv2d_23 (Conv2D)	(None, 224, 224, 16)	448
max_pooling2d_23 (MaxPooling2D)	(None, 112, 112, 16)	0
conv2d_24 (Conv2D)	(None, 112, 112, 32)	4,640
max_pooling2d_24 (MaxPooling2D)	(None, 56, 56, 32)	0
conv2d_25 (Conv2D)	(None, 56, 56, 64)	18,496
max_pooling2d_25 (MaxPooling2D)	(None, 28, 28, 64)	0
conv2d_26 (Conv2D)	(None, 28, 28, 128)	73,856
max_pooling2d_26 (MaxPooling2D)	(None, 14, 14, 128)	0
dropout_7 (Dropout)	(None, 14, 14, 128)	0
flatten_7 (Flatten)	(None, 25088)	0
dense_14 (Dense)	(None, 64)	1,605,696
dense_15 (Dense)	(None, 3)	195

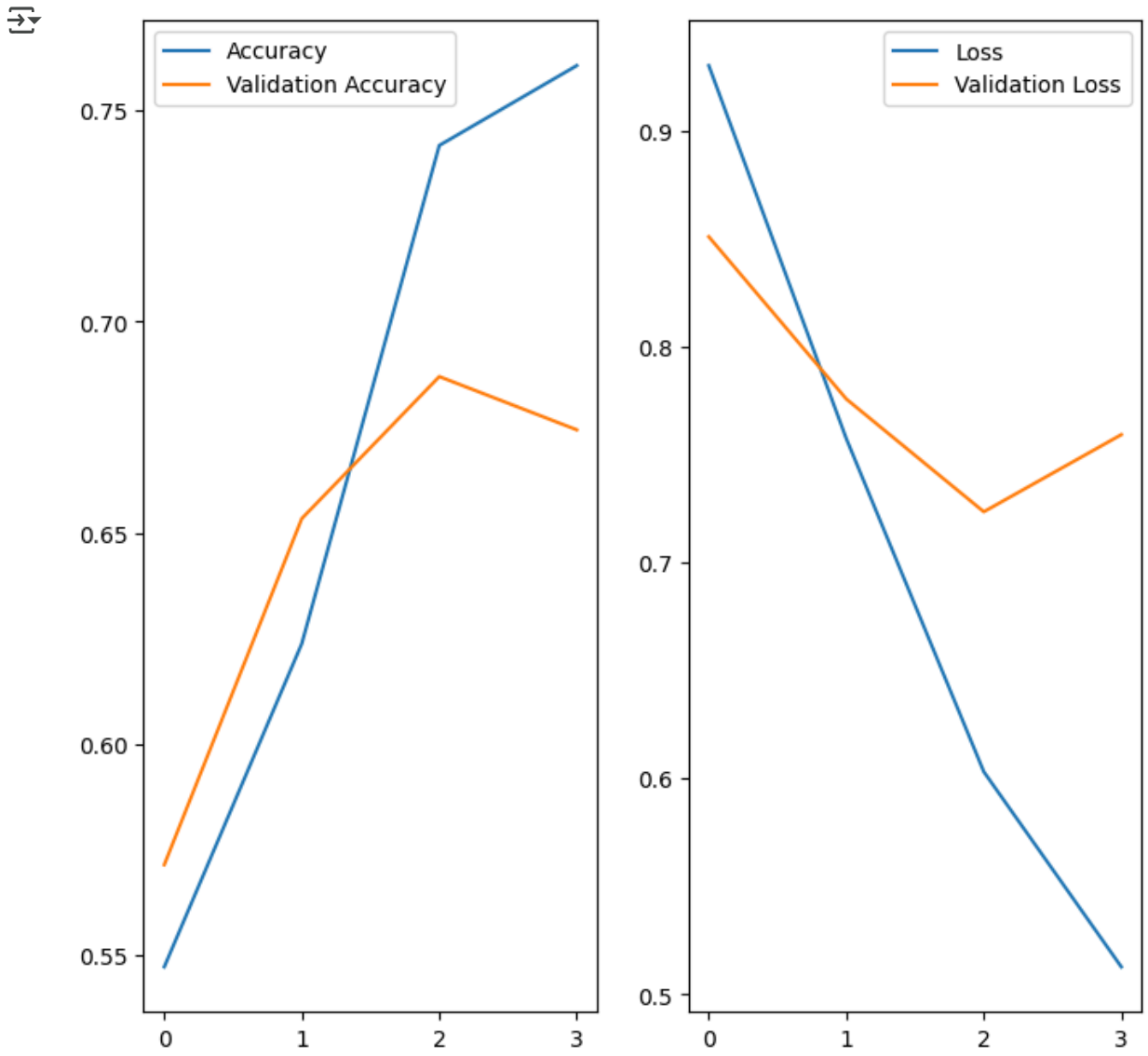
Total params: 1,703,331 (6.50 MB)
Trainable params: 1,703,331 (6.50 MB)

```
def train_model(batch_size = 32,epochs=4):
  train_ds,val_ds = create_data_sets()
  model.compile(optimizer="Adam",
            loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
            metrics=["accuracy"])

  history = model.fit(train_ds,
                    epochs=epochs,
                    validation_data=val_ds,
                    batch_size=batch_size)
  return history


#Train the model
history=train_model(batch_size = 32,epochs=4)
history.history.keys()
```

```
Found 1587 files belonging to 3 classes.
Using 1111 files for training.
Found 1587 files belonging to 3 classes.
Using 476 files for validation.
Epoch 1/4
/usr/local/lib/python3.11/dist-packages/keras/src/backend/tensorflow/nn.py:708: UserWarning: "`sparse_ca
  output, from_logits = _get_logits(
28/28 ━━━━━━━━━━━━━━━━━━━━ 90s 3s/step - accuracy: 0.4895 - loss: 0.9795 - val_accuracy: 0.5714 - val_lo
Epoch 2/4
28/28 ━━━━━━━━━━━━━━━━━━━━ 147s 3s/step - accuracy: 0.6105 - loss: 0.7821 - val_accuracy: 0.6534 - val_l
Epoch 3/4
28/28 ━━━━━━━━━━━━━━━━━━━━ 142s 3s/step - accuracy: 0.7500 - loss: 0.5849 - val_accuracy: 0.6870 - val_l
Epoch 4/4
28/28 ━━━━━━━━━━━━━━━━━━━━ 143s 3s/step - accuracy: 0.7586 - loss: 0.5129 - val_accuracy: 0.6744 - val_l
```

```
dict_keys(['accuracy', 'loss', 'val_accuracy', 'val_loss'])
```

```
#Plot the graph acc/val accuracy versus loss/validation loss
epochs=4
acc = history.history['accuracy']
val_acc =  history.history['val_accuracy']
loss = history.history['loss']
val_loss = history.history['val_loss']
ep_range = range(epochs)
plt.figure(figsize=(8,8))
plt.subplot(1,2,1)
plt.plot(ep_range,acc,label='Accuracy')
plt.plot(ep_range,val_acc,label="Validation Accuracy")
plt.legend()

plt.subplot(1,2,2)
plt.plot(ep_range,loss,label='Loss')
plt.plot(ep_range,val_loss,label="Validation Loss")
plt.legend()
plt.show()
```

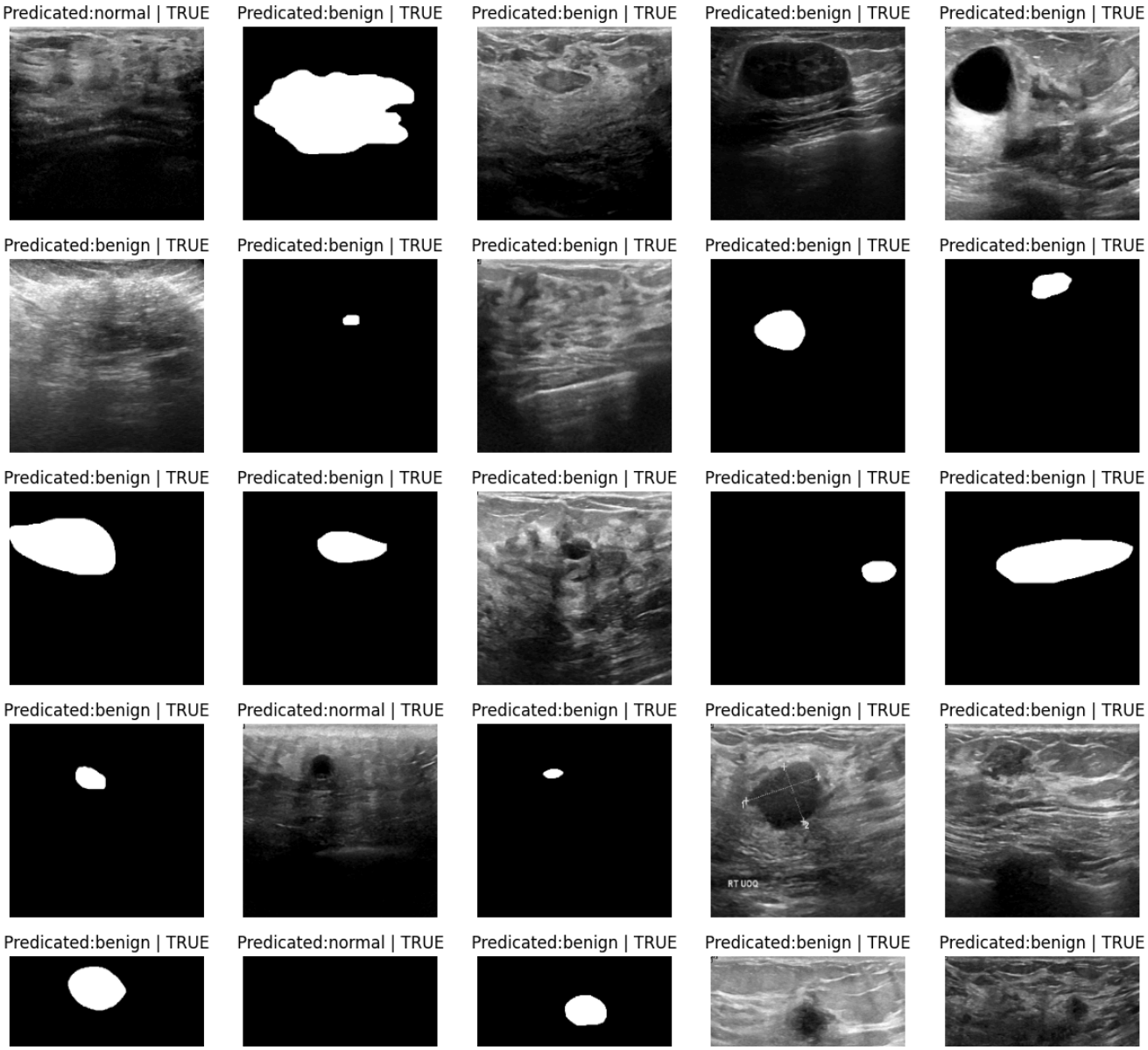


```
#Evaluate model with validation data set
train_ds,val_ds = create_data_sets()
loss, acc = model.evaluate(val_ds)
print('model, accuracy: {:5.2f}%'.format(100 * acc))
```

```
Found 1587 files belonging to 3 classes.
Using 1111 files for training.
Found 1587 files belonging to 3 classes.
Using 476 files for validation.
12/12 ━━━━━━━━━━━━━━━━━━━━ 18s 847ms/step - accuracy: 0.6652 - loss: 0.7885
model, accuracy: 67.44%
```

```
#Pedict the model using Validation data
plt.figure(figsize=(15, 15))
class_names = val_ds.class_names
result = ' | False'
for images, labels in val_ds.take(1):
    for i in range(25):

        ax = plt.subplot(5, 5, i + 1)
        img = images[i].numpy().astype("uint8")
        img = tf.expand_dims(img, axis=0)
        predication=""
        predictions = model.predict(img)
        predicted_class = np.argmax(predictions)
        if class_names[predicted_class] == class_names[labels[i]]:
            result = ' | TRUE'

        plt.imshow(images[i].numpy().astype("uint8"))
        plt.title('Predicated:'+ class_names[predicted_class]+result)
        plt.axis("off")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 63ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 71ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 67ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 64ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 72ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 91ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 81ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 86ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 83ms/step
```



```
#Create a folder saved_model under /content/drive/MyDrive to store bc_model.h5
def save_model():
  path = '/content/drive/MyDrive/saved_model'
  data_dir_path= pathlib.Path(path)
  data_dir_file_path = str(pathlib.Path(path)) + str("/bc_model.h5")
  model.save(data_dir_file_path)
  return data_dir_file_path


#Save the model
data_dir_file_path = save_model()
```

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

```
# Recreate the exact same model, including its weights and the optimizer
new_model = tf.keras.models.load_model(data_dir_file_path)
new_model.summary()
```

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

Model: "sequential_7"

Layer (type)	Output Shape	Param #
rescaling_7 (Rescaling)	(None, 224, 224, 3)	0
conv2d_23 (Conv2D)	(None, 224, 224, 16)	448
max_pooling2d_23 (MaxPooling2D)	(None, 112, 112, 16)	0
conv2d_24 (Conv2D)	(None, 112, 112, 32)	4,640
max_pooling2d_24 (MaxPooling2D)	(None, 56, 56, 32)	0
conv2d_25 (Conv2D)	(None, 56, 56, 64)	18,496
max_pooling2d_25 (MaxPooling2D)	(None, 28, 28, 64)	0
conv2d_26 (Conv2D)	(None, 28, 28, 128)	73,856
max_pooling2d_26 (MaxPooling2D)	(None, 14, 14, 128)	0
dropout_7 (Dropout)	(None, 14, 14, 128)	0
flatten_7 (Flatten)	(None, 25088)	0
dense_14 (Dense)	(None, 64)	1,605,696
dense_15 (Dense)	(None, 3)	195