```
import numpy as np
import pandas as pd
import seaborn as sns
from matplotlib import pyplot as plt
%matplotlib inline
```

```
import warnings
warnings.filterwarnings("ignore")
```

```
import tensorflow as tf
from tensorflow.keras import models, layers
```

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

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
# Creating Some Constants
batch_size = 32
CHANNELS = 1
```

```
# Load the dataset
dataset = tf.keras.preprocessing.image_dataset_from_directory(
          '/content/drive/MyDrive/Colab Notebooks/Alzheimers Classification/Alzheimer_s Dataset/train',
          shuffle = True,
          image_size = (176,208),
          batch_size = batch_size )
```

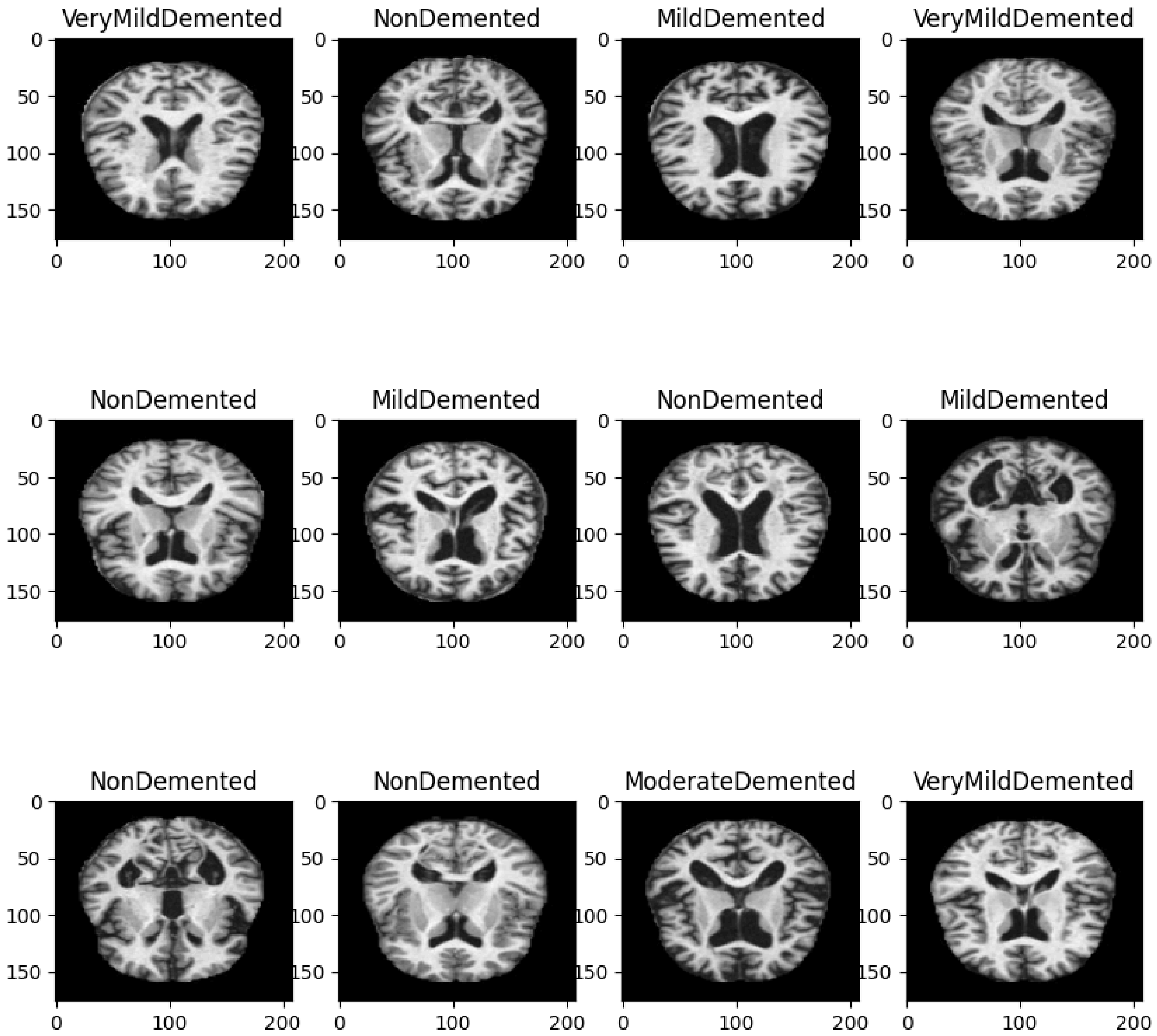
```
Found 5311 files belonging to 4 classes.
```

```
# Lets define class name
class_name = dataset.class_names
class_name
```

```
['MildDemented', 'ModerateDemented', 'NonDemented', 'VeryMildDemented']
```

```
# Lets see some images from each class

plt.figure(figsize = (10,10))
for image_batch, label_batch in dataset.take(1):
  for i in range(12):
    ax = plt.subplot(3,4,i+1)
```

```
    plt.imshow(image_batch[i].numpy().astype("uint8"))
    plt.title(class_name[label_batch[i]])
```



```
def get_dataset_partitions_tf(ds, train_split=0.8, val_split=0.1, test_split=0.1, shuffle=True, shuffle_size = 10000):

  ds_size = len(ds)

  if shuffle:
      ds = ds. shuffle(shuffle_size, seed=12)

  train_size = int(train_split * ds_size)
  val_size = int(val_split * ds_size)

  train_ds = ds.take(train_size)

  val_ds = ds. skip(train_size).take(val_size)
  test_ds = ds.skip(train_size).skip(val_size)
  return train_ds, val_ds, test_ds
```

```
train_ds, val_ds, test_ds = get_dataset_partitions_tf(dataset)
```

```
print("Training Size: ", len(train_ds))
print("Validation Size: ", len(val_ds))
print("Test Size: ", len(test_ds))
```

```
Training Size:  132
Validation Size:  16
Test Size:  18
```

```
# For confirming the define function is working properly or not
train_size = 0.8
len(dataset) * train_size
```

```
132.8
```

```
train_ds = train_ds.cache().shuffle(1000).prefetch(buffer_size=tf.data.AUTOTUNE)
val_ds = val_ds.cache().shuffle(1000).prefetch(buffer_size=tf.data.AUTOTUNE)
test_ds = test_ds.cache().shuffle(1000).prefetch(buffer_size=tf.data.AUTOTUNE)
```

```
resize_and_rescale = tf.keras.Sequential([layers.experimental.preprocessing.Rescaling(1.0/255)])
```

```
data_augmentation = tf.keras.Sequential([
    layers.experimental.preprocessing.RandomFlip("horizontal_and_vertical"),
    layers.experimental.preprocessing.RandomRotation(0.2)])
```

Building Model

```
model = models.Sequential([
        resize_and_rescale,
        data_augmentation,
        layers.Conv2D(32, (3, 3), activation='relu', input_shape=(32, 176, 208, 3)),
        layers.MaxPooling2D((2, 2)),
        layers.Conv2D(64, (3, 3), activation='relu'),
        layers.MaxPooling2D((2, 2)),
        layers.Conv2D(128, (3, 3), activation='relu'),
        layers.MaxPooling2D((2, 2)),
        layers.Conv2D(128, (3, 3), activation='relu'),
        layers.MaxPooling2D((2, 2)),
        layers.Flatten(),
        layers.Dropout(0.5),
        layers.Dense(512, activation='relu'),
        layers.Dense(4, activation='softmax')])
```

```
model.build(input_shape = (32, 176, 208, 3))
```

```
model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 sequential (Sequential)     (32, 176, 208, 3)         0

 sequential_1 (Sequential)   (32, 176, 208, 3)         0

 conv2d (Conv2D)             (32, 174, 206, 32)        896

 max_pooling2d (MaxPooling2  (32, 87, 103, 32)         0
 D)

 conv2d_1 (Conv2D)           (32, 85, 101, 64)         18496

 max_pooling2d_1 (MaxPoolin  (32, 42, 50, 64)          0
 g2D)

 conv2d_2 (Conv2D)           (32, 40, 48, 128)         73856

 max_pooling2d_2 (MaxPoolin  (32, 20, 24, 128)         0
 g2D)

 conv2d_3 (Conv2D)           (32, 18, 22, 128)         147584
```

```
 max_pooling2d_3 (MaxPoolin  (32, 9, 11, 128)          0
 g2D)

 flatten (Flatten)           (32, 12672)               0

 dropout (Dropout)           (32, 12672)               0

 dense (Dense)               (32, 512)                 6488576

 dense_1 (Dense)             (32, 4)                   2052

=================================================================
Total params: 6731460 (25.68 MB)
Trainable params: 6731460 (25.68 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

```
model.compile(
    optimizer='adam',
    loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits = False),
    metrics=['accuracy'])
```

```
history = model.fit(
          train_ds,
          epochs = 10,
          batch_size = 32,
          verbose = 1,
          validation_data = val_ds
)
```

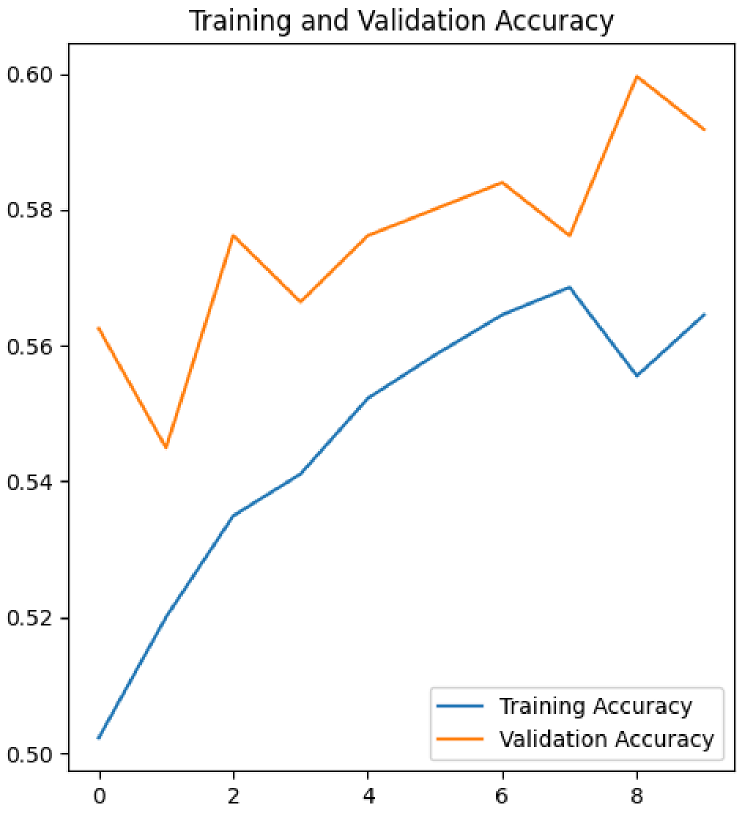
```
Epoch 1/10
132/132 [==============================] - 476s 3s/step - loss: 1.0645 - accuracy: 0.5022 - val_loss: 1.0441 - val_accuracy: 0.5625
Epoch 2/10
132/132 [==============================] - 378s 3s/step - loss: 1.0121 - accuracy: 0.5200 - val_loss: 0.9691 - val_accuracy: 0.5449
Epoch 3/10
132/132 [==============================] - 391s 3s/step - loss: 0.9457 - accuracy: 0.5349 - val_loss: 0.8883 - val_accuracy: 0.5762
Epoch 4/10
132/132 [==============================] - 380s 3s/step - loss: 0.9235 - accuracy: 0.5411 - val_loss: 0.8560 - val_accuracy: 0.5664
Epoch 5/10
132/132 [==============================] - 380s 3s/step - loss: 0.9192 - accuracy: 0.5522 - val_loss: 0.8443 - val_accuracy: 0.5762
Epoch 6/10
132/132 [==============================] - 372s 3s/step - loss: 0.9088 - accuracy: 0.5586 - val_loss: 0.8443 - val_accuracy: 0.5801
Epoch 7/10
132/132 [==============================] - 380s 3s/step - loss: 0.9009 - accuracy: 0.5645 - val_loss: 0.8376 - val_accuracy: 0.5840
Epoch 8/10
132/132 [==============================] - 381s 3s/step - loss: 0.8882 - accuracy: 0.5686 - val_loss: 0.8730 - val_accuracy: 0.5762
Epoch 9/10
132/132 [==============================] - 376s 3s/step - loss: 0.8951 - accuracy: 0.5555 - val_loss: 0.8179 - val_accuracy: 0.5996
Epoch 10/10
```

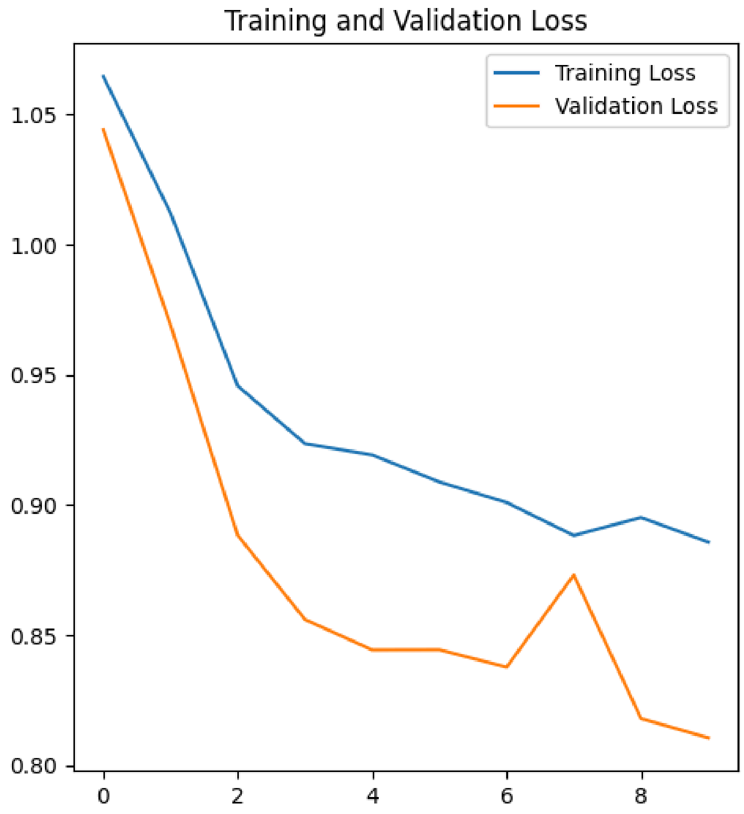
```
132/132 [==============================] - 379s 3s/step - loss: 0.8857 - accuracy: 0.5645 - val_loss: 0.8105 - val_accuracy: 0.5918
```

```
acc = history.history['accuracy']
val_acc = history.history['val_accuracy']

loss = history.history['loss']
val_loss = history.history['val_loss']
```

Plotting the loss function in the graph to understand it better

```
plt.figure(figsize=(12, 6))
plt.subplot(1, 2, 1)
plt.plot(range(10), acc, label='Training Accuracy')
plt.plot(range(10), val_acc, label='Validation Accuracy')
plt.legend(loc='lower right')
plt.title('Training and Validation Accuracy')

plt.subplot(1, 2, 2)
plt.plot(range(10), loss, label='Training Loss')
plt.plot(range(10), val_loss, label='Validation Loss')
plt.legend(loc='upper right')
plt.title('Training and Validation Loss')
plt.show()
```






```
import numpy as np
for images_batch, labels_batch in test_ds.take(1):

    first_image = images_batch[0].numpy().astype('uint8')
    first_label = labels_batch[0].numpy()

    print("first image to predict")
    plt.imshow(first_image)
    print("actual label:",class_name[first_label])

    batch_prediction = model.predict(images_batch)
    print("predicted label:",class_name[np.argmax(batch_prediction[0])])
```

```
first image to predict
actual label: VeryMildDemented
1/1 [==============================] - 1s 1s/step
predicted label: VeryMildDemented
```