Mid-progress Phase for DSAI 305 Project

First: EDA Techniques results

First of all: Exploring the number of classes and classes names

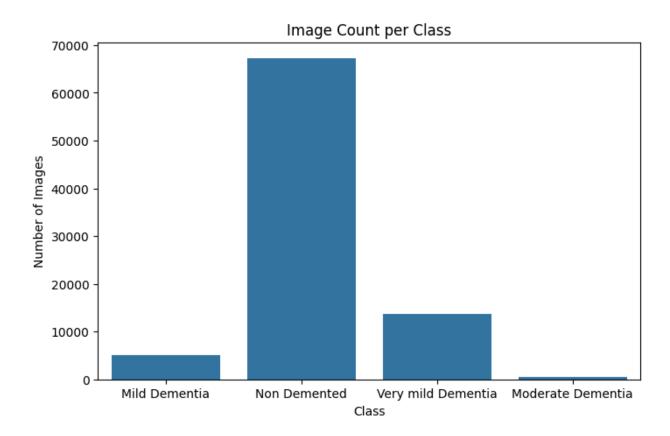
```
Classes found: ['Mild Dementia', 'Non Demented', 'Very mild Dementia', 'Moderate Dementia']
```

Exploring the numbers of images per each class and visualizing them

Mild Dementia: 5002 images Non Demented: 67222 images

Very mild Dementia: 13725 images Moderate Dementia: 488 images

Total Images: 86437

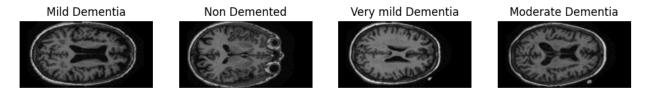


Exploring images height, width statistics

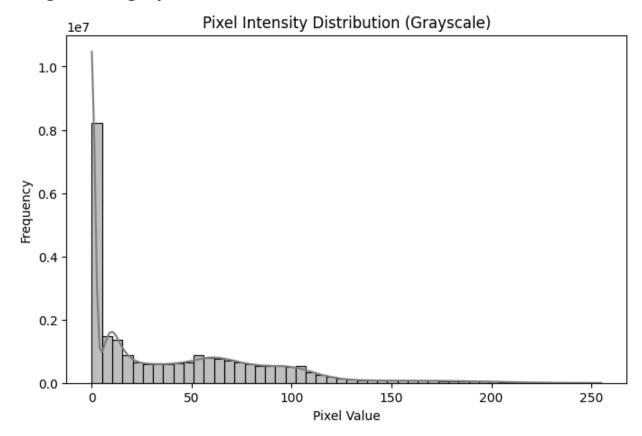
```
Image Height - Mean: 248.0, Min: 248, Max: 248
Image Width - Mean: 496.0, Min: 496, Max: 496
Channels: [3]
```

Display a sample image for each class

Sample Image from Each Class



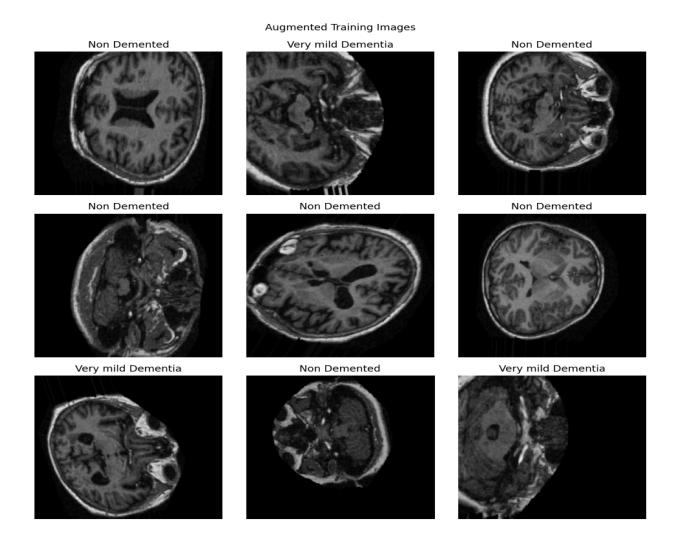
Visualizing pixels values distribution after converting the images into grayscale



Checking for duplicates or corrupted images

Found 0 duplicate images Found 0 corrupted images

Second: Images preprocessing results Robust preprocessing has been done through efficient data augmentation, pixel normalization and image resizing.



Third: Feature extraction and Model implementation VGG16 is used as a feature extractor and the classifier is a 100 neurons neural network and a softmax activation function as well as using RELU, ADAM optimizer, a regularization rate of 0.0006, and 10 epochs.

The model's architecture:

Layer (type)	Output Shape	Param #
input_layer (InputLayer)	(None, 224, 224, 3)	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1,792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36,928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73,856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147,584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295,168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590,080
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590,080
block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1,180,160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2,359,808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2,359,808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2,359,808
block5_conv2 (Conv2D)	(None, 14, 14, 512)	2,359,808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2,359,808
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
flatten (Flatten)	(None. 25088)	А

Model results

```
# Early stopping
early_stop = EarlyStopping(monitor='val_loss', patience=3,
restore_best_weights=True)

# Train the model
history = model.fit(
    train_generator,
    validation_data=test_generator,
    epochs=10,
    callbacks=[early_stop]
)
```

```
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        /usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:121: UserWarning: Your `PyDataset_class should call super()._in: self._warn_if_super_not_called()
Q
            Epoch 1/10
            2161/2161 -
                                       --- 1347s 617ms/step - accuracy: 0.7662 - loss: 0.7043 - val_accuracy: 0.7809 - val_loss: 0.5674
            Epoch 2/10
<>
            2161/2161 -
                                        --- 1321s 611ms/step - accuracy: 0.7842 - loss: 0.5699 - val_accuracy: 0.7858 - val_loss: 0.5868
            Epoch 3/10
{x}
            2161/2161 -
                                        -- 1358s 628ms/step - accuracy: 0.7867 - loss: 0.5658 - val_accuracy: 0.7833 - val_loss: 0.5633
            Epoch 4/10
            2161/2161 -
                                        — 1317s 610ms/step - accuracy: 0.7805 - loss: 0.5582 - val_accuracy: 0.7780 - val_loss: 0.5733
            Epoch 5/10
                                        -- 1325s 613ms/step - accuracy: 0.7746 - loss: 0.5686 - val_accuracy: 0.7777 - val_loss: 0.5454
            2161/2161 -
            Epoch 6/10
— 1339s 620ms/step - accuracy: 0.7798 - loss: 0.5552 - val_accuracy: 0.7782 - val_loss: 0.5896
            2161/2161 -
            Epoch 7/10
            2161/2161 -
                                         -- 1310s 606ms/step - accuracy: 0.7816 - loss: 0.5579 - val_accuracy: 0.7880 - val_loss: 0.5512
            Epoch 8/10
                                       - 1:49 475ms/step - accuracy: 0.7809 - loss: 0.5559
            1931/2161 -
```

The model has achieved an accuracy of 78% and then stopped due to the applied early stopping.

The project challenges:

- 1. The large size dataset has been a great challenge as the data includes about 80,000 images of brain MRI scans.
- 2. Using an imbalanced dataset as the model may get biased towards majority classes.
- 3. Choosing the right models and architecture.
- 4. Hardware limitations.
- 5. Preprocessing complexity.