LAB REPORT

Topic : Brain MRI Tumor Classification

Group Members:

- **Mobashra Abeer (19201092)**
- **Shaiane Prema Baroi (21101098)**
- **Fahmid Bin Kibria (19201063)**

Introduction

Brain tumor is a mass or growth of abnormal cells in the brain. There exists different types of brain tumors. They can be classified into two types: benign (non-cancerous) tumors and malignant (cancerous) tumors. These can be further classified into primary tumors and secondary tumors. Primary tumors initiate within the brain and secondary tumors develop from the spreading of tumors outside the brain (brain metastasis tumors). Moreover, tumors may generate varying symptoms that depend on the tumor size and part of the brain involved and the noticeable symptoms are headaches, vomiting, difficulty with vision, seizures, unconsciousness and so on. The growth rate and location of brain tumor determines to what extent it affects the brain. Treatments include a combination of surgery, radiotherapy and chemotherapy.

Methodology

[Dataset Description] The dataset that has been chosen for this project is titled as '**Brain MRI Images for Brain Tumor Detection**' and can be obtained from the following URL: https://www.kaggle.com/datasets/navoneel/brain-mri-images-for-brain-tumor-detection. It has a total folder size of 16MB and consists of exactly 253 images of brain MRI images. There are two classes of images which are labeled as: 'yes' with 155 images to indicate patients who have been diagnosed with a brain tumor and 'no' with 98 images to indicate patients who have not been diagnosed with a brain tumor. Out of all the 253 images, there are 239 images with .jpg extension, 6 images with .jpeg extension and 8 images with .png extension. All the images in the dataset are grayscale images where we observe white at high signal intensity regions, gray at intermediate signal intensity regions and black at low signal intensity regions.

[Pre-Processing Techniques Applied] The dataset for our project consists of images which is why we had to proceed with data augmentation as our pre-processing technique. During the process, we used different parameters such as width shift, height shift, shear, zoom rotation, horizontal flip, and brightness.

[Models Applied] The three models which we have chosen to train and test our dataset with are: (a) VGG-19, (b) Inception V3 and (c) ResNet50. In summary, we can use the following figures to describe the three individual models:

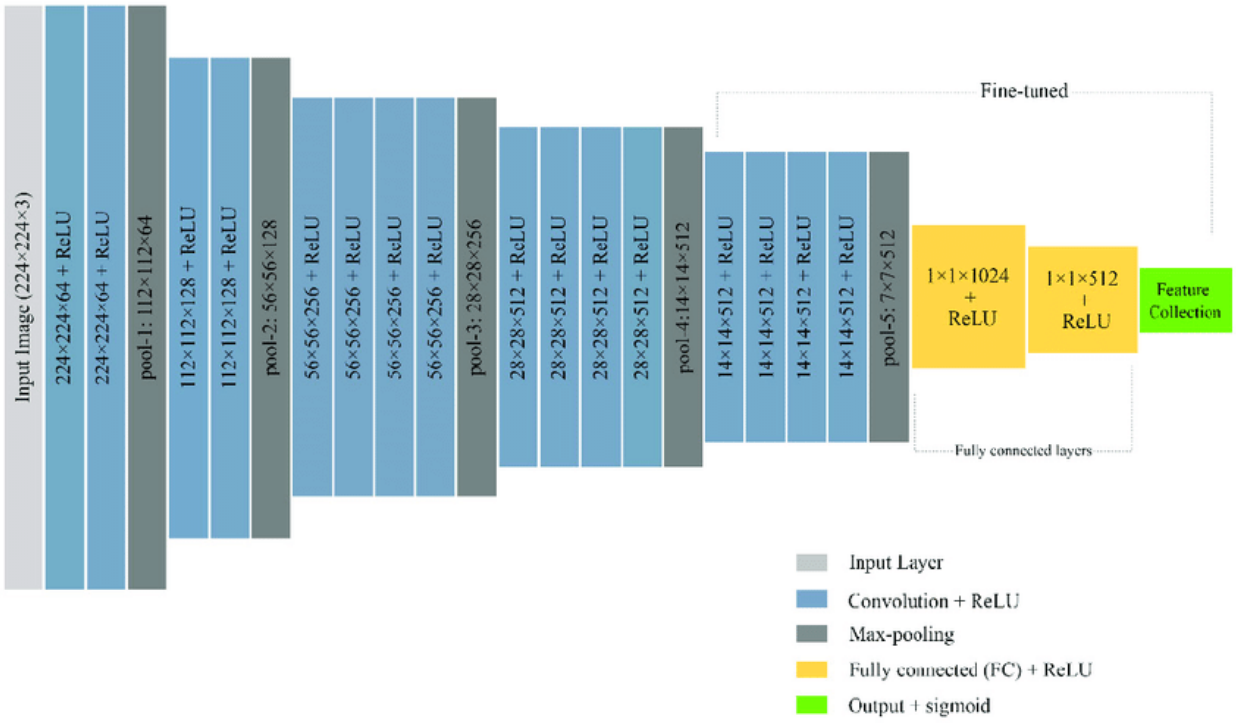

Figure (a) : VGG-19

VGG19 is a variant of the VGG model consisting of 19 layers where there are 16 Convolution layers, 3 Fully Connected (FC) layers, 5 MaxPool layers and 1 Dense layer.

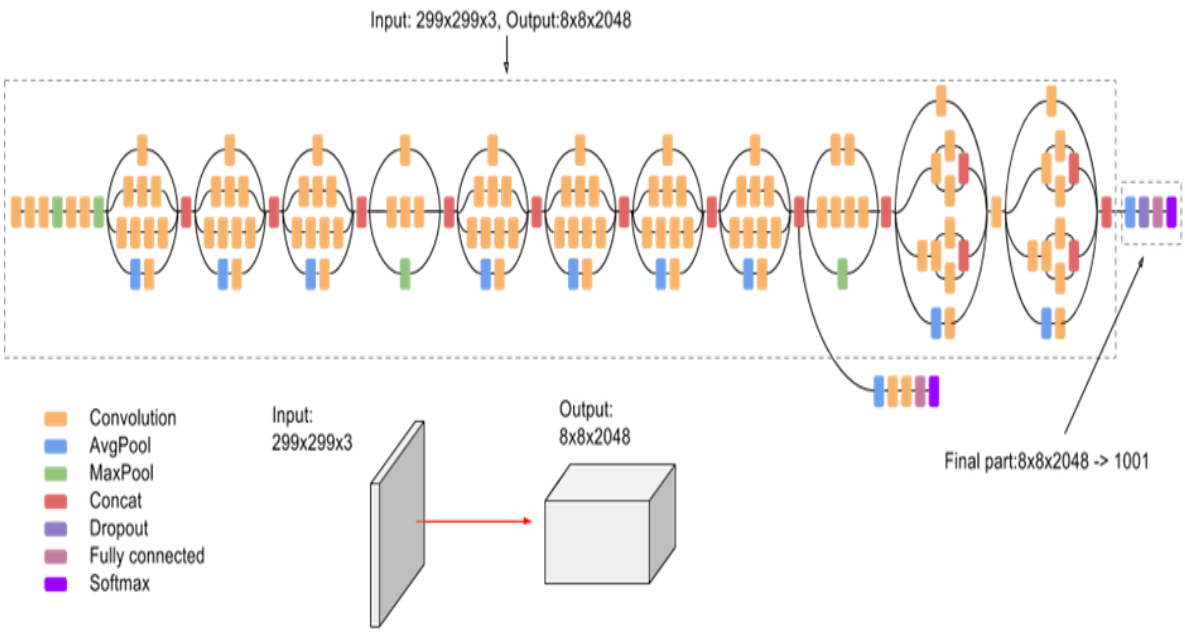

Figure (b) : Inception V3

Inception V3 is an optimized version of the inception V1 model. It has 42 layers in total and a lower error rate than its predecessor models. The modifications on Inception V3 include factorization into smaller convolutions, spatial factorization into asymmetric convolutions, utility of auxiliary classifiers and efficient grid size reduction.

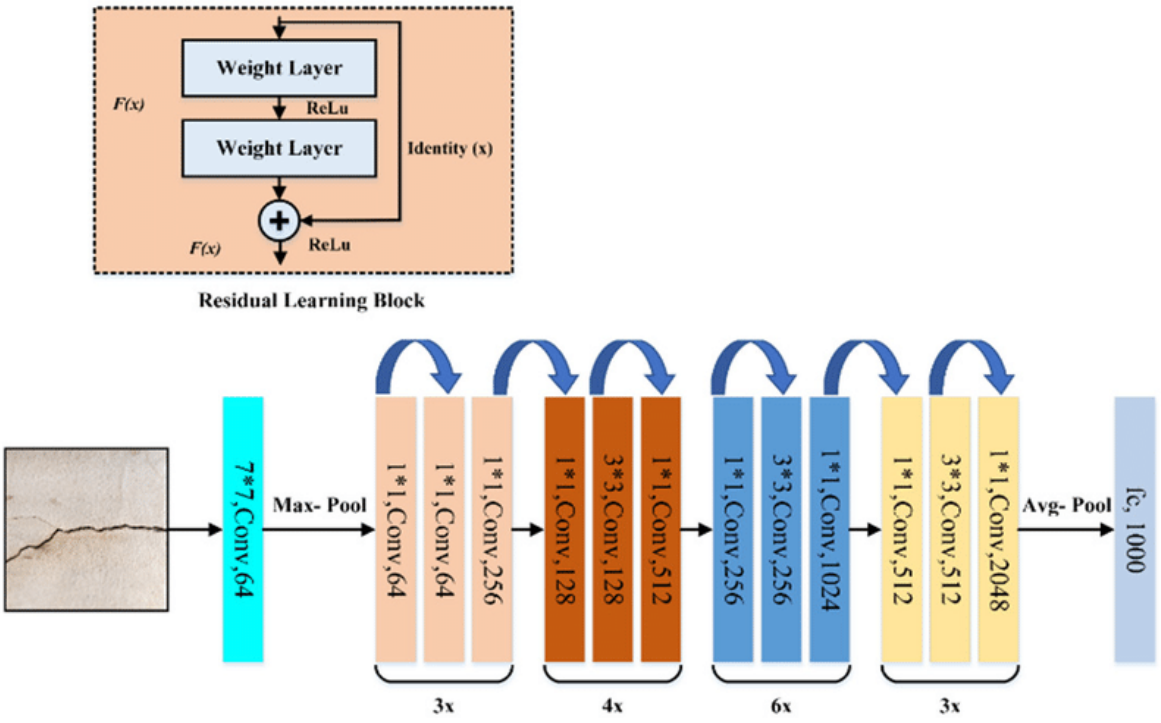

Figure (c): ResNet50

ResNet50 is a variant of the ResNet model consisting of 48 Convolution layers, 1 MaxPool layer and 1 Average Pool layer. There are 3.8 * 10^9 floating point operations.

Results

1. VGG19

   Confusion matrix:

   [[11 8]

   [3 28]]

Classification report:

	precision	recall	f1-score	support
0	0.58	0.79	0.67	14
1	0.90	0.78	0.84	36
accuracy			0.78	50
macro avg	0.74	0.78	0.75	50
weighted avg	0.81	0.78	0.79	50

Accuracy and Loss:

	Train	Test
Loss	0.860036	1.082608
Accuracy	0.806324	0.780000

2. InceptionV3

Confusion matrix:

[[19 0]

[3 28]]

Classification report:

	precision	recall	f1-score	support
0	1.00	0.86	0.93	22
1	0.90	1.00	0.95	28
accuracy			0.94	50
macro avg	0.95	0.93	0.94	50
weighted avg	0.95	0.94	0.94	50

Accuracy and Loss:

	Train	Test
Loss	0.355975	0.215994
Accuracy	0.913043	0.940000

3. ResNet50

Confusion matrix:

[[11 8]

[8 23]]

Classification report:

	precision	recall	f1-score	support
0	0.58	0.58	0.58	19
1	0.74	0.74	0.74	31
accuracy			0.68	50
macro avg	0.66	0.66	0.66	50
weighted avg	0.68	0.68	0.68	50

Accuracy and Loss:

	Train	Test
Loss	12.047807	13.014296
Accuracy	0.549407	0.680000

Conclusion

After observing the results from the three models, we can clearly conclude that VGG19 provides the best results among the three models. Even though InceptionV3 has a higher accuracy, yet there is a discrepancy between the accuracy of its train data and test data such that the accuracy of the test data is higher than the accuracy of the train data. This discrepancy occurred due to the number of epochs used for the model, which were not enough for the InceptionV3 model to give a more accurate result. On the other hand, the ResNet50 model gives quite a poor accuracy along with a discrepancy between its train data and test data. Overall, we can conclude that VGG19 has fitted data along with a good accuracy and no discrepancies.

References:

- https://www.kaggle.com/datasets/navoneel/brain-mri-images-for-brain-tumor-detection?resource=download
- https://www.kaggle.com/code/justicevil/detect-brain-tumor-vgg19-inceptionv3-val-acc-100#2.-Loads-Images
- https://www.kaggle.com/code/chandanakuntala/detect-brain-tumor-vgg19
- https://www.kaggle.com/code/devnithw/brain-tumor-detection-using-neural-network
- https://www.sciencedirect.com/science/article/abs/pii/S0893608020300940
- https://www.mdpi.com/2076-3417/12/14/7282/pdf
- https://arxiv.org/abs/1409.1556
- https://arxiv.org/abs/1512.03385
- https://arxiv.org/abs/1512.00567