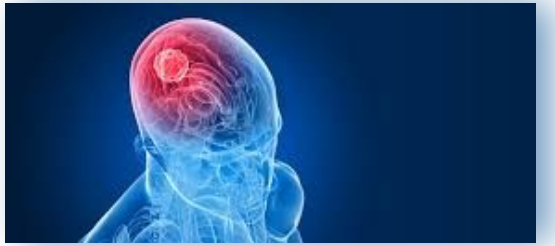


Brain Tumor Classification

Sabra Mabrouk

Problem Statement

- Manual interpretation
  - time-consuming
  - prone to errors

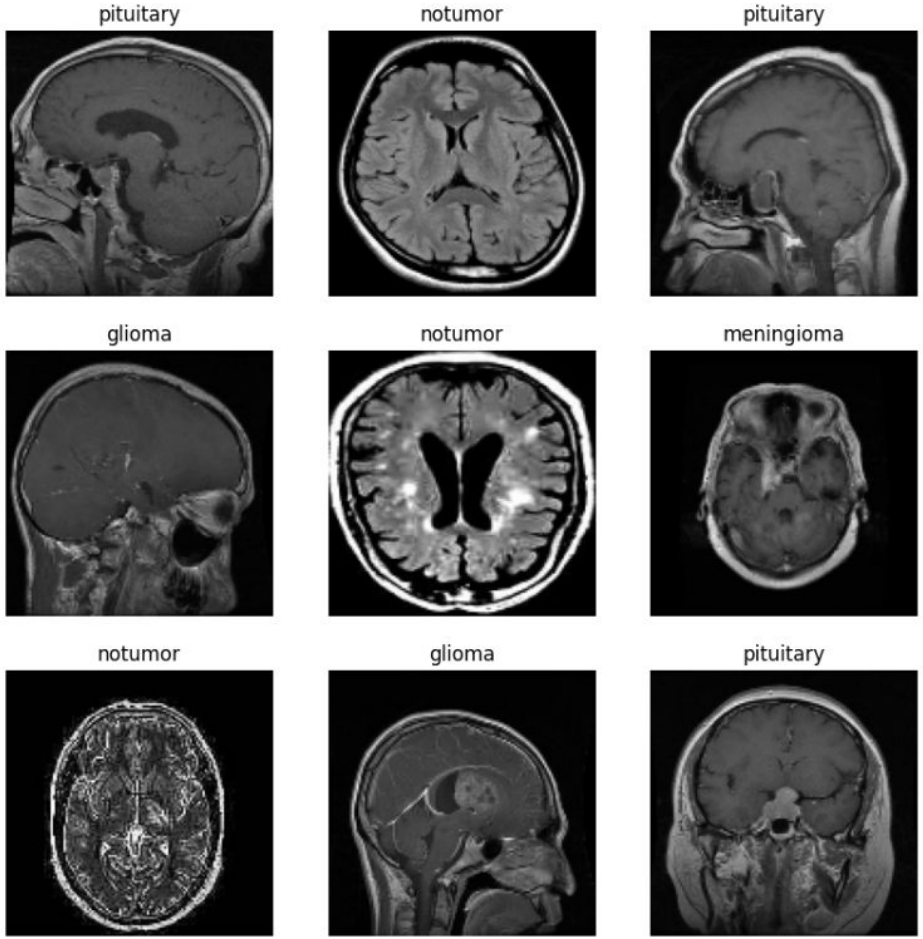
- Increasing number of MRI scans → **Automated solution**

Develop a deep learning-based model that can automatically classify brain tumors into multiple categories to assist in the early detection, diagnosis, and treatment planning for patients

Dataset

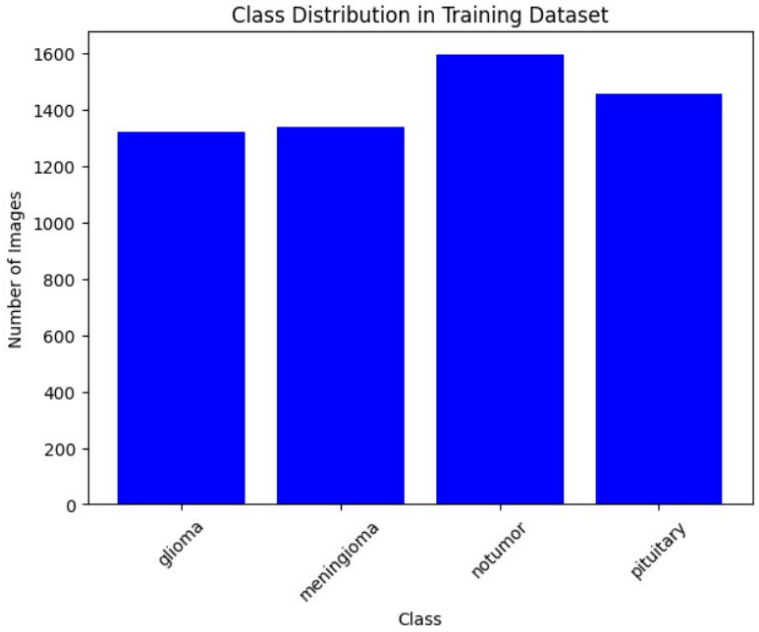
- Dataset : 7023 human brain MRI images
  - Training dataset: 5712 images
  - Testing dataset: 1311 images

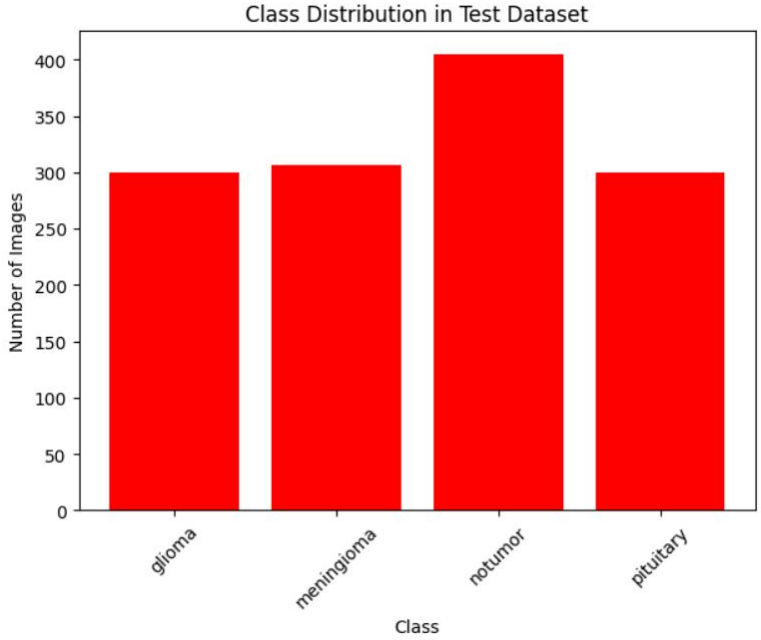
- 4 classes :
  - Glioma
  - Meningioma
  - Pituitary
  - No tumor



Exploratory Data Analysis

Class distribution

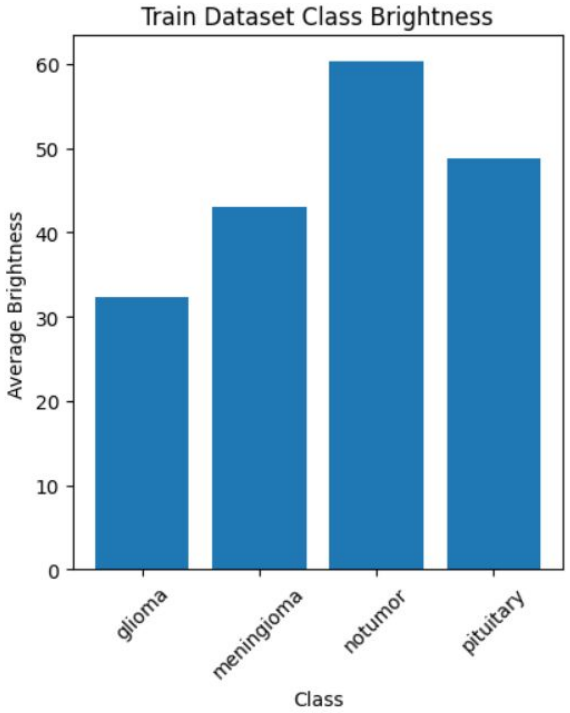


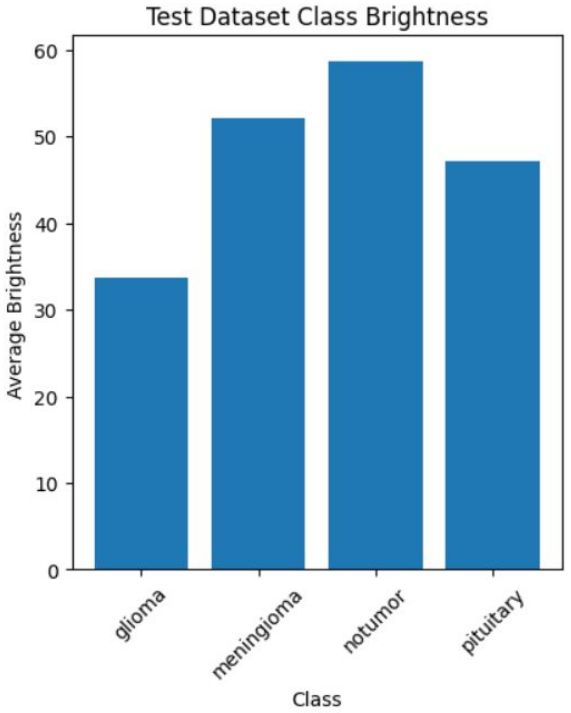


Exploratory Data Analysis

Image brightness

Images in the glioma class are darker than the other classes

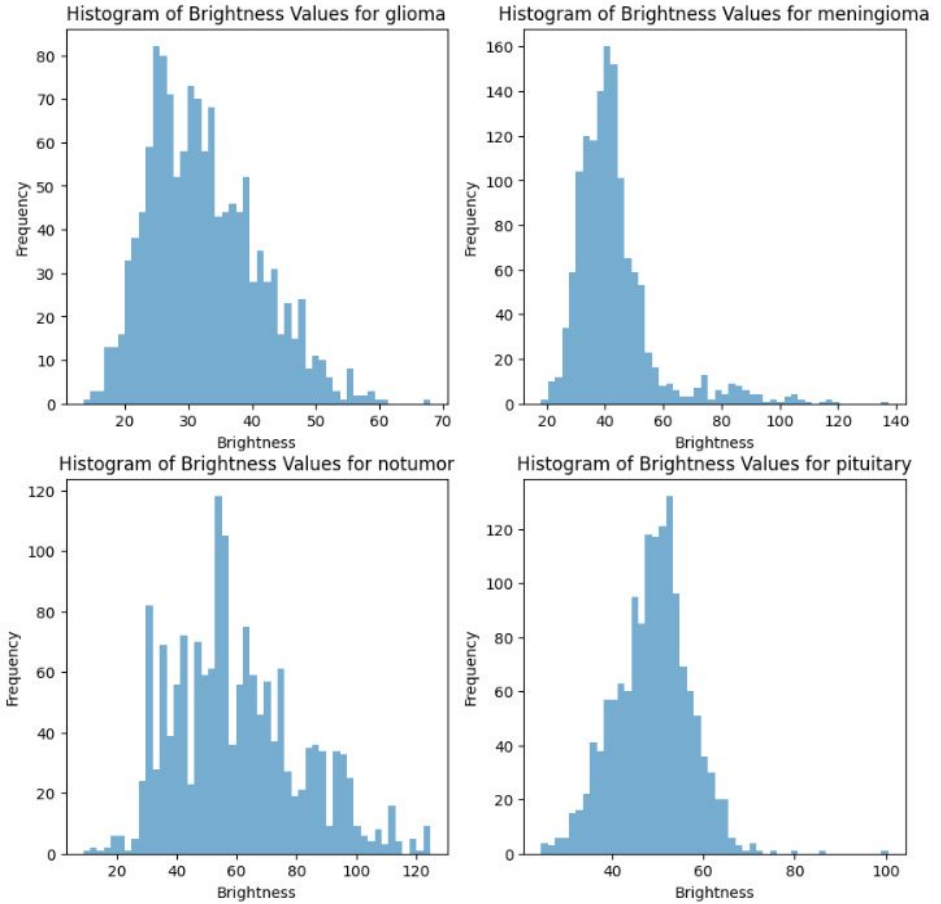




Exploratory Data Analysis

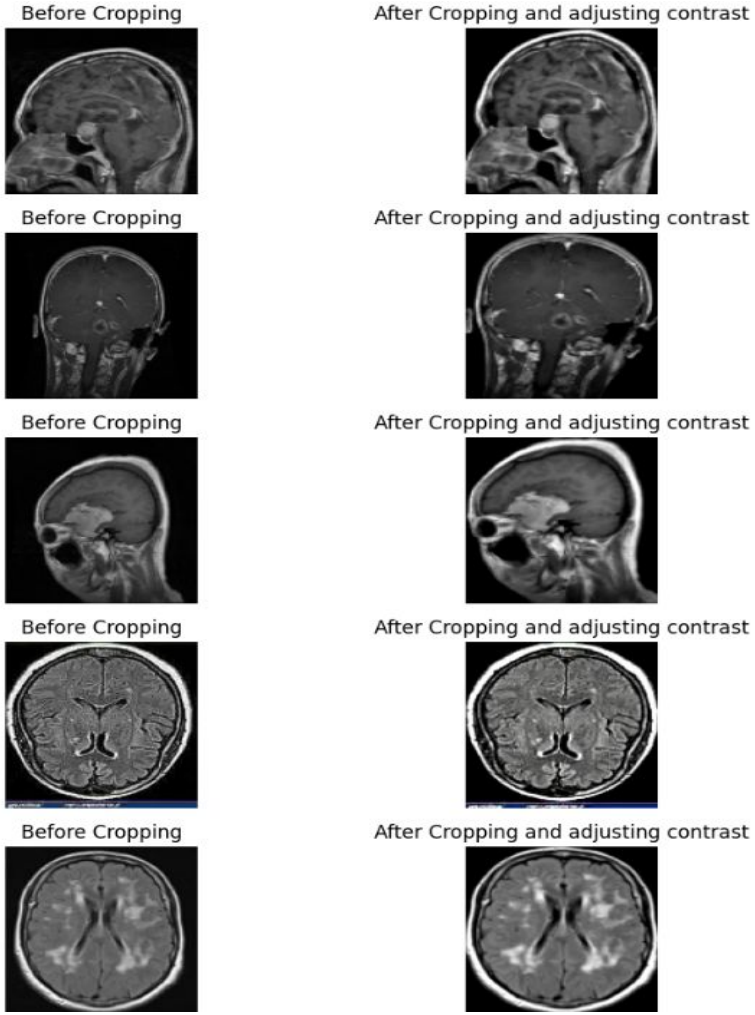
Histogram of brightness

Poor contrast for the Meningioma and pituitary classes

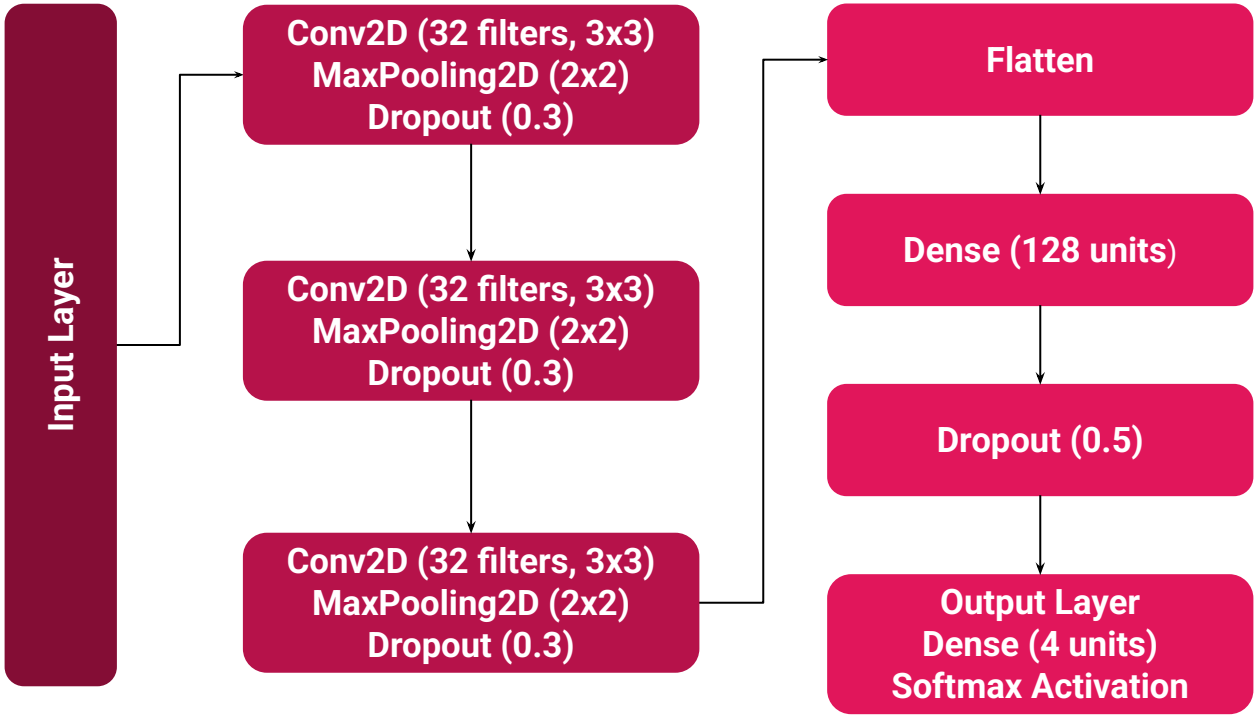


Preprocessing

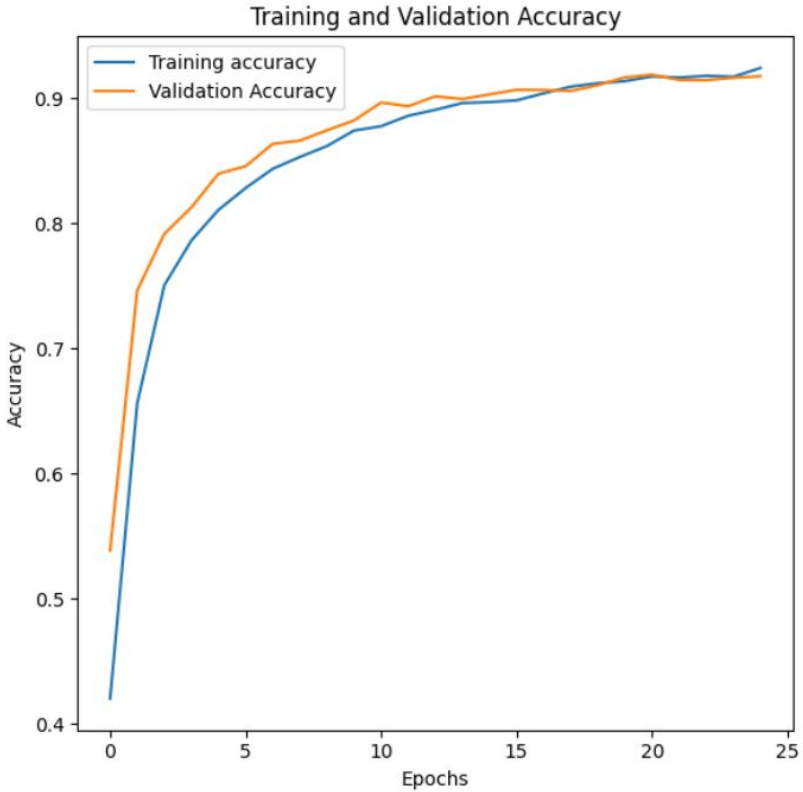
- One hot encoding labels
- Filter images : 5x5 Gaussian filter to reduce noise
- Cropping images: focus on the brain area
- Adjusting contrast: enhance the image quality
- Normalize image to [0,1]
- Resizing images to 125x125

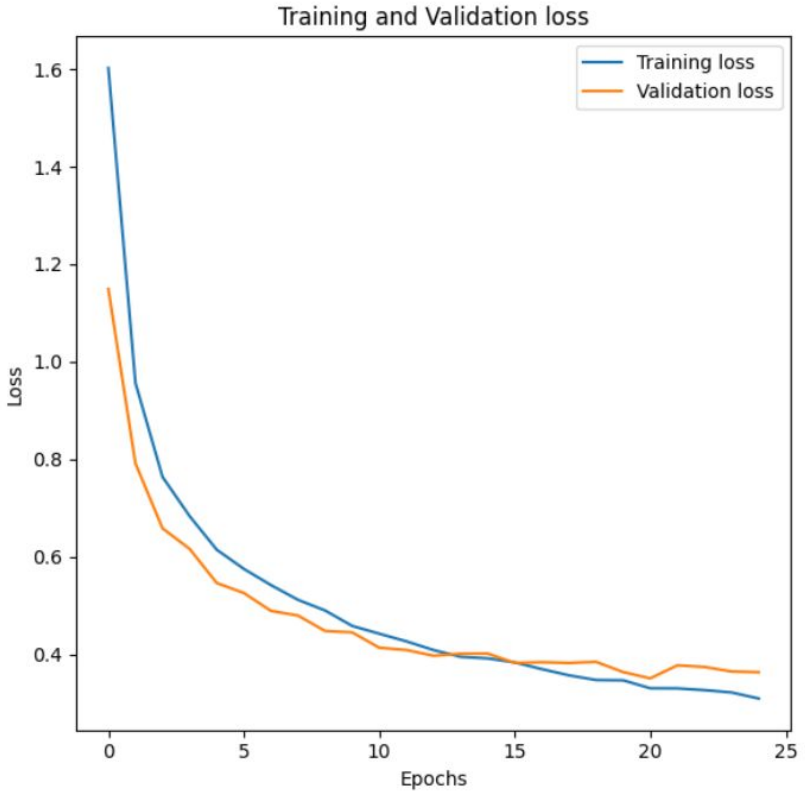


Modeling


Input Layer
Conv2D (32 filters, 3x3)
MaxPooling2D (2x2)
Dropout (0.3)
Conv2D (32 filters, 3x3)
MaxPooling2D (2x2)
Dropout (0.3)
Conv2D (32 filters, 3x3)
MaxPooling2D (2x2)
Dropout (0.3)
Flatten
Dense (128 units)
Dropout (0.5)
Output Layer
Dense (4 units)
Softmax Activation

Modeling


Training and Validation Accuracy
Training accuracy
Validation Accuracy
Accuracy
Epochs
0.4
0.5
0.6
0.7
0.8
0.9
0
5
10
15
20
25


Training and Validation loss
Training loss
Validation loss
Loss
Epochs
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
5
10
15
20
25

Evaluation

- The test set was preprocessed similarly to the training set
- Results

```
Test Loss: 0.33943164348602295
Test Accuracy: 0.91796875
```

Hyperparameter tuning

The tuned parameters are:

- The number of filters in the 3 convolutional blocks
- The dimensionality of the output space in the dense layer
- The learning rate of the optimizer “adam”

The best parameters are:

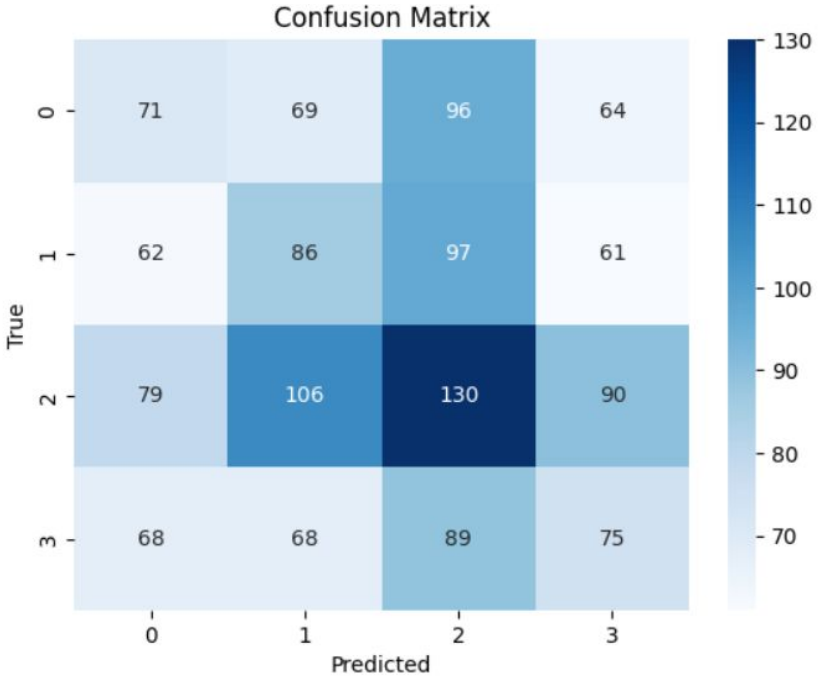
- 'filters_1': 64, 'filters_2': 64, 'filters_3': 512,
- 'dense_units': 256,
- 'learning_rate': 0.00022146929820420383

Mean validation accuracy cross folds	Standard deviation of validation accuracy across folds
0.953	0.013

Limitations

Reliability of the model ?

Metric	Value
Precision	0.272
Recall	0.272
F1 score	0.272
AUC-ROC	0.5



Conclusion

- Objective: classify brain Tumor MRI into 4 classes
- Trained CNN model:
  - 3 convolutional blocks with progressively increasing filter sizes and depths containing
    - Convolutional layer,
    - A max pooling layers to reduce spatial dimensions and retain important features.
    - A dropout layers to help mitigate overfitting
  - A layer to flatten the features into a one-dimensional vector
  - A dense layer with ReLU activation.
  - A softmax output layer is used for classification
- Results after tuning
  - High accuracy rate of 91%.
  - Poor recall rate 27%

Future work

- Generate more data: use data augmentation techniques (Rotating, shifting, flipping, Shearing, etc)
- Increase model complexity: adding more layers or more neurons in the dense layers.
- Tune more hyperparameters (batch size, dropout rate, etc)

Thank You!