Brain Tumour MRI Image Classification using Deep Learning

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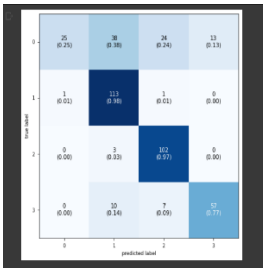

	precision	recall	f1-score	support
0	0.96	0.25	0.40	100
1	0.69	0.98	0.81	115
2	0.76	0.97	0.85	105
3	0.81	0.77	0.79	74
accuracy			0.75	394
macro avg	0.81	0.74	0.71	394
weighted avg	0.80	0.75	0.71	394

MODEL NAME	TRAIN ACCURACY %	VALIDATION ACCURACY %	TRAIN LOSS %	VALIDATION LOSS %
VGG16	0.99	0.72	0.02	3.85
VGG19	1.00	0.79	7.23	10.12
ResNet50	1.00	0.78	1.19	4.60
Xception	1.00	0.75	0.01	8.69
EfficientNetB0	1.00	0.77	0.002	2.71

Xception Model's Confusion Matrix: Xception Model's Classification: Report Overall Performance Metric Report:

INTRODUCTION

According to a New Zealand Ministry of Health (MoH) report, 7 per 100,000 males and 5 per 100,000 females are dying due to brain tumors each year in New Zealand. Brain tumors are hard to diagnose as they do not present any unique symptoms. Research from cancer.net and NZ MoH states that males, older people, non-Māori, and those who are exposed to chemicals and radiation are more susceptible to developing a brain tumor. Unfortunately, many countries lack the medical resources, including both trained doctors and equipment, to detect and diagnose brain tumors. This can lead to fatalities as a result. Our app attempts to address these problems using deep learning techniques to detect various types of tumors from MRI images of the brain. This may lead to speedy diagnoses, medication, and recovery.

Methodology Used

This project was developed using the Cross-Industry Standard Process for Data Mining (CRISP-DM). CRISP-DM methodology is very similar to Agile but, an Agile for a Data Science project. This methodology has six phases, namely: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Deployment. CRISP-DM methodology was highly beneficial because it provided functional templates for the development phase and, it was flexible and robust. Our project included all the phases within the CRISP-DM. Therefore, by using this CRISP-DM's template we could achieve all project objectives.

Project Outcomes

Pre-processed all the images into 224 x 224 pixels from the original image size

- Built five image classification models: VGG16, VGG19, Xception, ResNet50, EfficientNetB0
- Built Web Application using HTML, CSS, and JavaScript
- Choose the best model as Xception based on validation accuracy, recall, F1-Score, Precision, and Support Score
- Integrated Xception Deep Learning AI model with the Web application using the Flask Framework

Recommendations for future development

A Data Science project's efficiency is directly proportional to the amount of data that was used to build the project. To complete this project, we used a total of 3000 images belonging to four tumor classes. In the future, we could increase the efficiency of the overall project by bringing in new images, especially of the Glioma Tumor class. We could also increase the project's efficiency by building new custom CNN, R-CNN, and other deep learning models. Currently, we are

Results

We created five different Image Classification AI models for this project namely: VGG16, VGG19, ResNet50, Xception, and EfficientNetB0.

Out of the five models, we choose the Xception model as the best one based on the validation accuracy score, Recall, F1-Score and Support and integrated it with the Web application.:

While building the Deep Learning AI models, we found that all the five models performed poorly when trying to predict the 0^{th} class i.e., the Glioma Tumor Class. This issue could be addressed by including new images of the Glioma Tumor class and training the model again.

Overall, Xception model performs well in predicating the MRI images with tumor and their types.

The Web application was built on the Flask Framework which is a robust framework and has a very low latency rate. Building the Web App using Flask allows the users to deploy the app easily to the cloud services or hosting platforms.