https://github.com/jgloe/MRI_Classification Canva presentation Google Colab Notebook

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MRI Tumor Classification

OVERVIEW

Cancer research and detection is among the most important fields of medicine. Early detection of tumors is crucial for maximizing life expectancy and quality of life, particularly for brain cancer. Magnetic resonance imaging (MRI) is a powerful technique that measures a cross section of the brain and produces an image which can be used to detect anomalies such as tumors. While classification was historically done by humans, image recognition can be performed by Convolutional Neural Networks (CNNs). In this project, we applied several CNN architectures to the problem of classifying four types of tumor states based off of an MRI data set, compared their results and suggested future directions for this work.

GOALS

1. Can we classify brain tumors using MRI data? -Benign or malignant
2. If so, can we accurately classify among four classes: glioma, pituitary, meningioma, and no-tumor control?
3. Could we establish which model holds higher accuracy, precision, and recall?

RESULTS & STRATEGIES

AlexNet

AlexNet was trained for 25 epochs using a loss function of categorical cross entropy and an optimizer of stochastic gradient descent. It resulted in a validation accuracy of 93.9% and precision and recall over 90%.

EfficientNet V2

EfficientNetV2-XL-21k was trained for 25 epochs, leading to an accuracy of: 90.18% on the validation dataset, a precision of: 67.31%, and a recall of: 98.60%.

Other models: VGG-16, MobileNet, ResNeT

Three other CNN models were trained: VGG-16, MobileNet and ResNet. The former two models obtained greater than 90% accuracy, recall and precision after 10 epochs, however ResNet performed less well with oscillatory behavior observed as a function of epochs. More analysis and tuning of hyperparameters needs to be performed to optimize ResNet to better classify these data.

FUTURE ITERATIONS

Overall, these models can be improved with the addition of new data as well as performing data augmentation. More time could be spent tuning hyperparameters and testing a variety of loss functions.

This work can be applied in hospitals to more quickly, accurately and cheaply diagnose brain tumors, giving patients the best chances of survival and allowing medical facilities to more efficiently allocate scarce resources.