Multi-Class Alzheimer Classification using CNN

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What is the problem?

Alzheimer's disease is the most common type of dementia. The disease is gradual, starting with mild memory loss and potentially progressing to the loss of communication and environmental awareness. The brain regions that are responsible for thought, memory, and language are affected by Alzheimer's disease. The severity of each stage of Alzheimer's dementia, such as Non-Demented, Very Mild, Mild, and Moderate, will be predicted. Since there is no treatment for this condition, it can be used to diagnose the symptoms early and to prevent the initial use of medications that can cause side effects.

Why is it interesting?

A healthy brain has an appropriate amount of the chemical Acetylcholine. Reduced levels of the chemical itself as well as a loss of the nerve cells that respond to and use Acetylcholine are two problems in an Alzheimer's patient's brain. One of the treatments recommended for persons with mild to severe Alzheimer's disease is Memantine. According to studies, between 40 and 70% of those who take the medications have some sort of relief, with symptoms temporarily improving for 6 to 12 months. Cognitive stimulation treatment is an alternative diagnostic that is used. It is intended for those with mild to severe dementia. We want to create a model that can identify Alzheimer's at an early stage and anticipate the disease's progression because there are currently few diagnostic options for this condition.

What is the approach you propose to tackle the problem?

A classification model will be built that can accurately determine the level of dementia of an Alzheimer's patient from their MRI image. Our approach will be based on the given below steps:

- Feature Engineering: We are working with categorical and non-continuous data, we want to convert our labeled data into one-hot encodings. One-hot encodings are a way for the model to understand that we're looking at categorial instead of continuous data.

- Model Training: A Convolutional Neural Network will be implemented from scratch to classify MRI Images. Appropriate performance metrics like the F1- Score and AUC Score will be used to evaluate the model performance.

- Model Testing: Our model will be tested on a labeled Test dataset and Error-values will be calculated by comparing the predicted and the given image labels. F1-Score will be considered as a performance metric for model testing. The implemented CNN model will be compared with the State-Of-The-Art ResNet50 model with given performance metrics.

Why is the approach a good approach compared with other competing methods?

In order to reduce the need for feature extraction and automate the procedure, deep learning could be used as a feature extraction method. Instead of using DenseNet, which only adds a few new features and has incredibly narrow layers and a slow computation time where ResNet50 has shown that numerous contributing layers can be dropped. In order to automatically extract features from MRI images to classify Alzheimer, we will be using a CNN model (ResNet50).

What are the key components of my approach and results? Also, include any specific limitations.

We can train a better model and avoid the problem of decreasing gradient descent by building a model from scratch, using callbacks to control our learning rate, and stopping our model once it converges. The learning rate is a very important hyperparameter in the model and stopping our model early is one mechanism that prevents overfitting. There are some limitations in our approach, which could be like using a high learning rate will prevent the model from converging while having a learning rate too slow will increase our computational time.

References

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