Tech Stack

1. Pytorch
2. Numpy
3. Pandas
4. FastAi
5. Google Cloud Platform
6. OpenCV
7. Matplotlib
8. React.js
9. Flask
10. Python
11. Nodejs
12. Babel
13. Gulp

Description of Proposed Idea

Alzheimer's disease, a neurological disorder in which the death of brain cells causes memory loss and cognitive decline, is a geriatric disease or the one that is common amongst old people. Our idea aims at helping people detect the onset early along with providing help in monitoring the progress in people with Alzheimer's. We provide a deep learning based solution in detecting and segmenting the affected parts of the brain in MRI images. The MRI images are taken from the ADNI dataset. The trained deep learning model(s) will be hosted on a server and can be accessed by a front-end(web/mobile app) . The said approach helps the medical industry by speeding up the diagnosing process thereby prioritizing treatment . A well trained model can perform like an expert practitioner, and our objective will be to reduce the trade-off between speed and accuracy.

The Machine Learning backend of our Software

We propose to implement a deep-learning framework that will segment the affected part of the brain in the MRI scans. We will be using a U-Net model, which is an encoder-decoder model that will extract the features by downsampling the MRI image in the encoder block while the decoder will use those features to generate a segmented map labelling the affected regions of the brain. Connecting links will be present between the encoder-decoder to avoid loss of information.

The loss function we will use is a weighted average of Soft Dice Loss and Focal Loss. Focal loss tries to down-weight the contribution of easy examples so that the Convolutional Neural Network focuses more on hard examples. The Dice coefficient

is essentially a measure of overlap between two samples. This measure ranges from 0 to 1 where a Dice coefficient of 1 denotes perfect and complete overlap. Soft dice loss is simply, 1 -Dice coefficient, and can be minimized.

To evaluate our model, the metric we will use is ROC-AUC score, which is an intersection over union score of two matrices.

We will train 4 different models on 4 different Google Cloud virtual machines each with a Nvidia Tesla T4 GPU . The models will be trained on the metrics and loss functions discussed above. The best performing model will be hosted on a server. We will be using a two step approach,

1. Classify the image as Alzheimer's positive or negative
2. If positive , segment the image for the degenerate regions

The dataset used will be a subset of the ADNI dataset which consists of brain scans of people with Alzheimer's all over the world. We will be generating heat maps to ensure that the model is looking into the affected portion to make its conclusions.

The Web App Frontend of our Software

To deploy the ML model for production there will be a web app. The front-end will be developed in React and would include a single page which will take MRI images as input. These images will be fed into the trained model which will be running on a virtual machine running on the cloud.

The back-end is developed in Flask, a micro-framework written in python.

We will create two files,

1. Server.py
2. Request.py

In the server.py, we will code to handle POST requests and return the segmented images along with the label positive or negative. The request.py will send requests with the inputs to the server and receive the results to expose them.

For the authentication purpose, there will be a login and signup process.

Use Cases

The solution we have provided provides a helping hand to the few specialized physicians who are handling an increasing number of patients with Alzheimer's. It

should be noted that the only step needed in using our approach in the real world is a medium to send requests to the server. Thus once this step is done, there'll be little to no help needed in maintaining the model. The MRI scans that are sent to the server can be saved there for increasing the size of the dataset which helps in updating the model. This can be done by the admins of the server(us) without any trouble to the organization using our solution. With help from expert practitioners, this solution can be used even in places where specialised healthcare services are not possible. The solution is aimed at healthcare organizations . The chief physician of an organization can handle the monitoring while all the subordinates can work on treatment. This approach saves the valuable time of both patients and doctors. Depending on how high the organization is going to keep the price for their services, the cost might increase or reduce for the patients , while it's definitely a profit for the healthcare industry as a whole. We believe the government will help in regulating the prices of such AI based services keeping the healthcare industry from exploiting the technology.