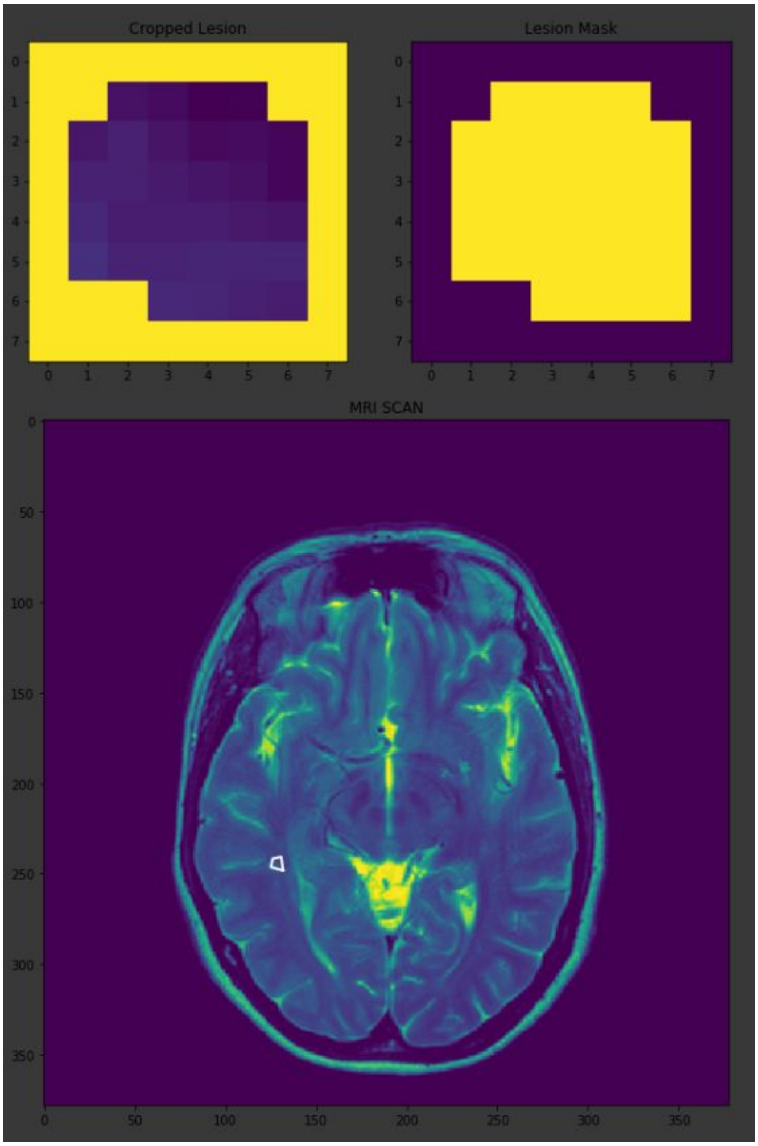
MULTIPLE SCLEROSIS REPORT WEEK 1

1. Download the dataset. Make sure that you are able to visualize MRI scans and read *.plq files with lesion coordinates and cropped views. The example is in the attached notebook.

Ans: Walkthrough is done on my notebook. Every single analysis of the dataset consists of a ‘bmp’ file containing the actual MRI scan image whereas the ‘plq’ file is a file having information about the coordinates of the lesion along with the lesion mask.

2. Describe the attached picture. What is the region highlighted on MRI scan, and how is this scan connected to the MS disease?

Ans: I visualized the dataset, understood the meaning of the different files and the column on the excel sheet.



The entire image can be divided into three parts.

a. The top left image is a part of the actual image cropped from the MRI scan. This is the lesion on the brain which is manually segmented.
b. The top right image is the image mask. A mask is a matrix which when operated with the image in a Convolutional manner will give either an restored image, an equalized image or a segmented image. In this particular case, the mask gives us the segmented part of the brain having the lesion.
c. The bottom image is the entire T2 MRI scan of the brain of a patient with a mark at the location containing the lesion and which has been highlighted with a white outline.

MS stands for Multiple Sclerosis, which is a demyelination(Myelin is an insulating layer in our nerves) disease that affects the brain, the spinal cord or the optical nerve. This disease affects vision, balance, muscle control and other basic functionalities of the body. Lesions are formed on the brain white matter which is often referred to Normally Appearing White Matter(NAWM) in contrast to Normal White Matter(NWM). The detection of Multiple Sclerosis is done using T2 MRI scan where T2 is a sequence used in microwave imaging. In this paper, the authors have connected the disease with the patients being diagnosed with CIS(Clinically Isolated Syndrome), which is a disease course of MS caused by the inflamation or demyelination of the myelin in the brain.

3. What is the target variable in the dataset? What is the meaning of this score?

Ans: The research paper is an attempt to map the T2 MRI scan image to an EDSS score, i.e, the overall paper can be viewed as an EDSS multivariate regression task. Hence, this is the target variable of the dataset.

The EDSS(abbreviation of Expanded Disability Status Scale). This scale was developed by neurologist John Kurtzk. It is a scale in the range of 0.0 to 10 with increments of 0.5 which express the severity of the disease. This can be viewed as a benchmark of the amount of demyelination that has occurred in the patient's brain. Broadly, an EDSS score of 1.0 to 4.5 refers to people who are able to walk without any sort of aid. EDSS scores of 5.0 to 9.5 are defined by impairment to walking.

4. Propose the hypothesis about the lesion features that, in your opinion, can be connected with the further progress of MS disease.

Ans: The paper has actually tried to use Image Processing techniques in order to extract vital information about the image of 0 months and the image of 6-12 months. This extracted information would be used in the multivariate analysis of the problem to map these input features to the EDSS score. The following hypothesis are suggested by me which may change in the course of the project by acquisition of a better understanding of the domain:

a. **Shape features**: There were significant differences found between features like eccentricity of the lesion, major length axis, minor length axis and the convex area of the lesion at 0 month and 6-12 month. Therefore a multi-regressive model can be trained for the above mentioned task. Also, as an alternative, the entire problem can be viewed as a classification task with EDSS scores of 1.0 to 9.5 with increments of 0.5 which will pretty much eliminate the probability of obtaining an outlier at the end of the analysis.
b. **Textural Differences:** There were significant differences between the Textural features of the NAWM and the NWM at 0 month and at 6-12 months. Hence, the various statistical parameters, elements of the Spatial Gray Level Dependence Matrix, elements of the Statistical Feature matrix, the H1 Fractal Dimensional Analysis, Neighbourhood Grey Tone, etc as proposed in the paper. This textural analysis gives us a temporal analysis tool for obtaining the EDSS score and also monitoring the EDSS score with time.

References:

1. https://www.medicalnewstoday.com/articles/37556.php
2. https://www.nationalmssociety.org/What-is-MS/Types-of-MS/Clinically-Isolated-Syndrome-(CIS)
3. https://www.mstrust.org.uk/a-z/expanded-disability-status-scale-edss