Brain Tumor Segmentation and Classification

“ The Gradients”

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Problem Statement

- Segment the tumor part from the MRI scans of brain.
- Identify the kind of brain tumor from categories : Meningioma, Glioma, Pituitary tumor

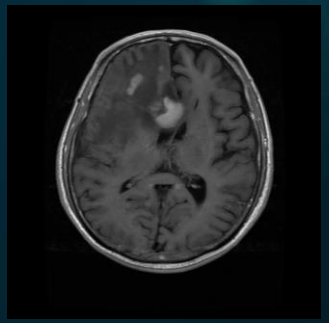
Dataset

3064 T1-weighted contrast enhanced images 512 x 512 x 1

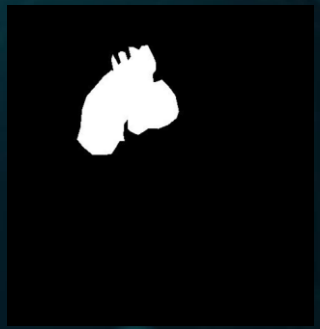
233 patients with three types of tumors

1. Meningioma (708 slices)
2. Glioma (1426 slices)
3. Pituitary tumor (930 slices)

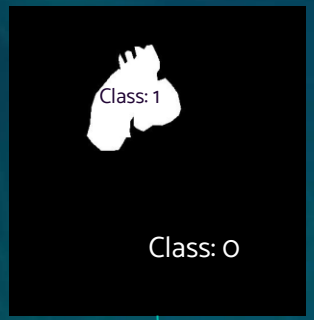
MRI Scan



Tumor Mask



Loss and Evaluation Metric



Unbalanced Classification

- **Imbalance of class at pixel level**

Loss : Binary cross-entropy + Focul loss + Dice Loss

Log loss

Gives more loss for predictions that are far away from actual.

Balances the loss for each class

Metric : Mean IoU

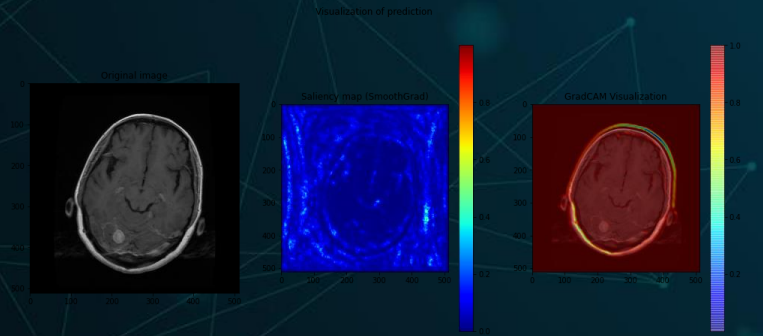
Mean over the IoU of each class (in our case, Tumor region and Non-Tumor region). Therefore It is a balanced metric.

Models and Performance

Base Models Classification

Accuracy was very low i.e., even less than 0.5 — **FFNN**

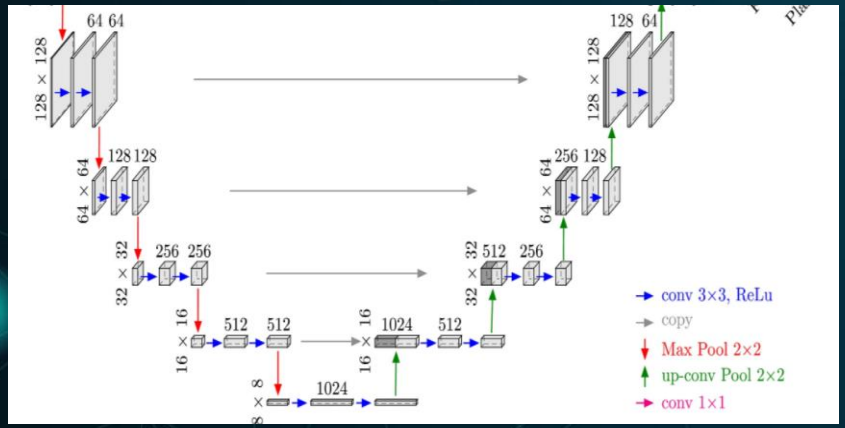
CNN — Got accuracy around 0.8965



- Saliency maps depicts it takes the whole information of brain
- We want the location of tumor and information on tumor for classification
- Led to using semantic segmentation using UNET

Semantic Segmentation

UNET Architecture



- **Precise locations:** Use of skip connections i.e., concatenating output of transpose convolution with feature maps from the encoder of same level

Basic Autoencoder
Loss: 0.532
Mean IOU : 0.8353

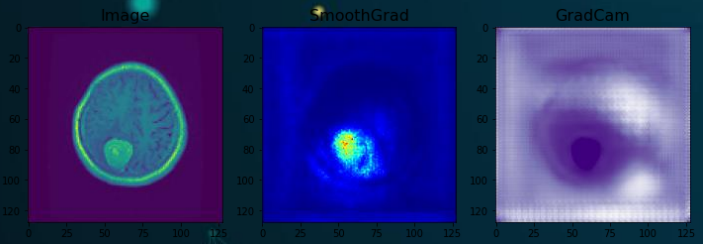
Simple UNET
Loss: 0.3813
Mean IOU : 0.8499

UNET with batchnorm
Loss: 0.3113
Mean IOU : 0.8442

Transfer Learning
Loss: 0.3149
Mean IOU : 0.6266

Classification from encoded layer of UNET

- We want classification based on tumor information
- Trying classification using encoded layer of UNET

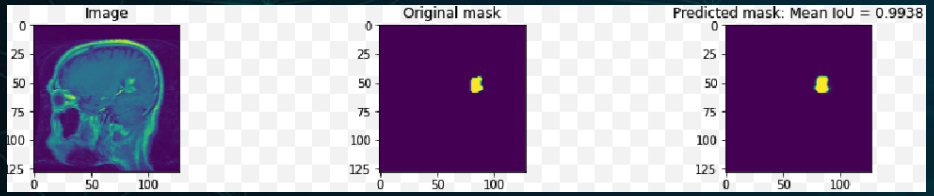


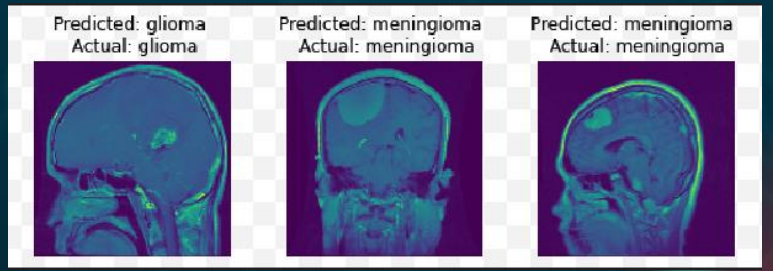
Accuracy: 0.853 — **Simple UNET**

UNET with batchnorm — **Accuracy: 0.9159**

HYPOTHESIS

- We are segmenting the image to the same space dimension, so the information about the location of tumor is preserved

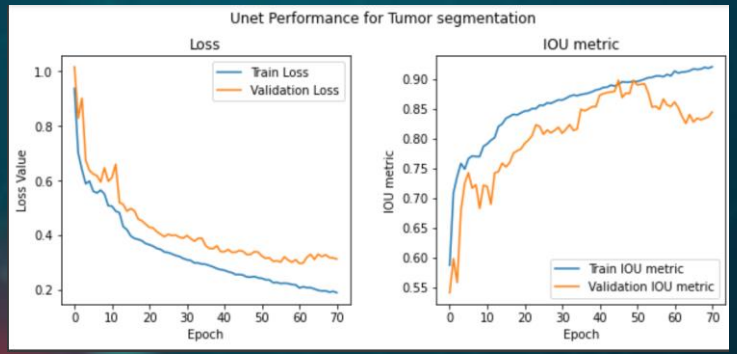




Results

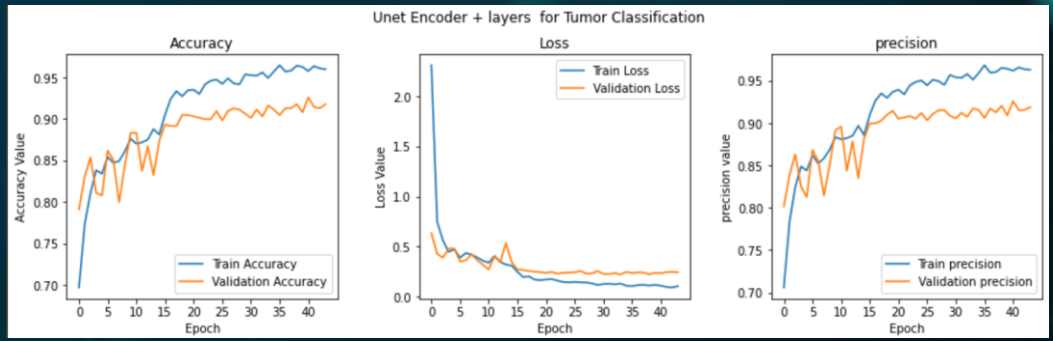
Segmentation

Models	Loss	Mean IOU
Basic Autoencoder	0.532	0.8353
Simple UNET	0.3813	0.8499
UNET with batchnorm	0.3113	0.8442
Transfer Learning - UNET	0.3149	0.6266



Classification

Models	Accuracy
Basic model with FCNN	0.4651
Basic model CNN	0.8965
Simple UNET	0.853
UNET with batchnorm	0.9159



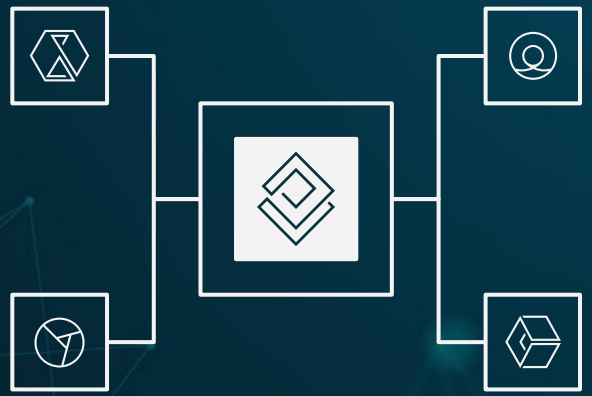
Conclusion and Inference

AutoEncoder

Using Base autoencoder we couldn't achieve the good Saliency map but for UNET we could

Best Model

The model, UNET with batch norm and data augmentation gave the best result for the data



Mean IOU

We have used mean iou metric for segmentation because the tumor and non-tumor pixels are unbalanced

Loss

Addition of three losses give good result compared to using individual loss

IMPROVEMENTS

Improve the Classification

We can try improving the classification part by analysing the incorrect label.

Improve the shape

We can work on improving the shape of the tumor while segmentation

Transfer learning

Train for more epochs since the graph seems improving

Data augmentation

Try with new data and do data augmentation according to the data

THANKS!

Team Members

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