Introduction

- Gliomas are the most commonly occurring type of brain tumors and are potentially very dangerous, with about 90% of Gliomas belonging to a highly aggressive class of cancerous tumors known as Glioblastoma Multiforme (GBM).
- Multi-sequence Magnetic Resonance Imaging is the primary method of screening and diagnosis for Gliomas.
- Tumor regions currently are segmented by expert radiologist, which is time-consuming, expensive.
- Inspired by the success of Convolutional Neural Networks (ConvNets), I developed a novel ConvNet model with spatial-pooling for automated segmentation of gliomas from multi-sequence MRI data.

Problem Statement and Dataset

- MICCAI Brain Tumor Segmentation (BraTS) Challenge 2018 dataset.
- Goal: classify every voxel in the image as either (i) healthy tissue, (ii) necrosis or non-enhancing tumor (red), (iii) edema (green), or (iv) enhancing tumor (yellow).
- Sample: Images of 210 high-grade glioma (HGG), 75 low-grade glioma (LGG) patients.
- Image size: 240X240X155 voxels, contain 4-channels T1, T1 contrast enhanced, T2, and FLAIR images.

Multi-Planar ConvNet with Spatial-Pooling for segmentation

- The ConvNet architecture, used for slice wise segmentation along each plane, is an encoder-decoder type of network.
- The encoder or the contracting path uses pooling layers to down sample an image into a set of high-level features, followed by a decoder or an expanding part which uses the feature information to construct a pixel-wise segmentation mask.
- During the down sampling or the pooling operation network loses the spatial information.
- Up sampling in the decoder network through interpolation produces segmentation error around the object boundary.

Solution: Introduce novel layer called “spatial-max-pooling”, which can retain the max locations to be subsequently used in the un-pooling operation through the spatial-max-un-pooling layer.

Results

- The proposed encoder-decoder type ConvNet model for pixel-wise segmentation performs better than other patch based models.
- Integrated prediction from multiple anatomical planes (axial, sagittal and coronal) performs superior.
- Novel concepts such as spatial pooling and un-pooling reduced segmentation error around the boundary of the VOI.

Conclusion

- Evaluation using dice score =

References