Brain Tumor Segmentation With Deep Neural Networks

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Motivations

- Provide a fast and well-performing segmentation system for brain tumor segmentation
- Compare a Deep Convolutional Neural Network (DCNN) approach to other systems

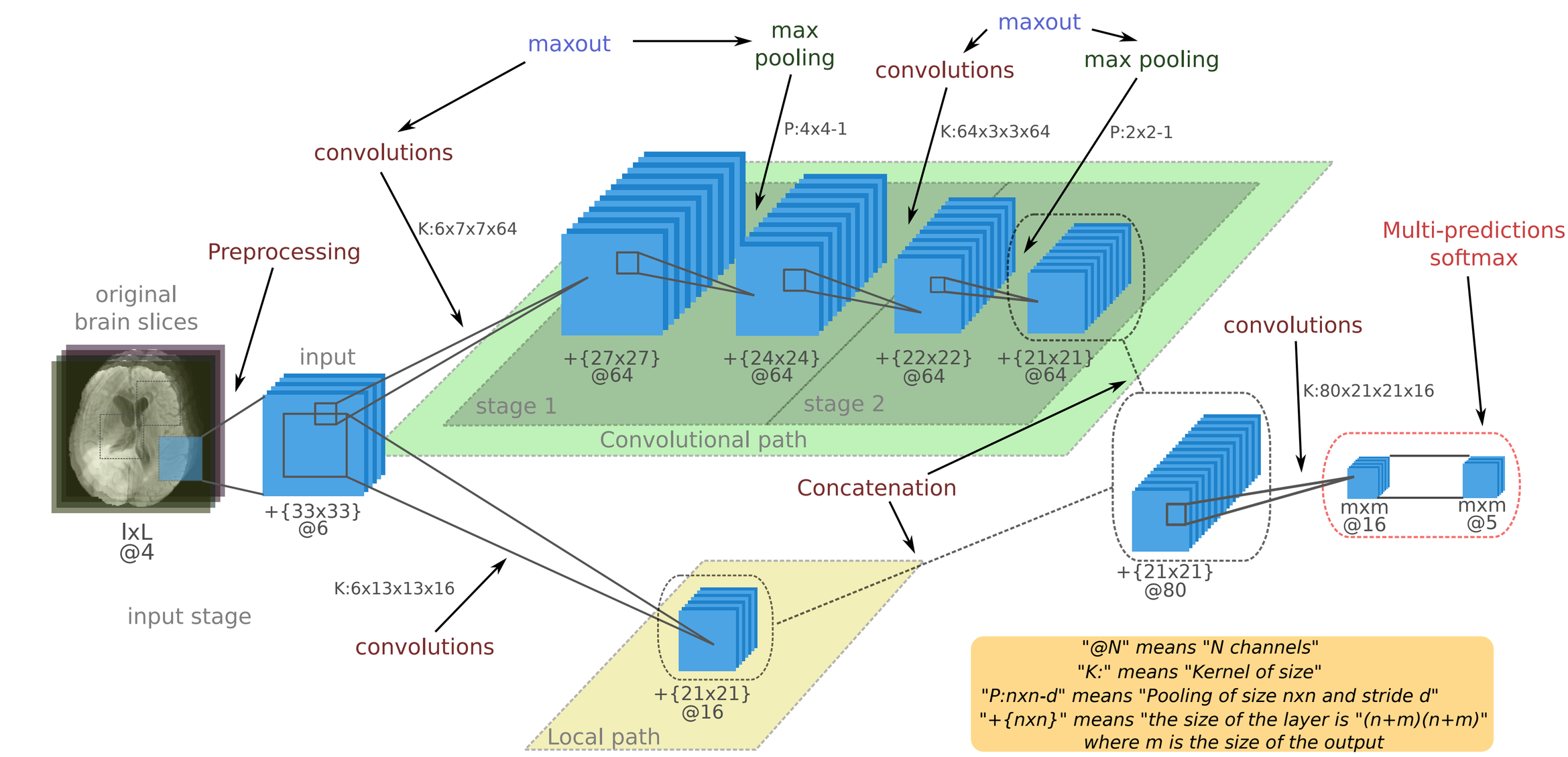
Why Use Deep Convolutional Neural Networks ?

- Able to learn feature representations for new domains and modalities
- Tend to behave particularly well when a lot of data is available
- Have demonstrated state of the art performance for other computer vision problems

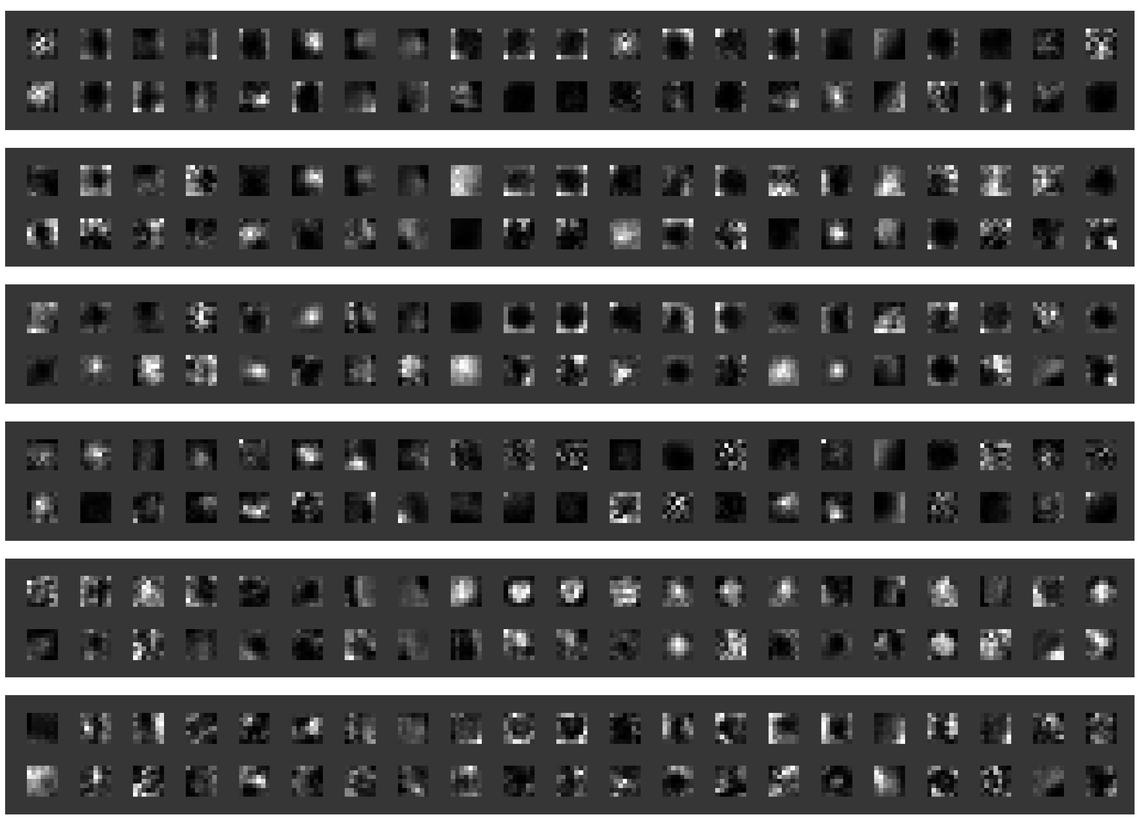
Framework

- We remove intensity outliers of the MRI images ($FLAIR$, $T1$, $T1C$, $T2$)
- We apply N4ITK on T1 and T1c
- We normalize the data per brain and per channel
- We compute two channels ($T1c - T1$, and a channel containing $T1c - mirror(T1c)$, the mirror being applied on a line basis)
- The Neural Network is applied to give a label probability map
- We remove some false positives by removing tumor pieces with unlikely shape

Our Network

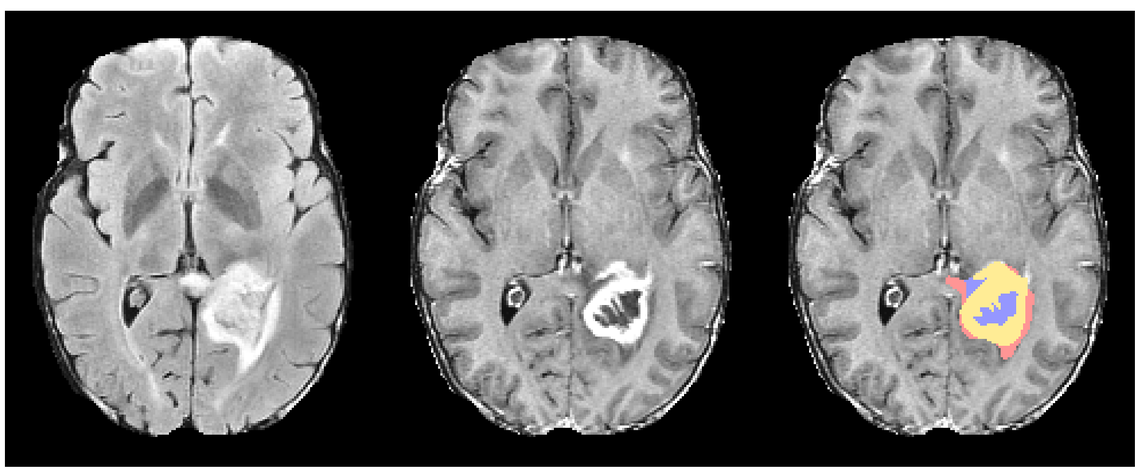


Filters



Extract of some filters learned by the network at the first layer of the 'convolutional path'. From top to bottom, the images are the filters on the different input channels: $FLAIR$, $T1$, $T1c$, $T2$, $T1c - T1$, $T1c - mirror(T1c)$. The filters are grouped by two: The Maxout Convolutional layer does the max over the two filters applied to the input.

Results on BRATS 2013 data



Example of predictions on brain HG_0310 slice 77

Name	Dice score			Positive Predictive Value			Sensitivity		
	Complete	Core	Enhancing	Complete	Core	Enhancing	Complete	Core	Enhancing
Train HG/LG	0.79	0.68	0.57	0.81	0.75	0.54	0.79	0.67	0.63
Leaderboad	0.72	0.63	0.56	0.69	0.64	0.50	0.82	0.68	0.68
Challenge	0.85	0.74	0.68	0.85	0.74	0.62	0.85	0.78	0.77

Results on the 2013 datasets, with a model trained with the 2013 data.

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