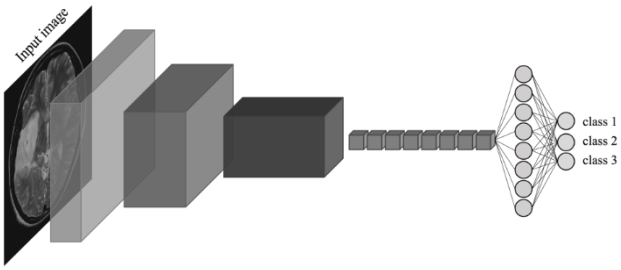
Multimodal AI for brain tumor classification in MR images

Background

Patients diagnosed with brain tumors undergo radical treatment such as surgical tumor resection, chemotherapy and radiotherapy. Radiological images, such as magnetic resonance (MR) images, are currently used in clinics for visualizing the tumor region and tune treatment planning. Having an automatic tool that can perform tumor type classification based solely on MR images could is useful in the treatment of patients with brain tumor. We have earlier performed preliminary analysis of single sequence images that show an acceptable accuracy however if the multiple sequences are combined using multimodal deep learning methods the results will potentially be improved. Therefore, the aim of this thesis is to implement and evaluate a deep learning algorithm that can leverage the information contained in multiple MRI sequences to classify pediatric brain tumor types.



Schematic representation of an MR image (2D) classified by a deep learning model

Data: Latest BRATS (~1000) and U-PENN-GBM (~640). MR images (at least 4 sequences) of 2-5 brain tumor classes. The number of subjects used will depend on the task.

Objectives

1. Review of the available literature to gain insight into the brain tumor type classification problem and how deep learning can be used for such task. There is plenty of literature available.
2. Pre-processing of the available MR images through, for example intensity normalization, and preparing data input pipeline for deep learning model training.
3. Training of a 3D deep learning foundation model suitable for the task and the dataset available.
4. Implementation of at least two fusion methods and compare the results using rigorous statistical methods.
5. Implement and use activation maps to explain the model prediction.
6. Identification and discussion of the challenges faced while implementing and training the deep learning model and suggestion of the future steps for the improvement of the method.

Please note that the tasks are subject to change depending on the results obtained during the workflow. A computer with a 6 core CPU, 64 GB RAM and 2 × Nvidia RTX 2080 Ti graphics cards is available.

Required background:

Interest in medical images, solid knowledge of Python deep learning (PyTorch or TensorFlow)

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