Semantic Segmentation of Multimodal Brain Tumor Dataset (BraTS2020)

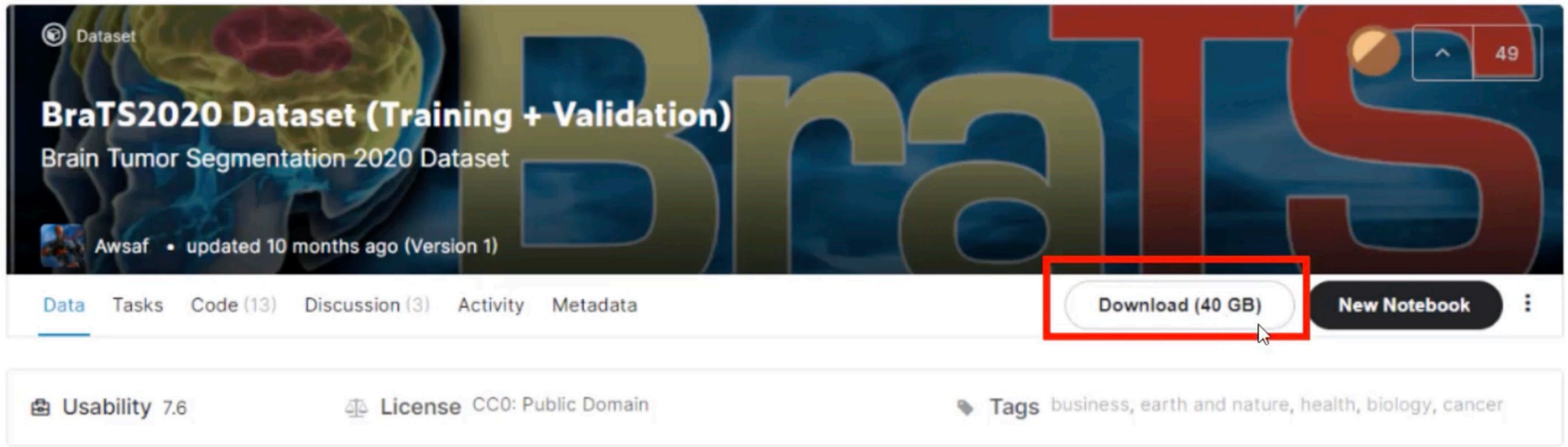
Using 3D U-Net

Multimodal Brain Tumor Segmentation Challenge 2020:
Data

@DigitalSreeni

Dataset information

https://www.kaggle.com/awsaf49/brats20-dataset-training-validation



Description

Context

BraTS has always been focusing on the evaluation of state-of-the-art methods for the segmentation of brain tumors in multimodal magnetic resonance
scans. BraTS 2020 utilizes multi-institutional pre-operative MRI scans and primarily focuses on the segmentation (Task 1) of intrinsically heterogeneous
appearance, shape, and histology) brain tumors, namely gliomas. Furthemore, to pinpoint the clinical relevance of this segmentation task, BraTS'20 als
the prediction of patient overall survival (Task 2), and the distinction between pseudoprogression and true tumor recurrence (Task 3), via integrative a
radiomic features and machine learning algorithms. Finally, BraTS'20 intends to evaluate the algorithmic uncertainty in tumor segmentation (Task 4).

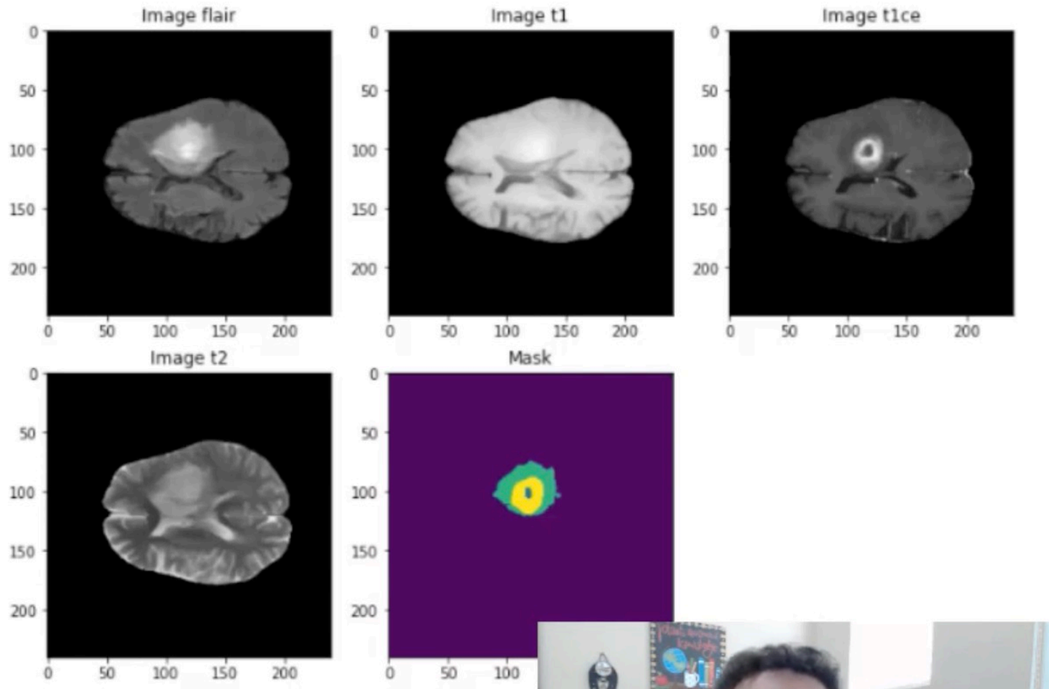
Dataset information

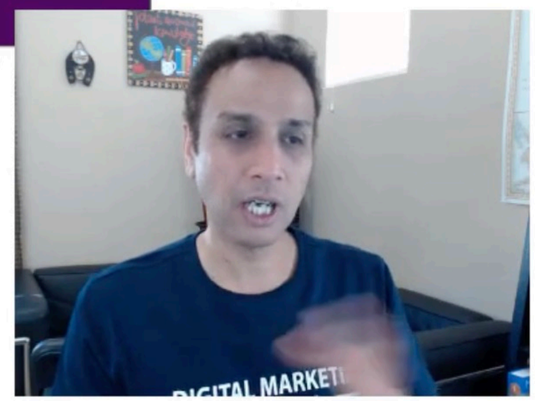
- Multimodal scans available as NIfTI files (.nii.gz)

- Four 'channels' of information – 4 different volumes of the same region
  i. Native (T1)
  ii. Post-contrast T1-weighted (T1CE)
  iii. T2-weighted (T2)
  iv. T2 Fluid Attenuated Inversion Recovery (FLAIR) volumes

- All the imaging datasets have been segmented manually and were approved by experienced neuro-radiologists.

- Annotations (labels):
  - Label 0: Unlabeled volume
  - Label 1: Necrotic and non-enhancing tumor core (NCR/NET)
  - Label 2: Peritumoral edema (ED)
  - Label 3: Missing (No pixels in all the volumes contain label 3)
  - Label 4: GD-enhancing tumor (ET)





Our Approach

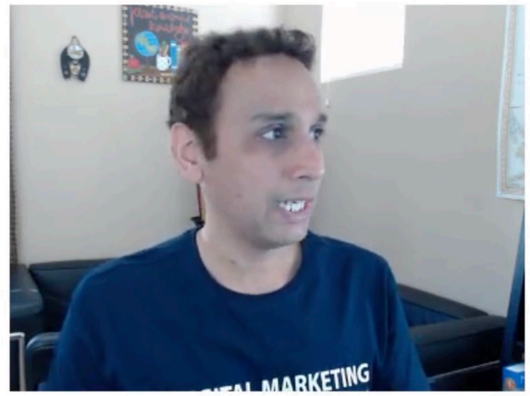
High level steps (details are on the following slides)

Step 1: Get the data ready

Step 2: Define custom data generator

Step 3: Define the 3D U-net model

Step 4: Train and Predict

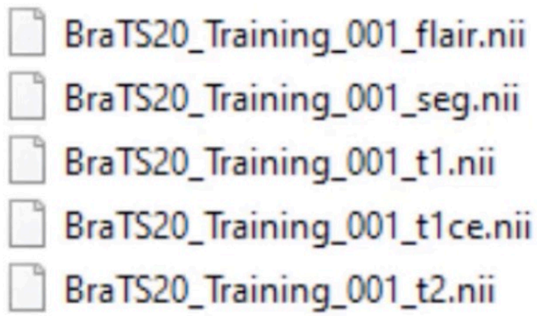


Our Approach

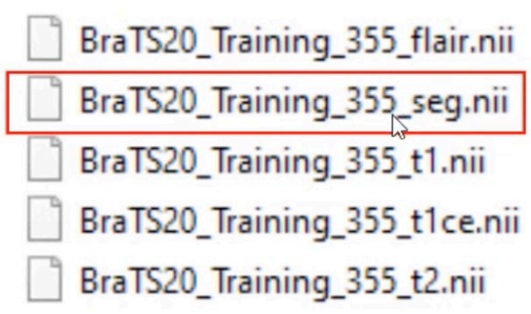
Step 1: Get the data ready

- Download the dataset and unzip it.
- Segmented file name in Folder 355 has a weird name. Rename it to match others.
- Install nibabel library to handle nii files (https://pypi.org/project/nibabel/)

371 such folders



Contents of each folder



Rename the seg file in folder 355 to match others

Our Approach

Step 1: Get the data ready

- Scale all volumes (using MinMaxScaler).
- Combine the three non-native volumes (T2, T1CE and Flair) into a single multi-channel volume.
- Reassign pixels of value 4 to value 3 (as 3 is missing from original labels).
- Crop volumes to remove useless blank regions around the actual volume of interest (Crop to 128x128x128).
- Drop all volumes where the amount of annotated data is less that certain percentage. (To maximize training on real labeled volumes).
- Save all useful volumes to the local drive as numpy arrays (npy).
- Split image and mask volumes into train and validation datasets.

Our Approach

Step 2: Define custom data generator

- Keras image data generator only works with jpg, png, and tif images. It will not recognize npy files. We need to define a custom generator to load our data from the disk.

Step 3: Define the 3D U-net model

- Extend the standard 2D U-Net into 3D OR
- copy the code from online OR
- use 3D segmentation models library

Step 4: Train and Predict

- Train by loading images in batches using our custom generator.
- Predict and plot data for visualization.