Tumor Detected!

MARVLVS

Challenge

Come up with a software solution to a problem of **accidental tumor findings** being missed on regular brain CT scans when visiting the emergency room

Single out slices that have **abnormalities** for the doctor to examine in more detail.

Browser **application** used on the data from emergency room. P

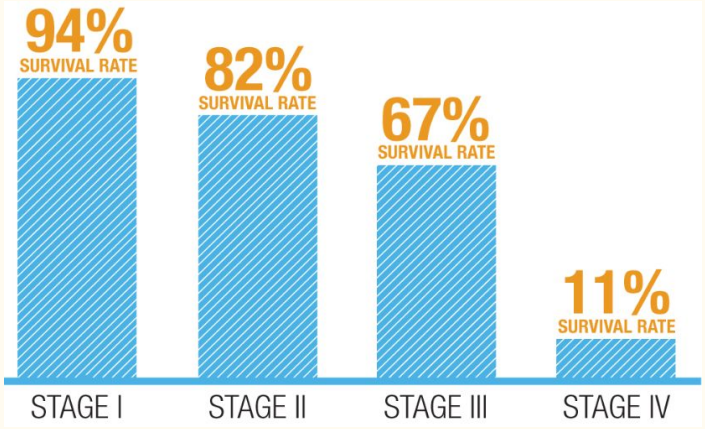
CT is cheaper and faster than MRI.

Practical application

Screening software would single out suspicious slices

Slices are then sent to a **radiologist/oncologist** for further review

Large scale screening method could greatly increase the **cancer survival rate**

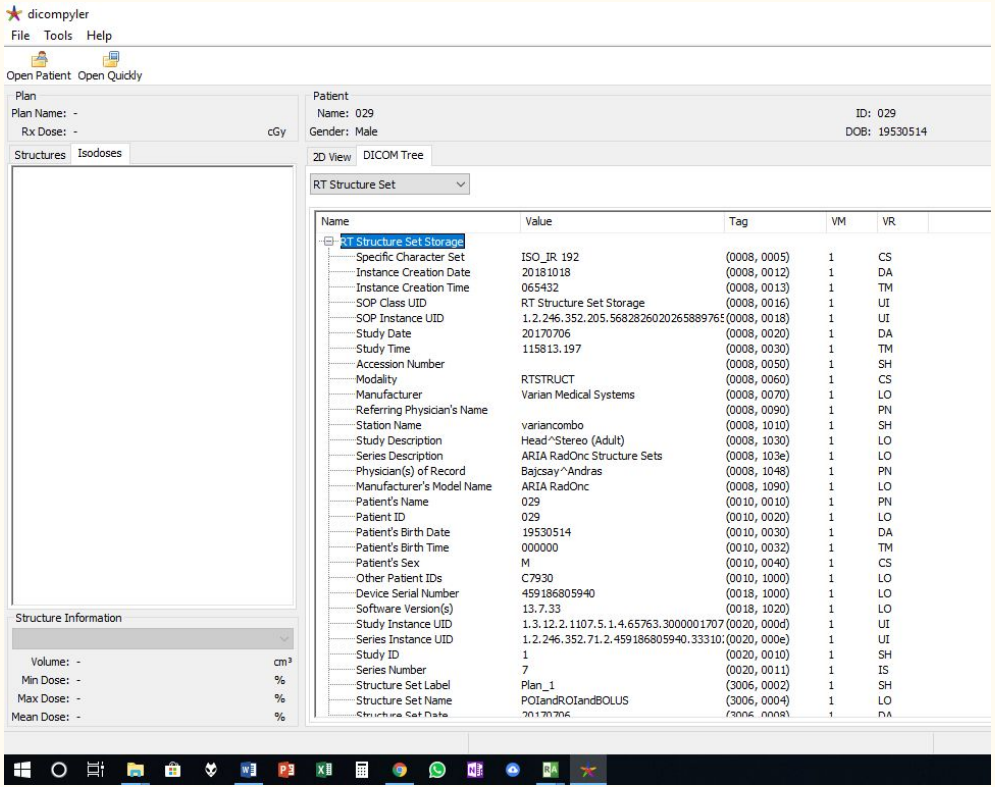


Comparison of two used methods

	Supervised slice classification with CNN	Unsupervised slice ordering based on brain symmetry
Labels required	Yes	No
Data hungry	Yes	No
Recognizes tumors	Yes	No
Robust towards rotation	Yes	No
Train time	Long	Short

Deep Learning Approach

Accessing the data



Preprocessing the data

1) Starting and ending point of each tumor in a CT

2) Resizing (w/ Aspect Ratio) - 224x224 px

3) Associating slices with CT data (FrameOfRefUID)

4) Assigning “Tumor” or “Not Tumor” to slices

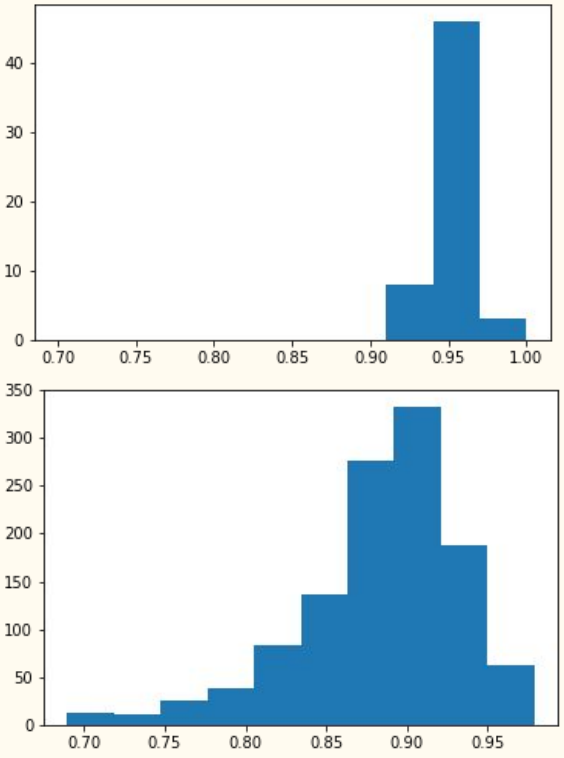
- And muuuch more

Feeding the neural net

- ConvNets - standard for supervised learning with images
- VGG16
- Hungry for data

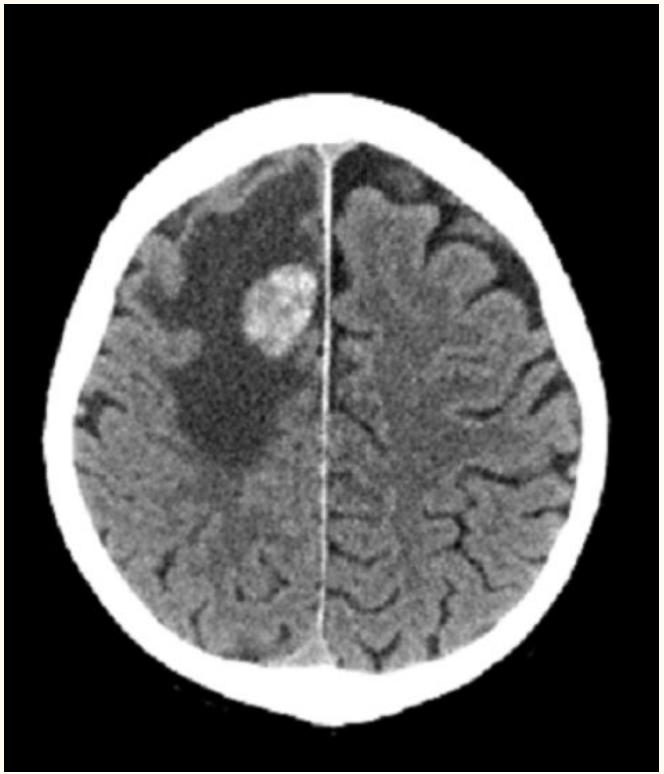
Brain Symmetry Approach

Using brain symmetry for tumor detection



Healthy

With tumors



Using brain symmetry for tumor detection

Recovery of symmetry axis of a mass.

Recovery of linear dependency of two splitted parts.

Table 2: Comparison of different segmentation techniques.

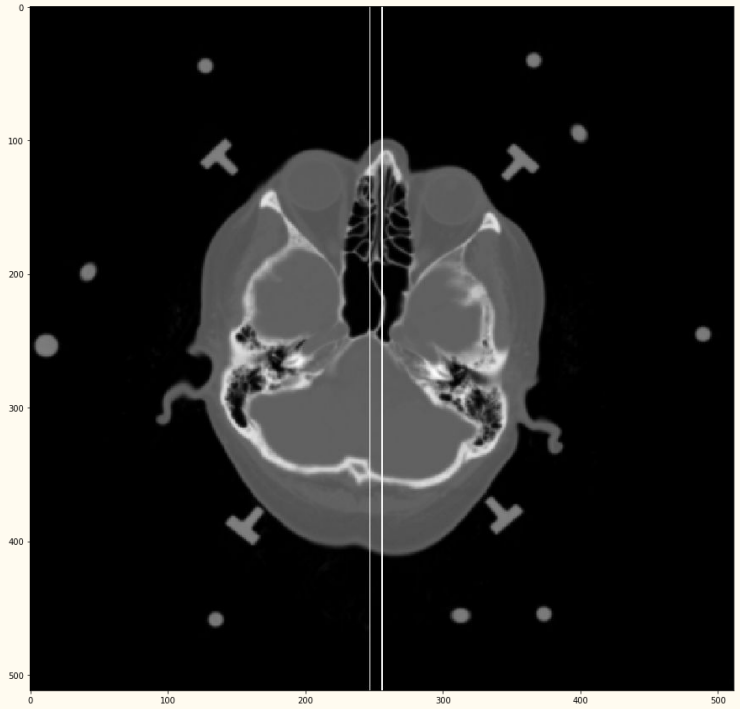
Techniques	Prior knowledge	User interaction required	Work in presence of noise	Simple
Supervised	Yes	Yes	Yes	No
Unsupervised	Yes	Yes	Yes	Yes
Registration	Yes	No	No	Yes
Symmetry	No	No	Yes	Yes

* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3966434/pdf/CMMM2014-712783.pdf

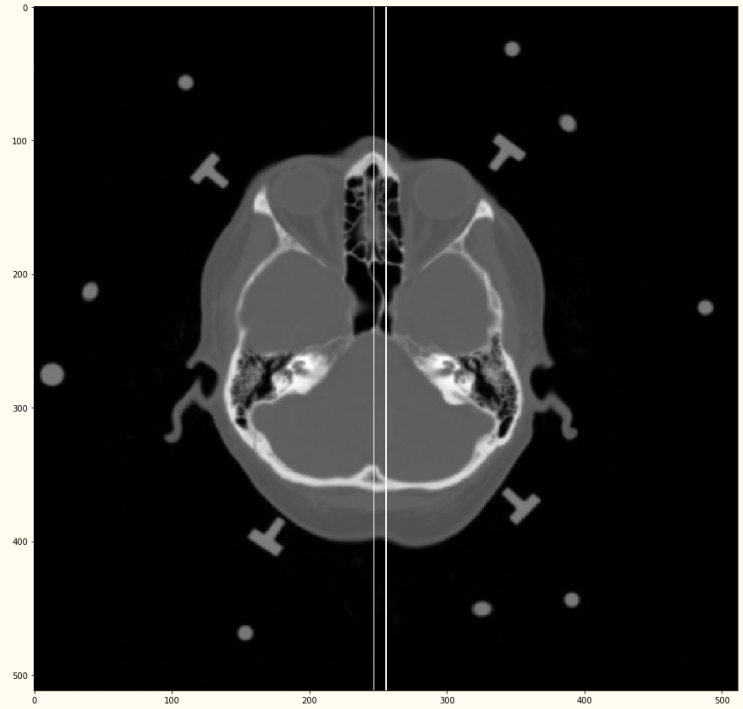
Saddique, Mubbashar, Jawad Haider Kazmi, and Kalim Qureshi. "A Hybrid approach of using symmetry technique for brain tumor segmentation." *Computational and mathematical methods in medicine* 2014 (2014).

Challenges - Rotation

Original

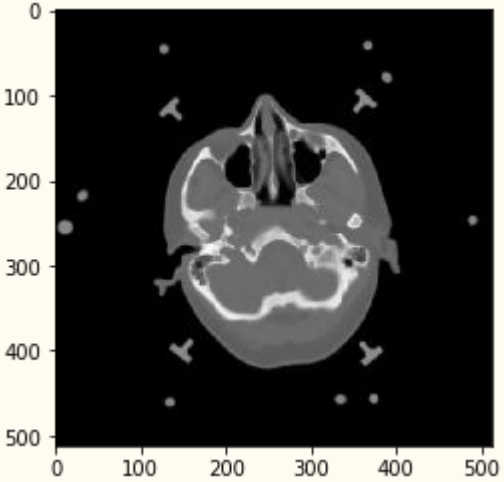


Rotated

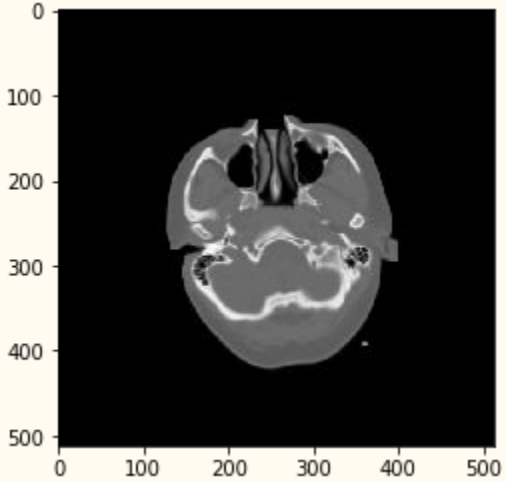


Challenges - Noise, Extreme values

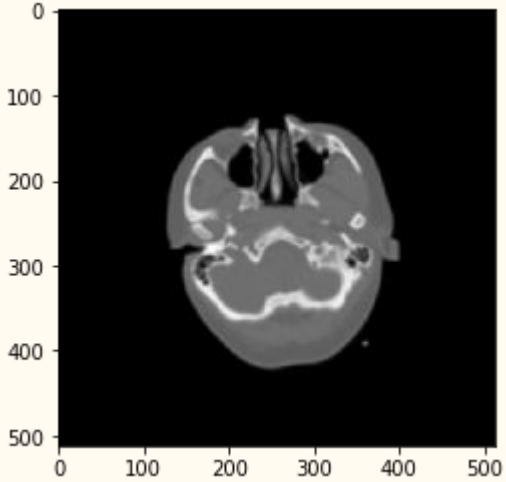
Original



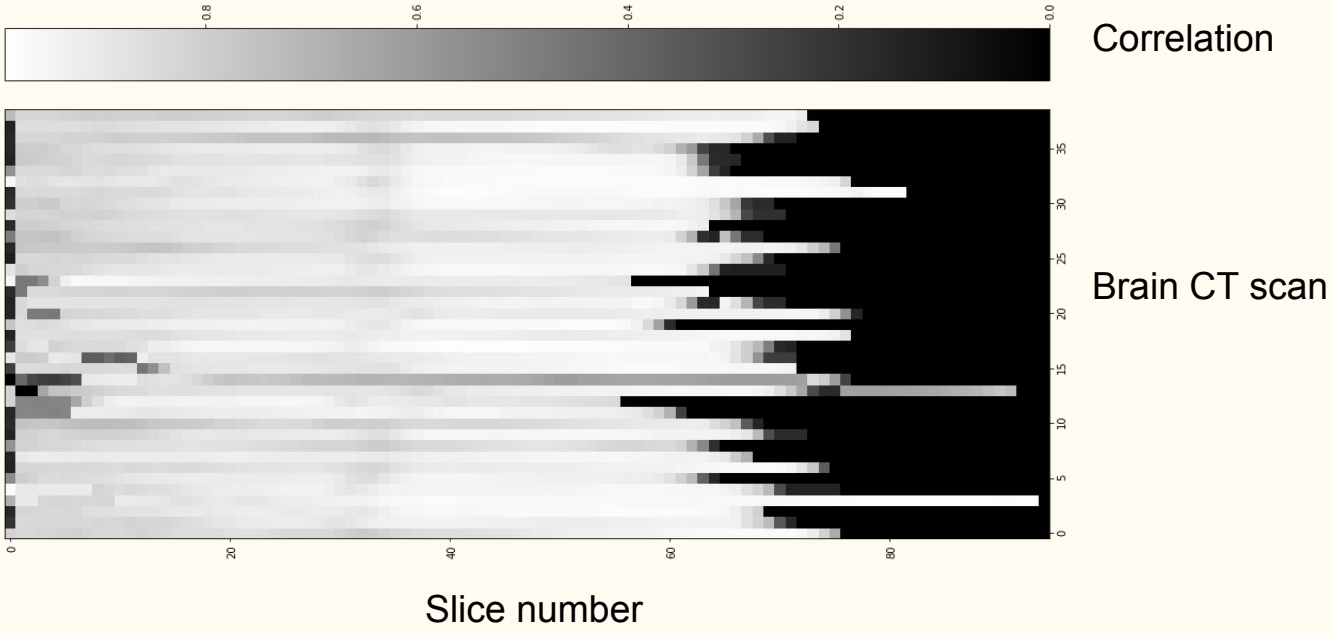
Noise removed



Extreme values smoothed

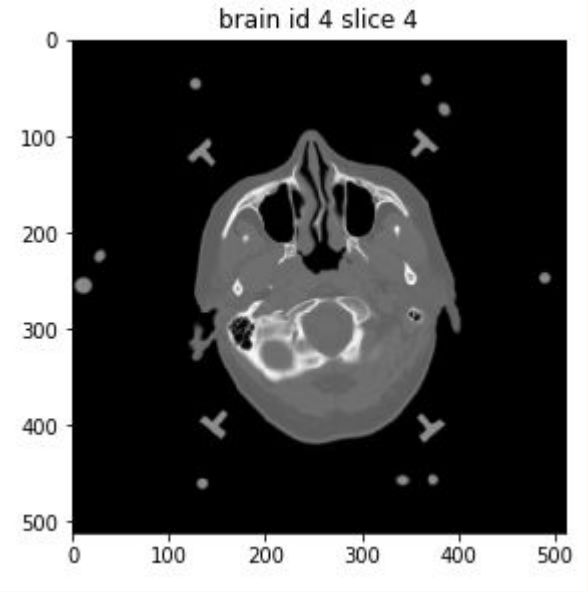


Summary results - all tumor brains

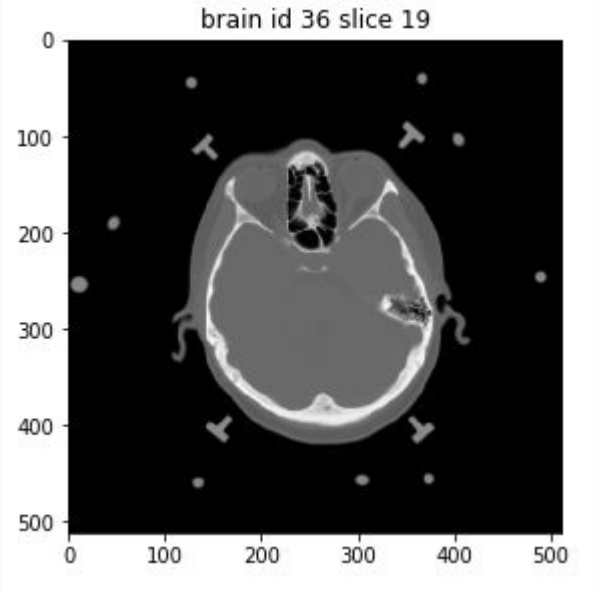


Symmetry results- examples

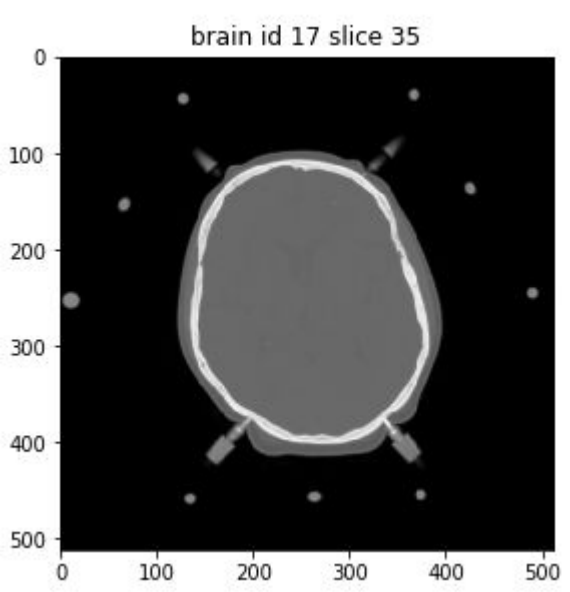
Improperly rotated slice, with noise, very low correlation



Slice with tumor. Correlation coefficient in lower middle interval



Slice with high correlation coefficient



Software interface