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Brain tumor detection and classification using Deep Learning

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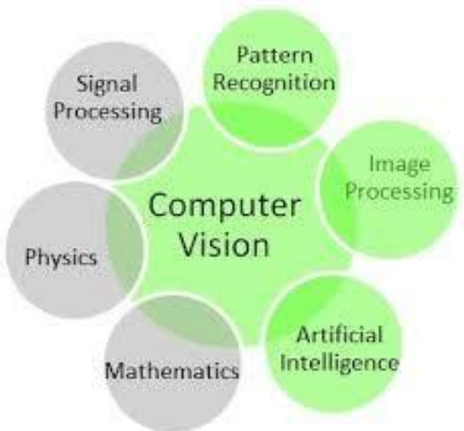
1. Background-Aim

- **Magnetic resonance imaging (MRI)** is a commonly used imaging technique for capturing brain images.
- Both ML and DL techniques are popular in analyzing MRI images.
- Application of **automated classification techniques** using ML and AI → **higher accuracy**
- The role of **AI tools** in the diagnosis of various types of oncology is steadily increasing.
- The manual diagnosis by doctors is slow and subject to inter-observer variations, especially with the increasing number of new cases reported on a daily basis .
- Detection & Segmentation methods for brain tumors was developed using brain MRI images as input to DL networks.
- **Automatic detection and localization of brain tumors:**
- **Task 1: Classification (tumorous/no tumorous)**
- **Task 2: Segmentation (exact tumor area)**



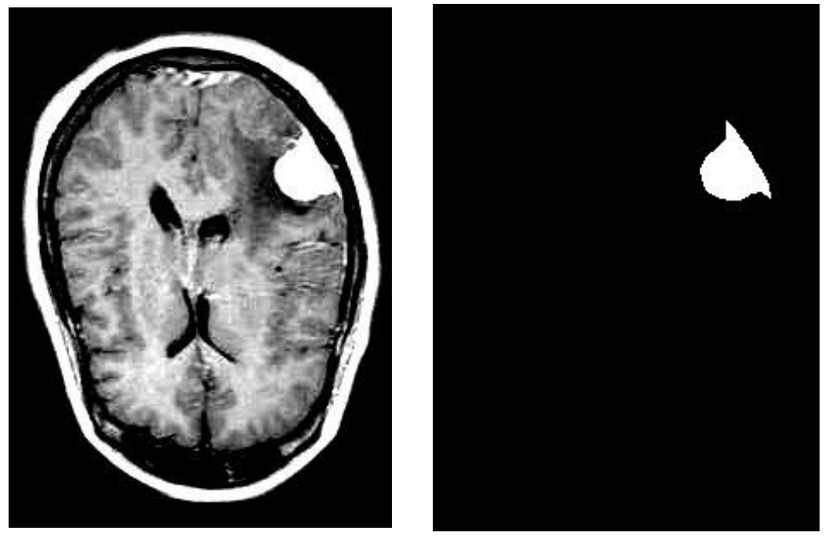
2. Materials & Methods

Dataset
Br35H::Brain Tumor Detection 2020

- yes: **1500 tumorous** brain MRI
- no: **1500 non tumorous** brain MRI
- pred: 60 brain MRI without label
- Training set, validation set, testing set
- Br35H-Mask-RCNN

Method

- **Binary classification task** →two class labels (tumor not detected/tumor detected)
- **Thresholding segmentation task** → compare all pixels of a gray image with a specified threshold

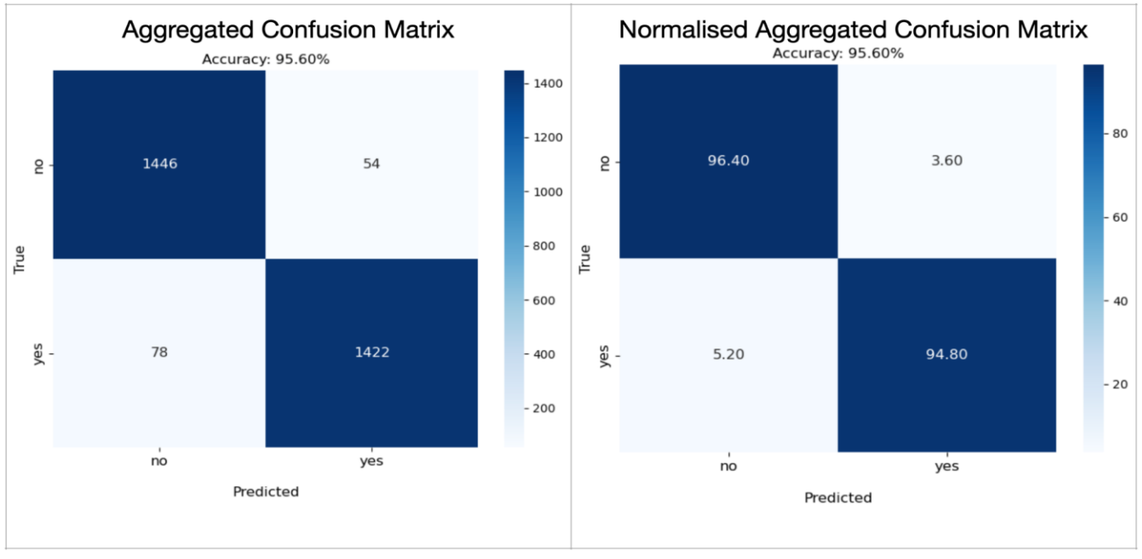


3. Results

Task 1 : Classification

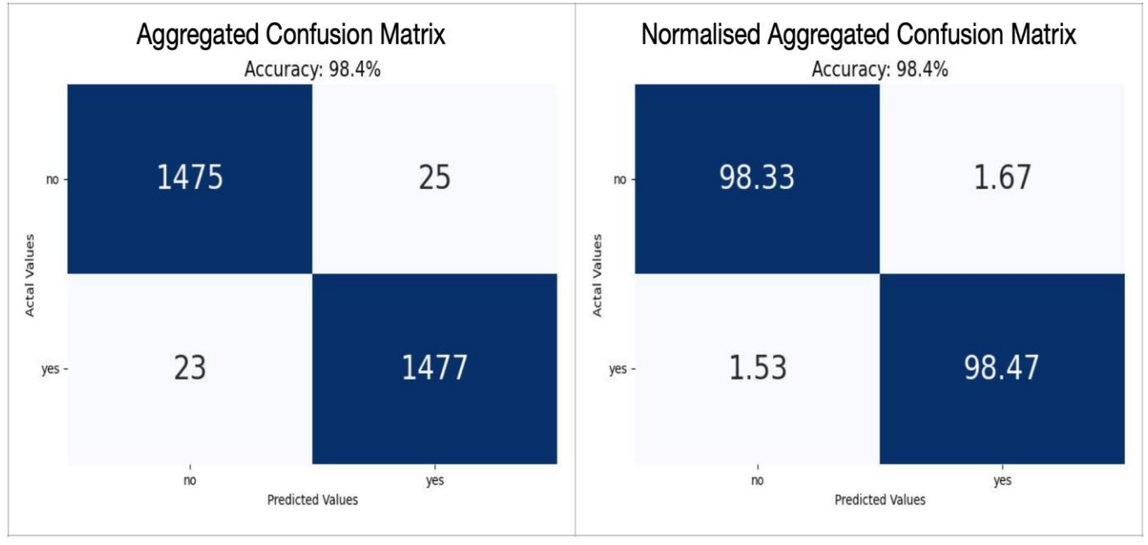
1st approach:

- **CNN based model** (Chattopadhyay, Arkapravo, and Mausumi Maitra. "MRI-based Brain Tumor Image Detection Using CNN based Deep Learning Method." Neuroscience Informatics (2022): 100060.)
- Accuracy 95,6%



2nd approach:

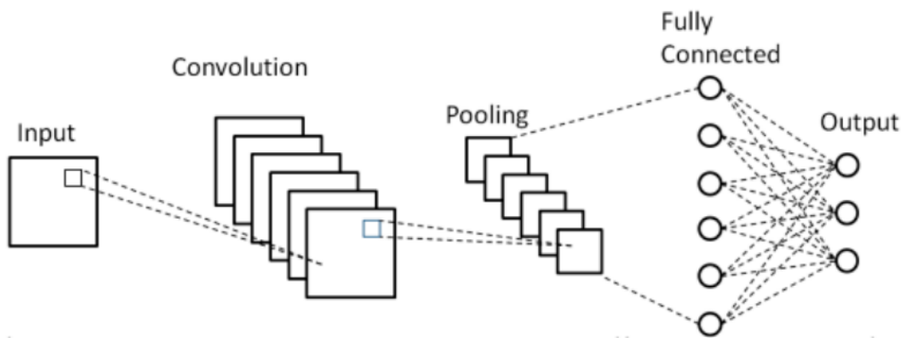
- Transfer the knowledge of a **pretrained ResNet50 model**
- **Accuracy 98,4%**



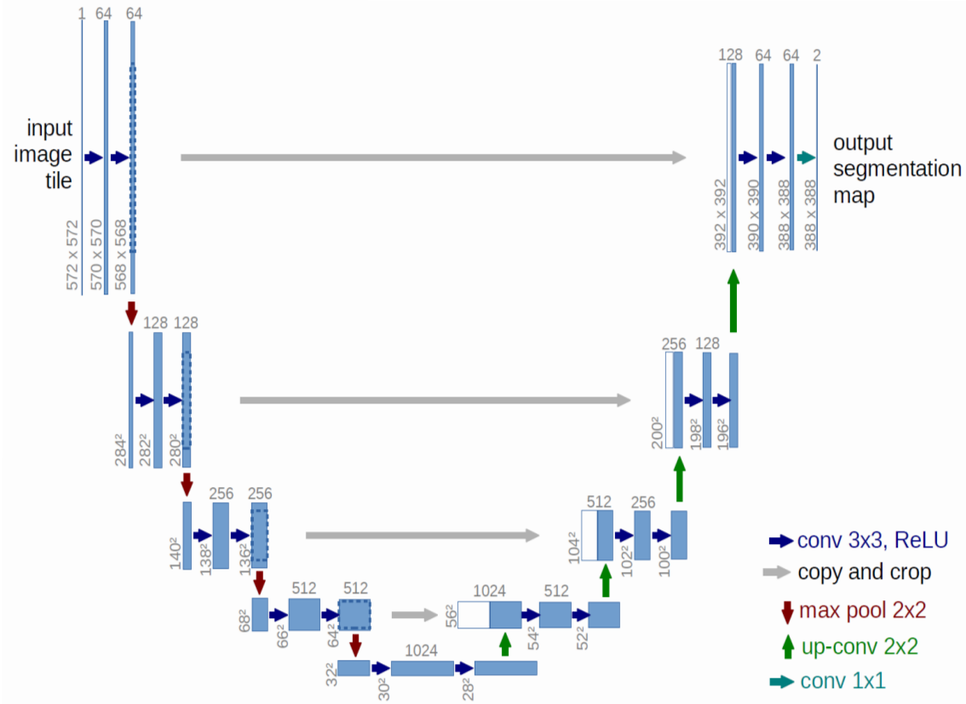
3. Results

Task 2 : precise localization of brain tumors in MRI images

- **Automated segmentation** → ML and DL techniques → **automatically identify and delineate the regions of interest.**
- MRI image segmentation aims to **accurately identify** and separate different anatomical structures or pathologies within the scanned image.
- **Image segmentation** → image segments
- **Semantic image segmentation** → label each pixel with a corresponding class (tumor/no tumor)



- **Convolutional neural network (CNN)** and **U-Net** have shown great success in brain tumor MRI image segmentation by learning hierarchical features and capturing complex patterns
- **ResNet50:** improved accuracy and performance



3. Results

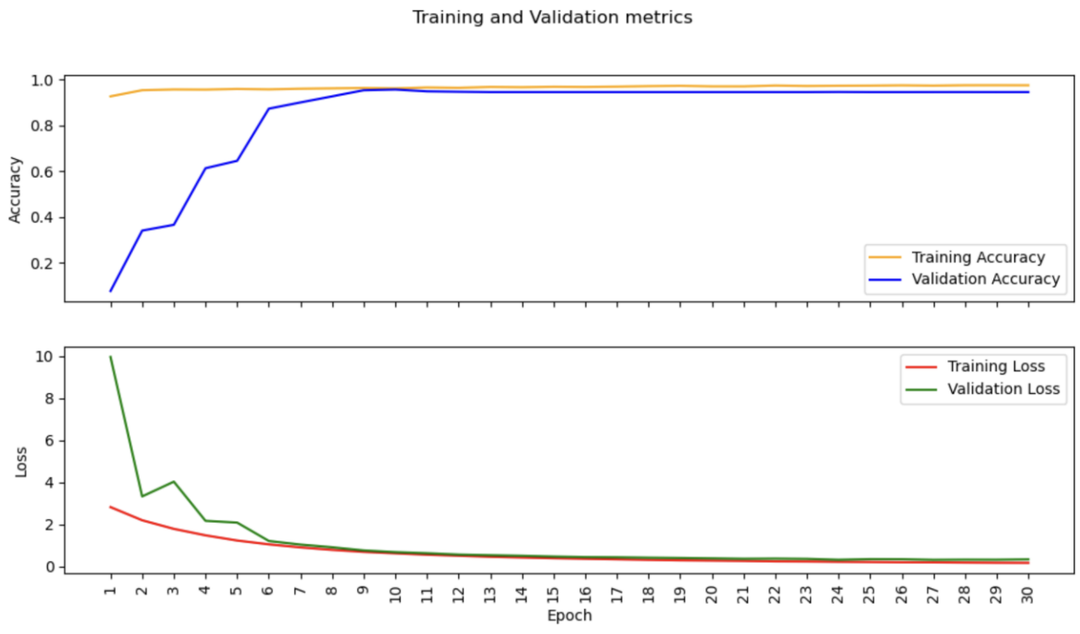
Task 2 : precise localization of brain tumors in MRI images

<u>1st approach:</u>

- **U-Net** Architecture

Results:

- the testing loss is 0.35
- the testing accuracy is 94.14%

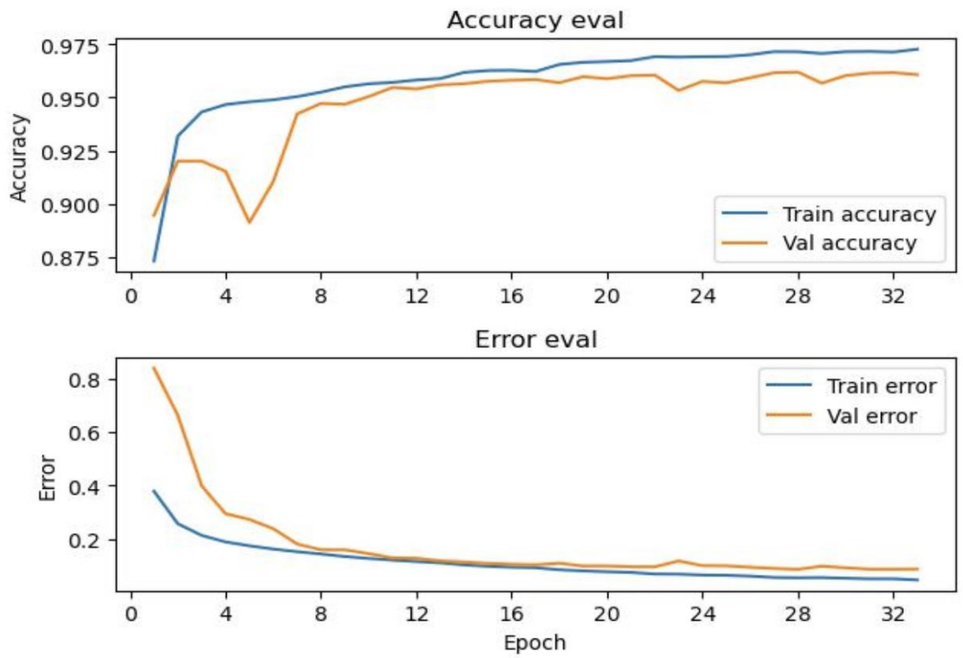


<u>2nd approach:</u>

- U-Net Architecture with Resblocks

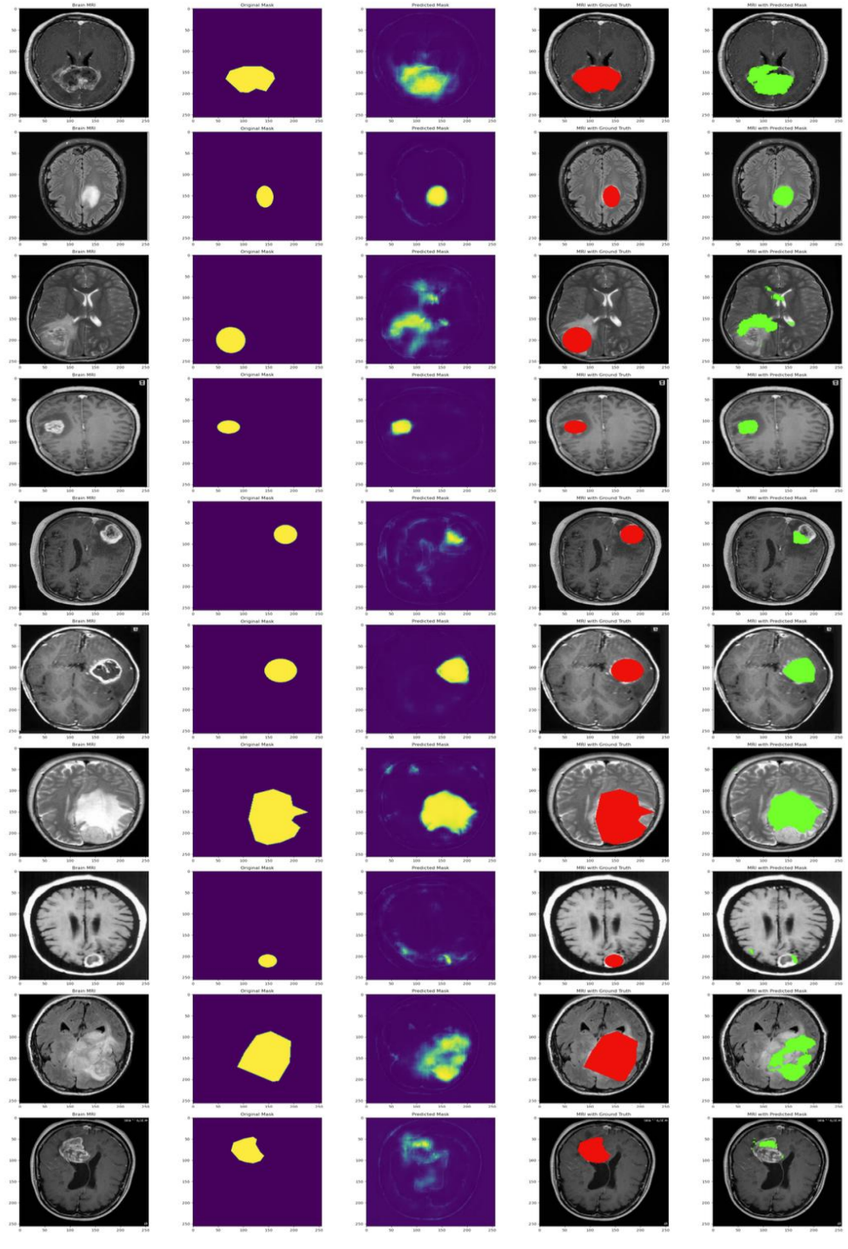
Results:

- the testing loss is 0.11
- The testing accuracy is 95.15%

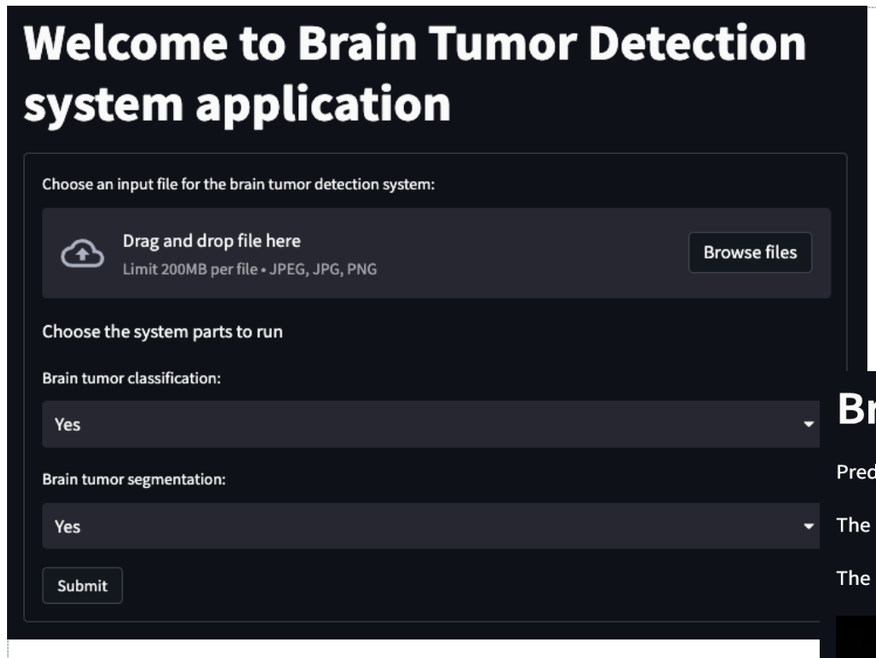


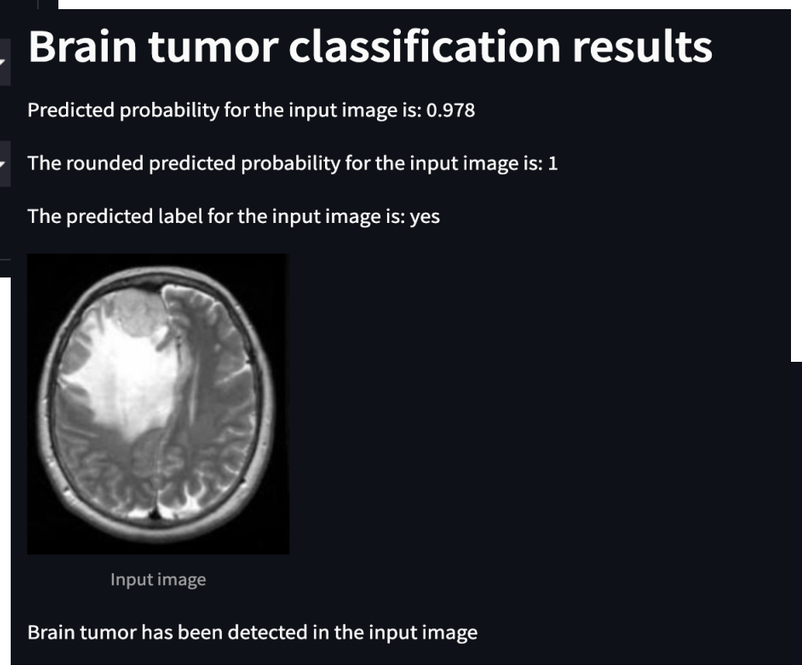
3. Results

- Column 1: original image (input MRI)
- Column 2: mask from the dataset
- Column 3: output mask
- Column 4 & 5: the two previous masks of the second and third columns respectively applied on the original image



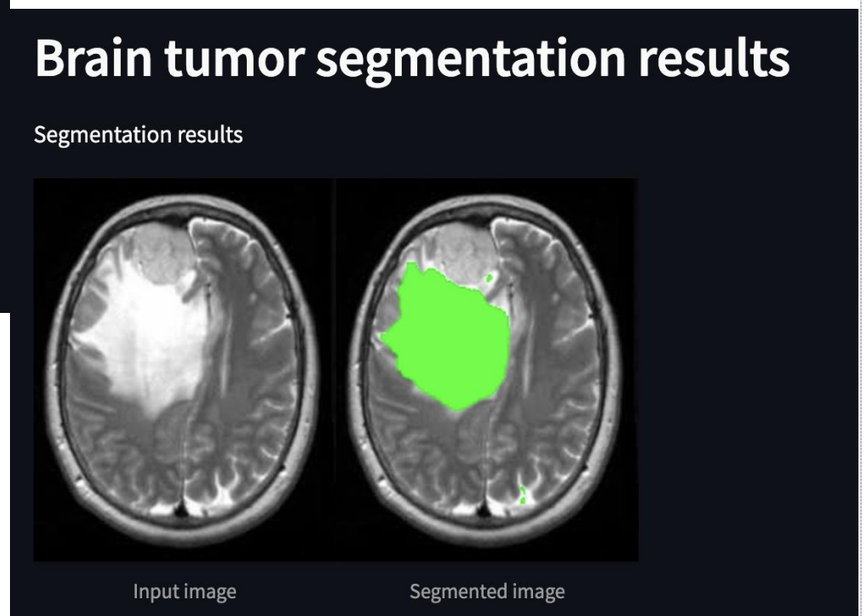
4. User Interface App





Based on the models :

ResNet50 and **U-Net Architecture with Resblocks**



5. Conclusion

- Deep Learning is the state-of-the-art Machine Learning approach.
- Deep Learning in pattern recognition can bring revolutionary changes in health care
- The tools provided by AI improve the clinical practice by **assisting clinicians.**
- AI provides tools to aid medical practice that are more accurate than classical methods as they do not set strict and rigid rules but adapt to the data we provide.
- Machine Learning and Deep Learning is expected to become an **essential technology for medical specialists.**

6. References

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