Project 4 - Team 4

Revolutionizing Brain Tumour Detection: A Machine Learning Approach

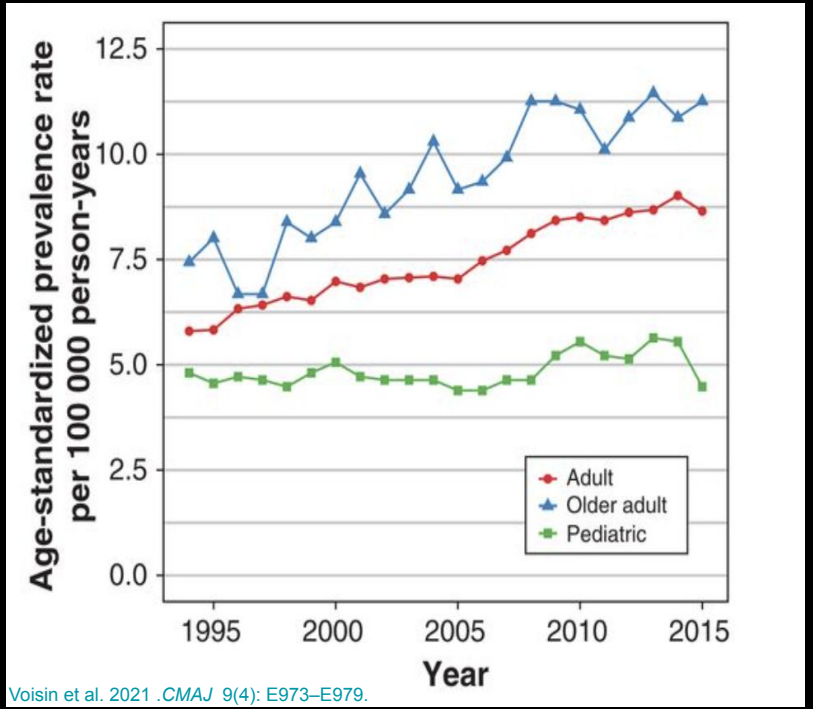
April 18th, 2023

Youssouf Ismael, Hinna Ahmad, Komal Taware, Natasha Girdharry

https://github.com/ngirdharry/Project-4-Team-4-Brain-Tumor-Detection-using-Machine-Learning-and-MRI-Images.git

Epidemiology of Brain Tumours

- **The incidence of primary brain tumours has increased from 1992 to 2017(1).**
- **Primary brain tumours account for 2% of newly diagnosed cancers in North America(1).**
- **Approximately 55,000 Canadians are surviving with a brain tumour(2).**



Voisin et al. 2021 .*CMAJ* 9(4): E973–E979.

1. Voisin et al. 2021 .*CMAJ* 9(4): E973–E979.
2. https://www.braintumour.ca/facing-a-brain-tumour/facts-about-brain-tumours/

Primary Brain Tumours: Incidence and Prognosis

- **Malignant brain tumours constitute 35.9% of all primary brain tumours, with high-grade gliomas occurring most commonly (3). Others include meningiomas and pituitary tumours.**

- **The prognosis for patients is poor despite aggressive treatment with a 5-year survival rate of 27% (2).**

- **Increased health care resources and techniques are needed to improve identification of these tumours in order to effectively deliver evidence-based care to ensure preservation of life for affected patients.**

3. Davis et al 2015. *J Registry Manag.* 42:139–45.

Challenges in Primary Brain Tumour Diagnosis

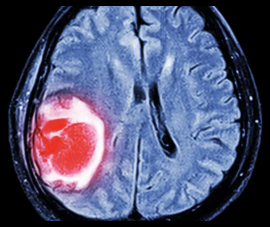
- **Poor Symptom Specificity (4)**
  - Symptoms of primary brain tumours can be non-specific and easily attributed to other conditions, leading to delayed or missed diagnosis.

- **Access to MRI Machines (4)**
  - MRI is the preferred imaging modality for diagnosing primary brain tumours, but availability and wait times can pose a significant challenge in some areas.

- **Physician knowledge**
  - Distinguishing between malignant and non-malignant brain tumours can be challenging, requiring specialized knowledge and experience.
  - Approximately 38% of MRI's that receive a second opinion require treatment changes (5).

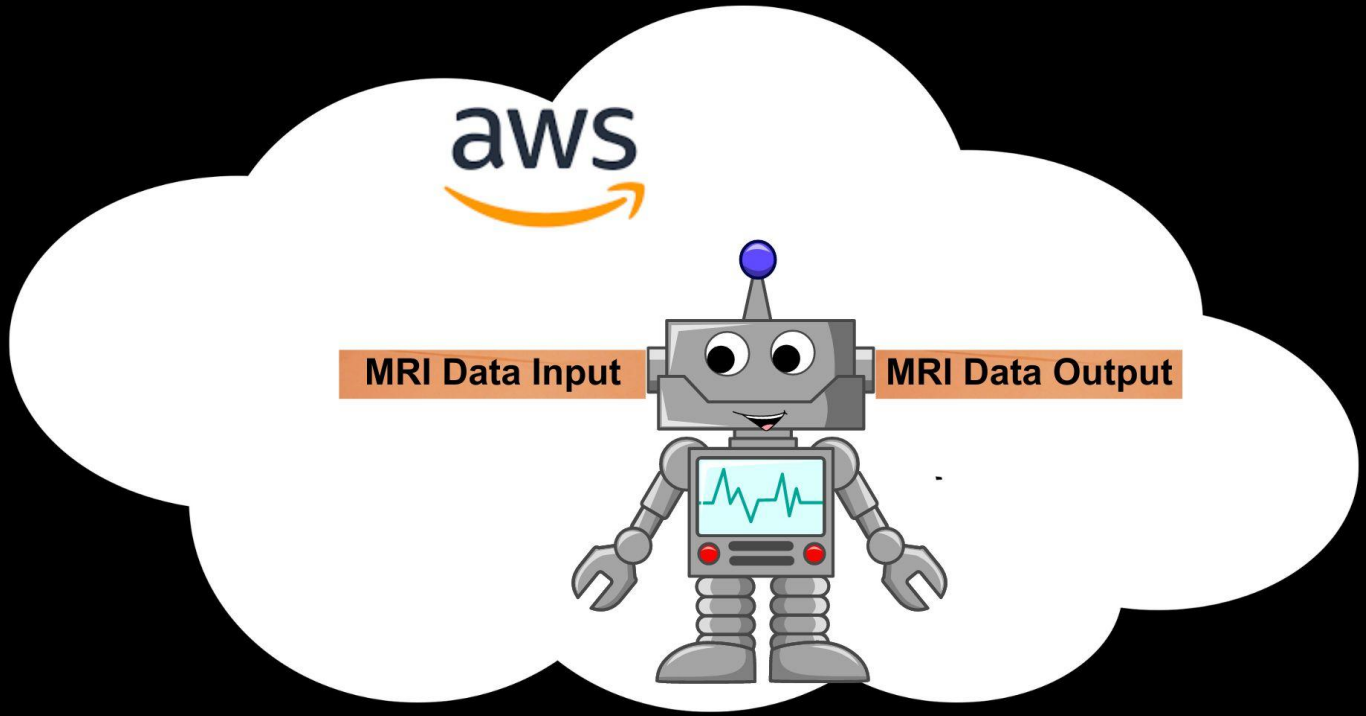
4. Penfold et al 2017. *Br J Gen Pract.* 67(659): 278–279.
5. Lysack et al 2013. *WJOHNS 39(42).*

Project Objective



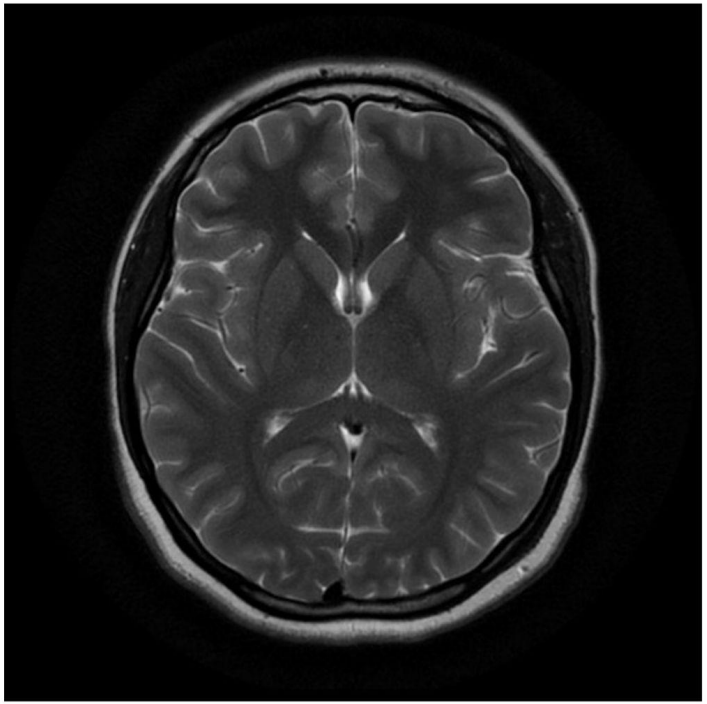
Develop a deep learning model to accurately identify and classify brain tumours using MRI scanning images, using Convolutional Neural Networks (CNN) with the goal of improving early detection, reducing physician burden, and enhancing patient outcomes.

Databases Overview



Classifying Tumour Example

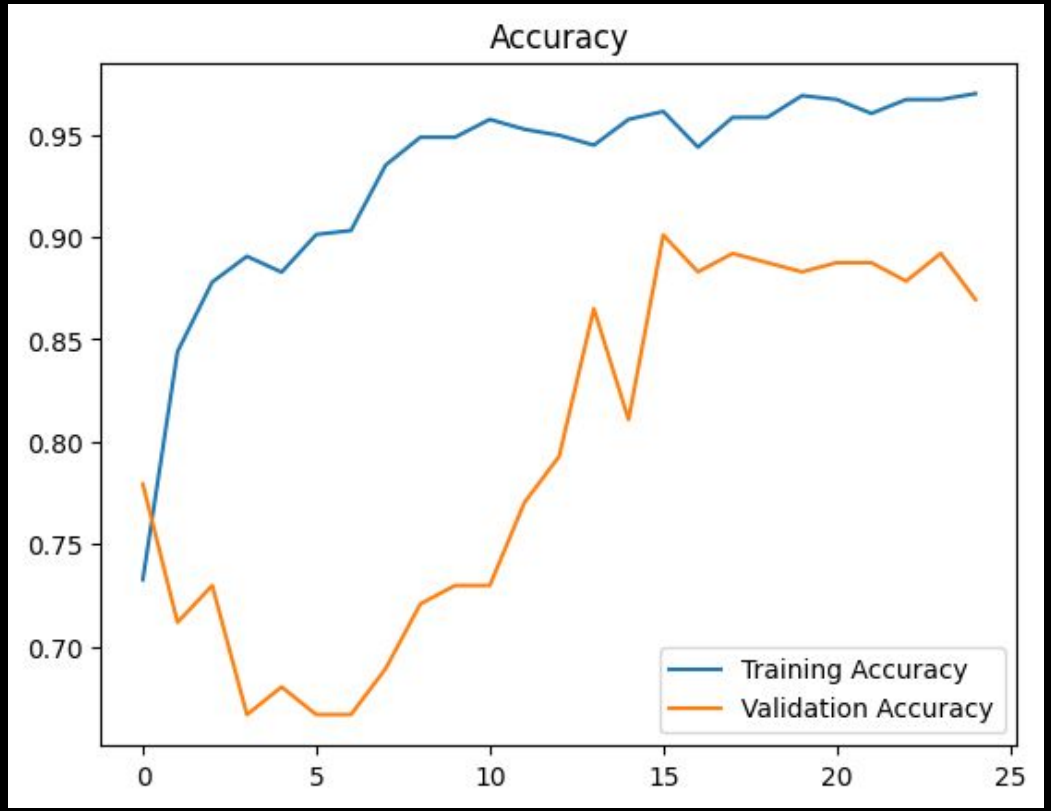
MRI Scan without a Tumour



MRI Scan with a Tumour

Using Neural Networks as the Brain behind our Brain Tumour Detection Model

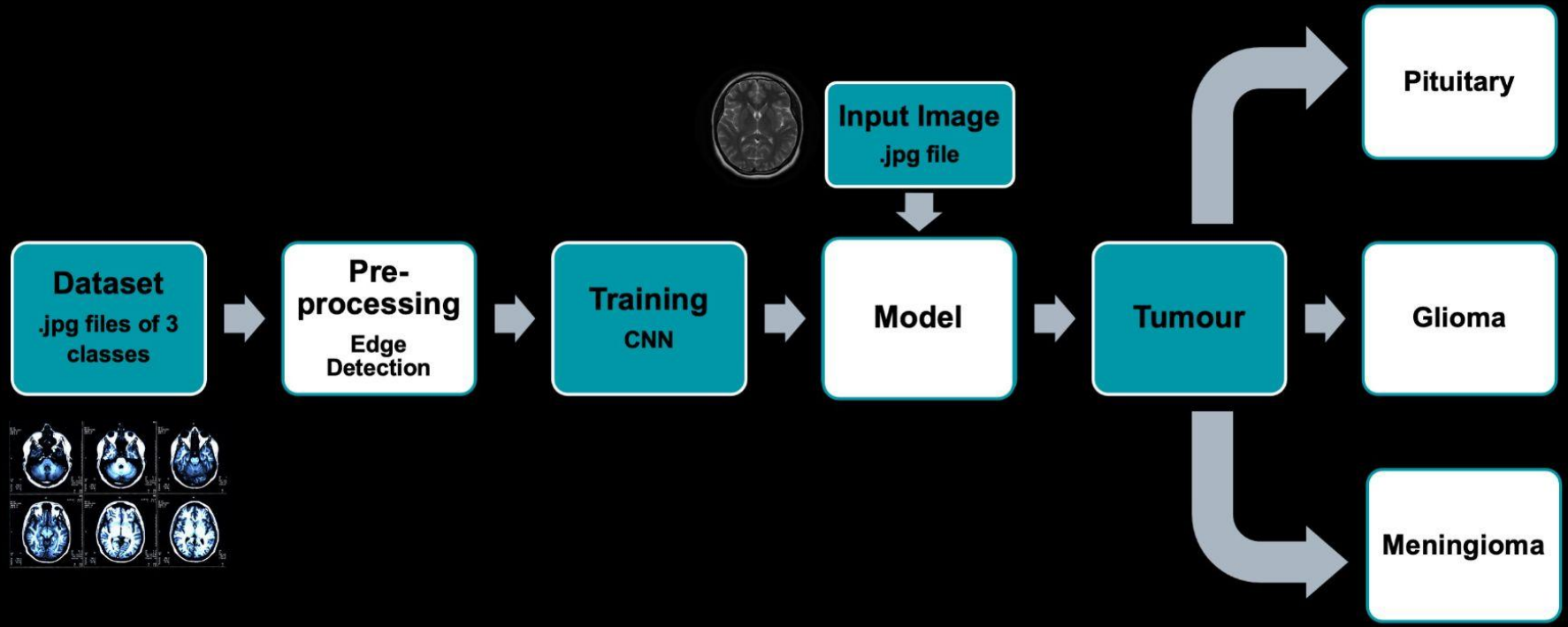
Analysis of Model 1



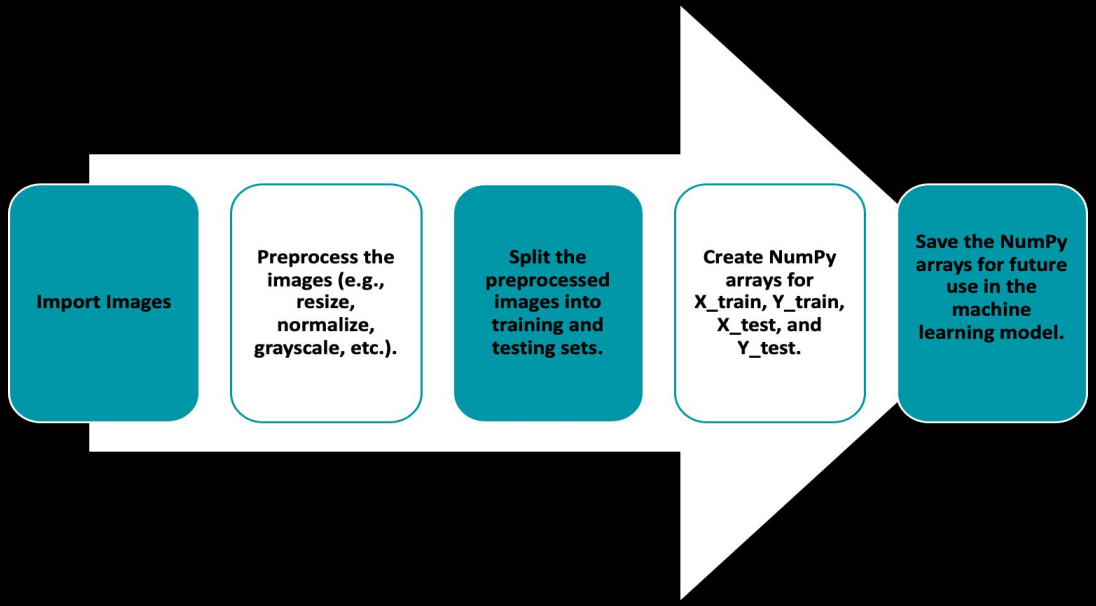
We set out to create a model that was not only accurate, but prioritized minimizing false negatives to avoid legal liability for the hospital.

We're proud to announce we have achieved a Recall of 97%!!

Architecture Diagram

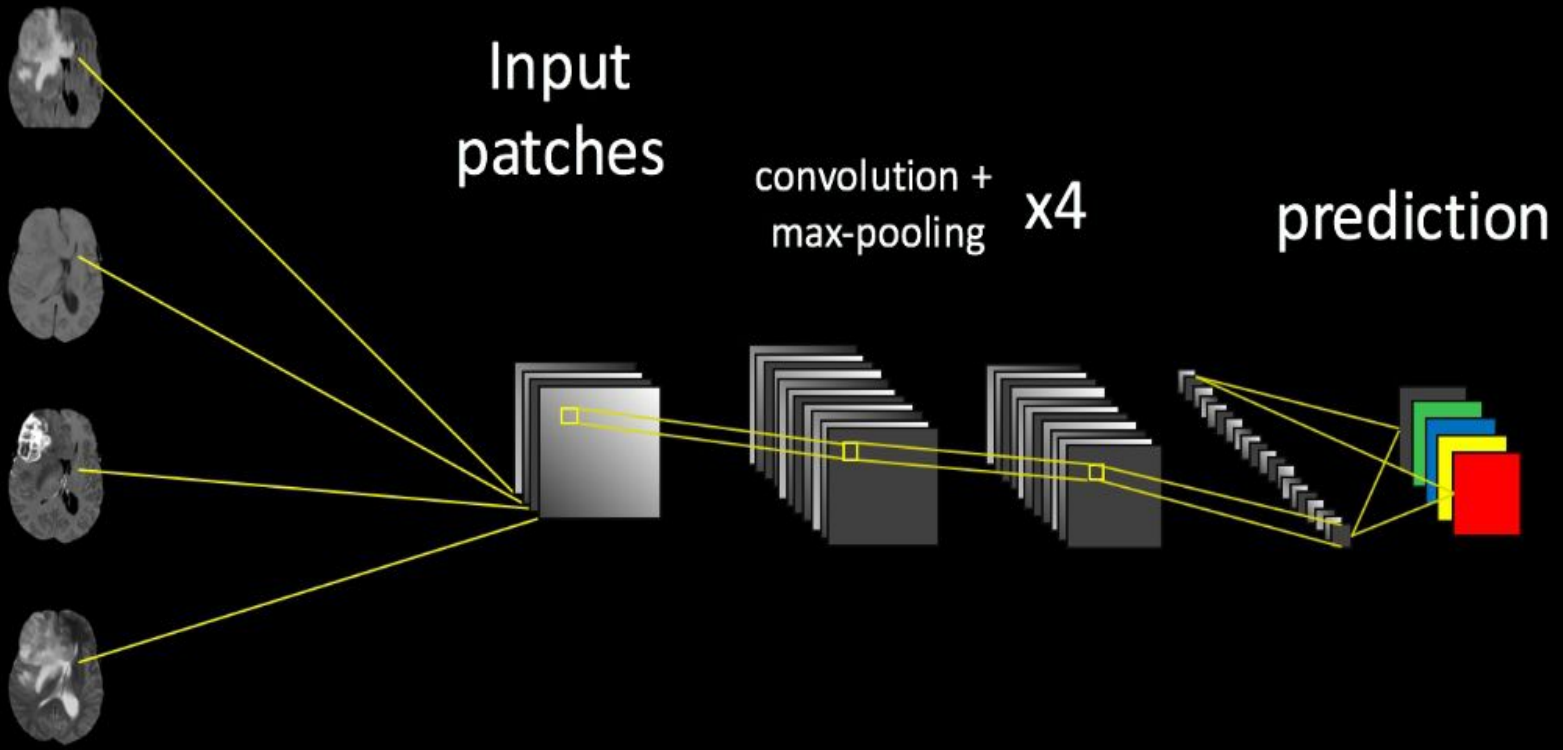


Brine-tuning: The Art of Pickling During Machine Learning Development



- Using pickle.dump() to save preprocessed files helps to save time, since the data can be directly used for training neural networks without repeating pre-processing.
- Loading data can be done with pickle.load().

Building the network



Model Accuracy

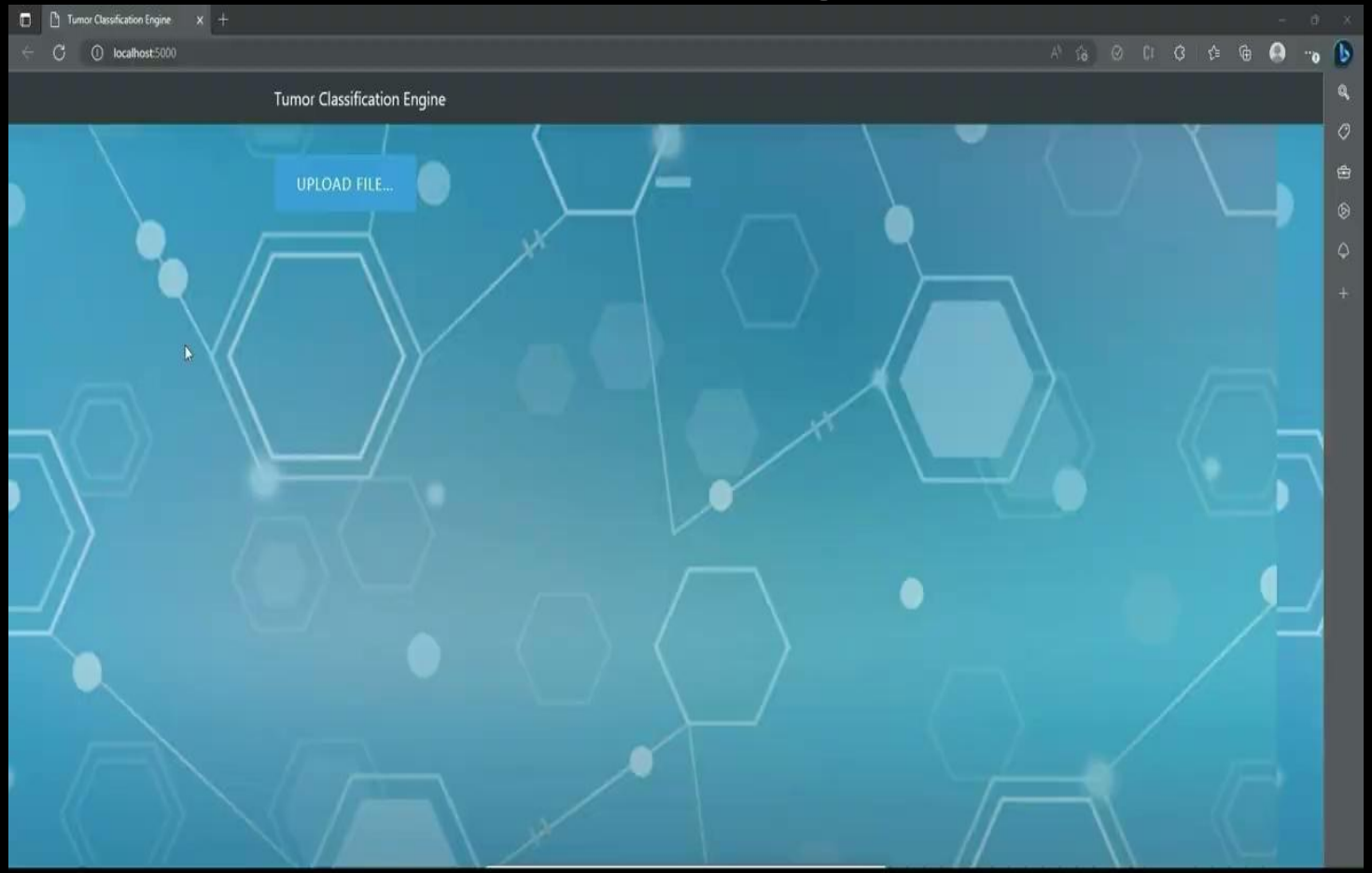
- **Our tumor differentiating model has achieved an accuracy of 94%.**

- **We take the pressure off the health care providers and free them to pour their time and energy into what matters, helping their patients.**

Flask Deployment

Flask Based API

Webpage


Tumor Classification Engine
localhost:5000
Tumor Classification Engine
UPLOAD FILE...

Limitations & Challenges

- **CNN Model Limitations**
  - The pre-processing techniques used to augment the images could introduce noise or distortions that can negatively impact the performance of the algorithm.

- **Small dataset limits generalizability**
  - The performance of the algorithm may be impacted by the quality of the input images.
  - The Model may not generalize well to unseen/new data.

- **Integration into clinical workflow and ethical considerations must be addressed**
  - The reliance on machine learning can take away the human element from the process and cause an over reliance on the model.

Conclusions

- We were able to train a CNN model to accurately determine whether a patient has a tumor with a very high bias against false negatives.

- We also trained a model to quickly help diagnose what type of tumor is present in a patient.

- The web app we created provides a simple way for healthcare providers to use the model for pre-screening or second opinions on diagnoses.

Thank you for listening!

Questions?

https://github.com/ngirdharry/Project-4-Team-4-Brain-Tumor-Detection-using-Machine-Learning-and-MRI-Images.git