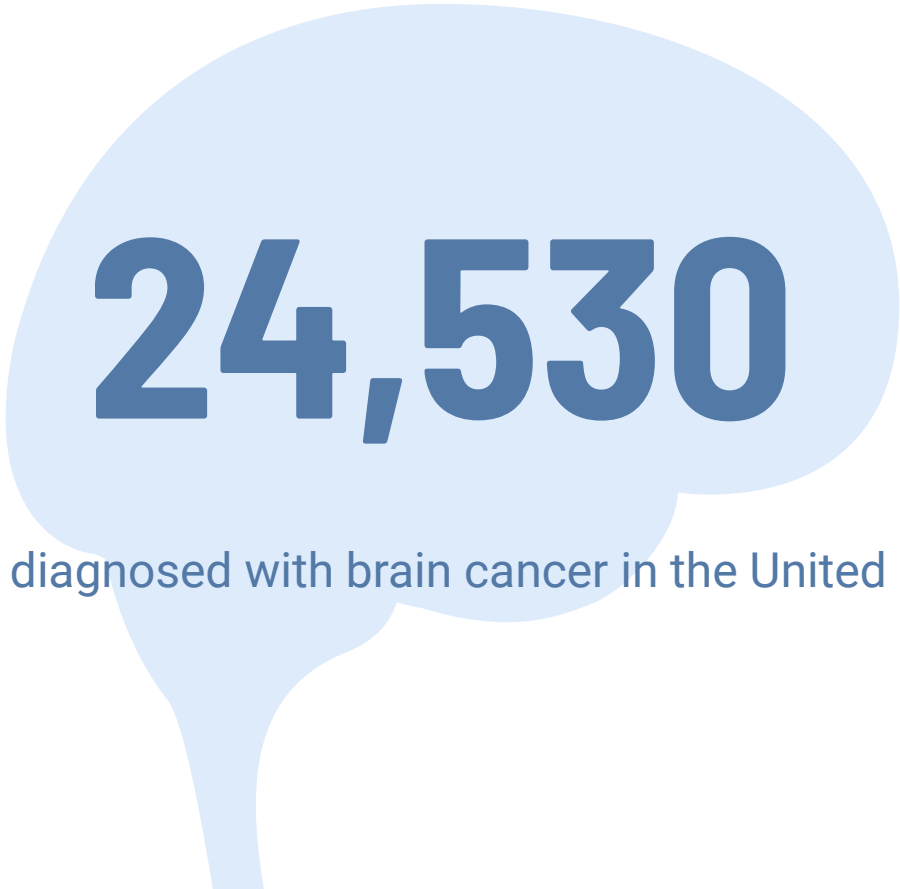




Brain Tumor Classification

Neha Dipali, Jonathan Jan, Sam
LaPlatney, Ally McNulty, Karthick
Ramasubramanian

A large, light blue, stylized brain shape is centered in the image. It has a thick, dark blue outline and a lighter blue fill. The number '24,530' is written in a bold, dark blue font inside the brain shape.

24,530

Patients will be diagnosed with brain cancer in the United States in 2021

The image features a light blue background with stylized, abstract human profiles in a darker blue shade. A large, light blue speech bubble is centered on the page, containing the text '32.6%'. Below the speech bubble, the text '5 year survival rate for patients diagnosed with brain cancer' is written in a dark blue, sans-serif font.

32.6%

5 year survival rate for patients diagnosed with brain cancer

FLOW OF PRESENTATION

01

MOTIVATION

02

DATASET

03

**DATA
PREPROCESSING**

04

CNN MODELS

05

KEY TAKEAWAYS

06

NEXT STEPS

Current Challenges in Brain Cancer Detection

Human Error

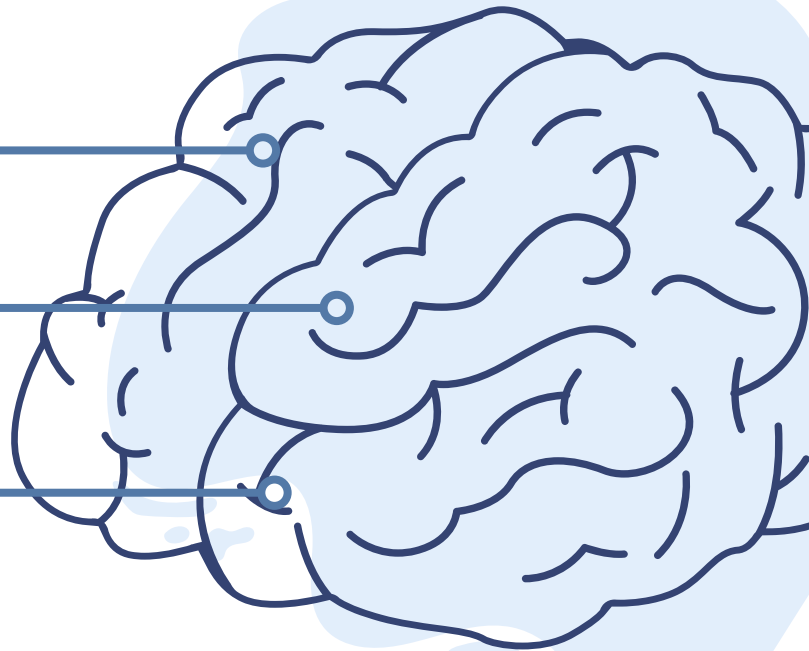
Radiologist Diagnostic
Sensitivity ranges from
72%-90%

Cost

Average cost of brain MRI
ranges between \$1000-
\$8400

Access & Speed

Underserved populations
wait longer to see a
radiologist



History of CNN models/Applications



1990's

First applications of
modern day CNN
Networks (Lecun, MNIST
Dataset)

Advent of Deep CNNs
(AlexNet)

2012



History of CNN models/Applications



**2012 -
Present**

CNNs widely used across
many industries

Preliminary investigations
using deep learning for
tumor segmentation

2014



Topic of rapidly growing interest

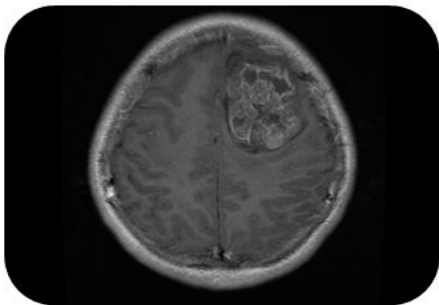
5,000+

Research papers already published on the topic this year

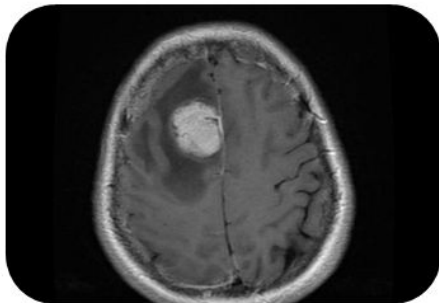
A hand is holding a film strip that displays a grid of brain MRI scans. The scans are arranged in two columns: the left column shows axial cross-sections of the brain, while the right column shows sagittal cross-sections. Each individual scan includes technical data such as patient identifiers (e.g., '21 11', '21 12'), sequence names (e.g., 'MAGNETOM', 'T1W'), and slice thickness (e.g., '2 mm'). A large, semi-transparent blue circle is positioned on the right side of the image, partially overlapping the film strip. Inside this circle, the word 'Dataset' is written in a clean, white, sans-serif font.

Dataset

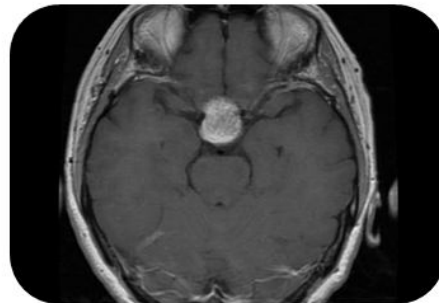
About the Dataset Used



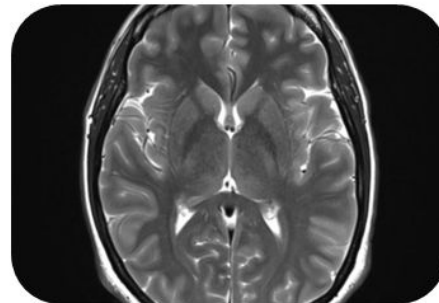
Glioma



Meningioma



Pituitary Tumor



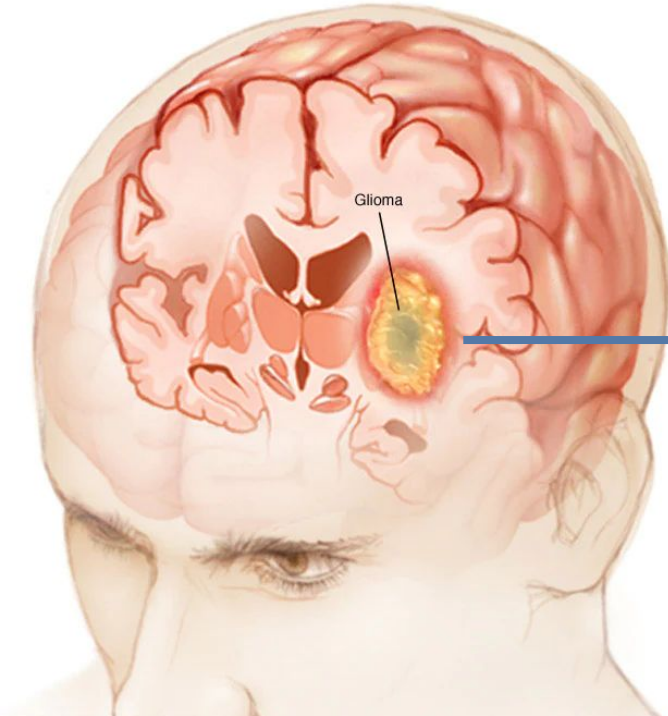
No Tumor

Training Set - 5,712 images

Test Set - 1,311 images

Source: [Brain Tumor MRI Dataset | Kaggle](#)

Gliomas



Originate in the gluey supportive cells around the nerves (**glial cells**)

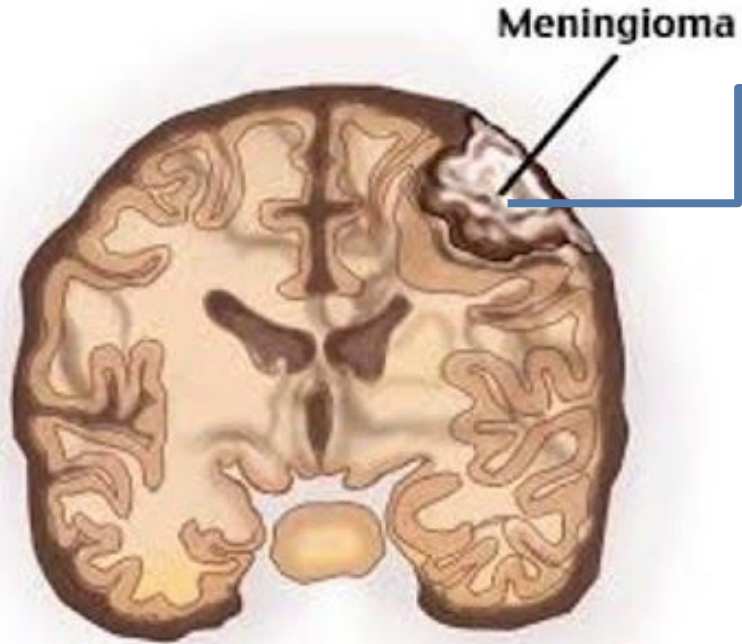
One of the **most common** types of brain tumors

Causes Unknown

Symptoms - Headaches, Confusion, Memory Loss, Speech problems or Seizures

Most common in adults aged **45-65**

Meningiomas



- Arise the meninges (membranes surrounding the brain and spinal cord).

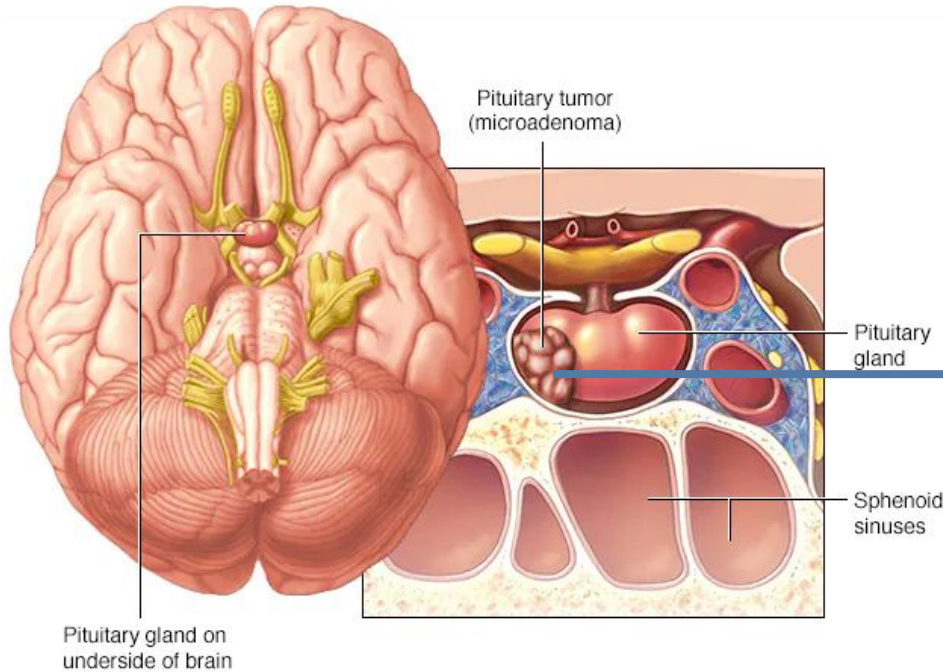
Often grow very slowly without causing symptoms

Most common type of brain tumors

Symptoms - Changes in vision, Headaches, Hearing Loss, Memory Loss, Seizures, Language difficulty

More common in older women

Pituitary Tumors



- Affect the normal functioning of the pituitary gland

Over-production or under-production of hormones such as HGH, TSH, Prolactin etc.

Non-cancerous in most cases

Symptoms - Headaches, Peripheral Vision Loss, Acromegaly (excess HGH), Sexual Dysfunction (excess Prolactin), Weight Loss (excess TSH)



Data Preprocessing

Approach



Resize

Images with similar
widths and heights



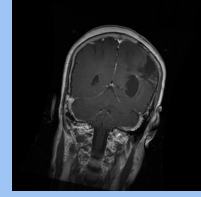
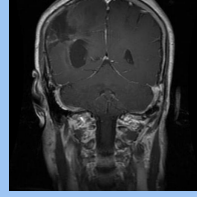
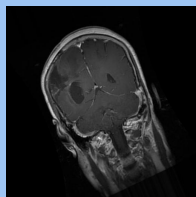
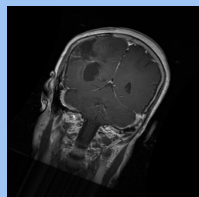
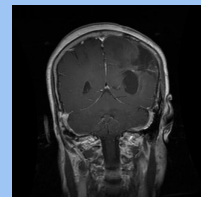
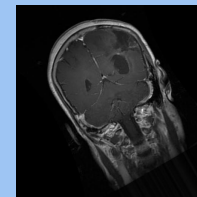
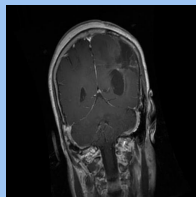
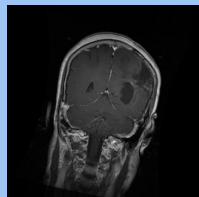
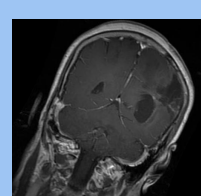
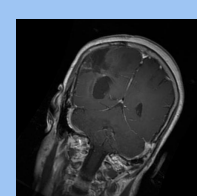
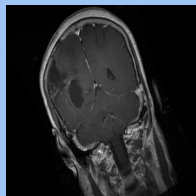
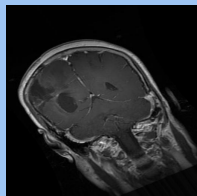
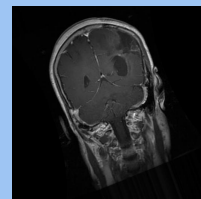
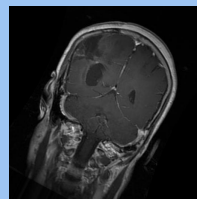
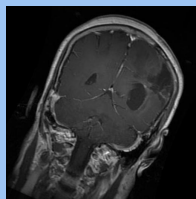
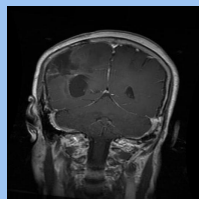
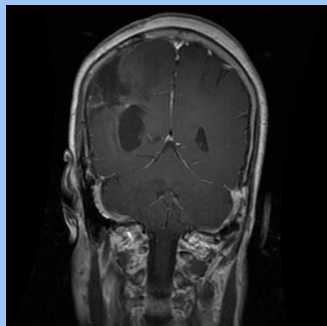
Augmentation

Increase diversity without
collecting new data

Augmentation

```
#define ImageDataGenerator class  
generator_train = ImageDataGenerator(rescale=1./255,  
                                     rotation_range=30,  
                                     horizontal_flip=True,  
                                     shear_range=0.2,  
                                     height_shift_range=0.07,  
                                     zoom_range=0.2)
```

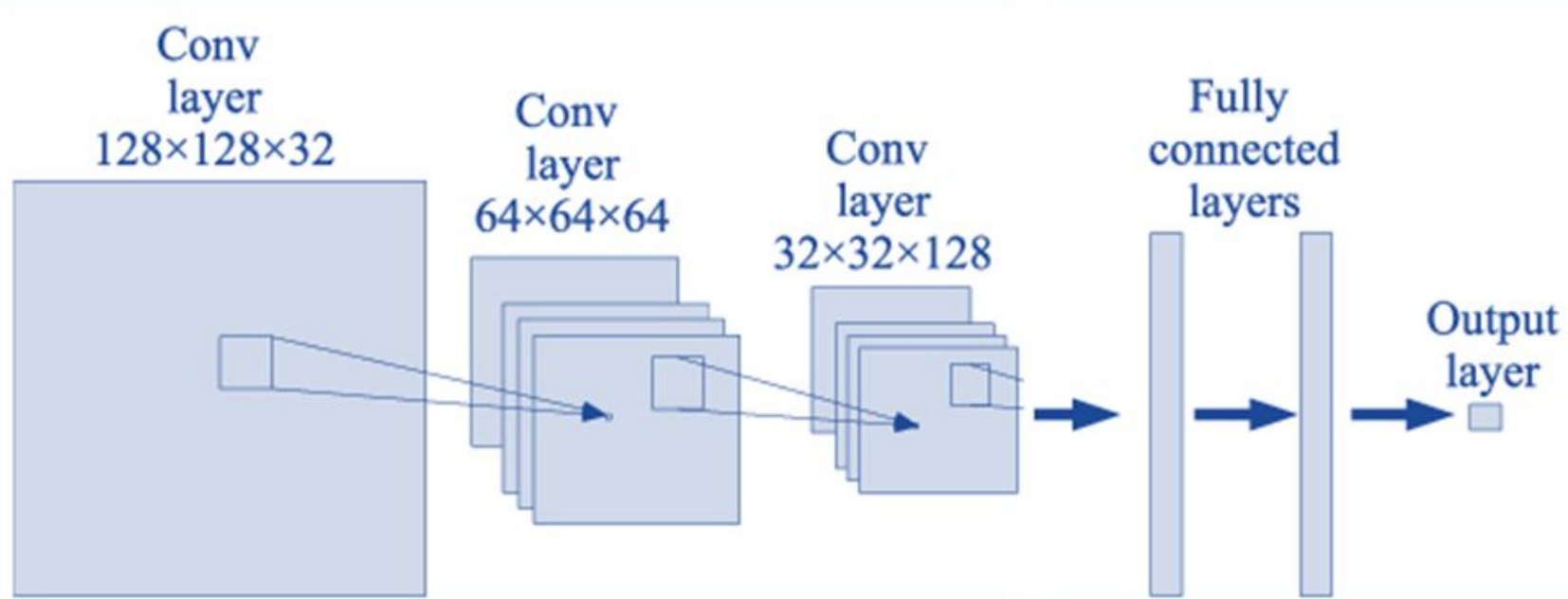

Augmented Images



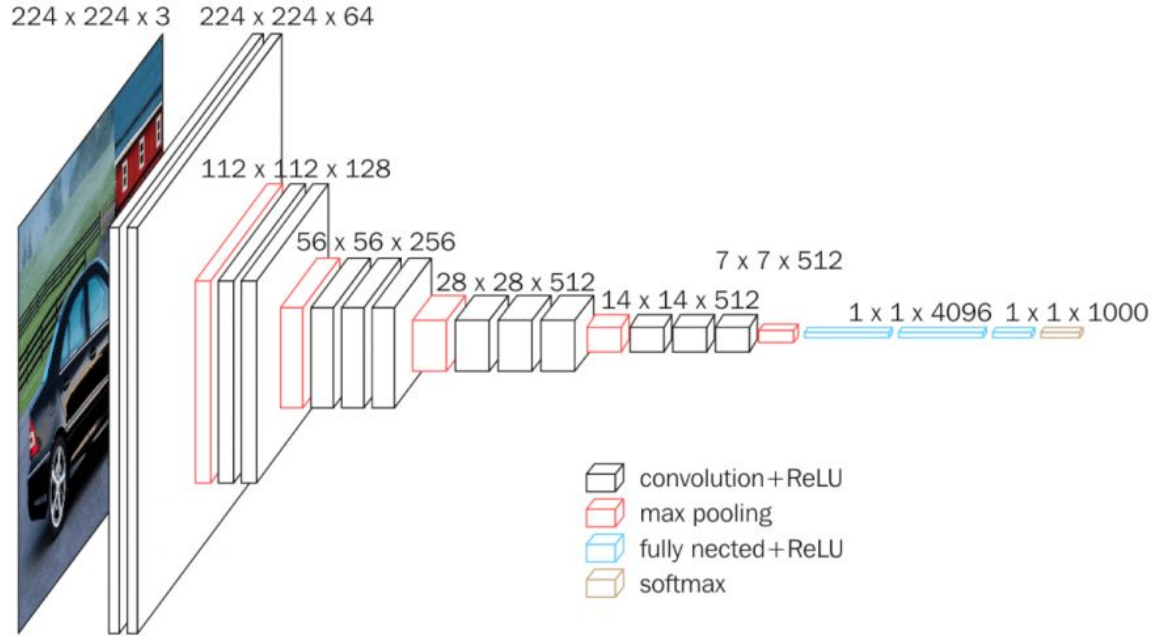
CNN Models



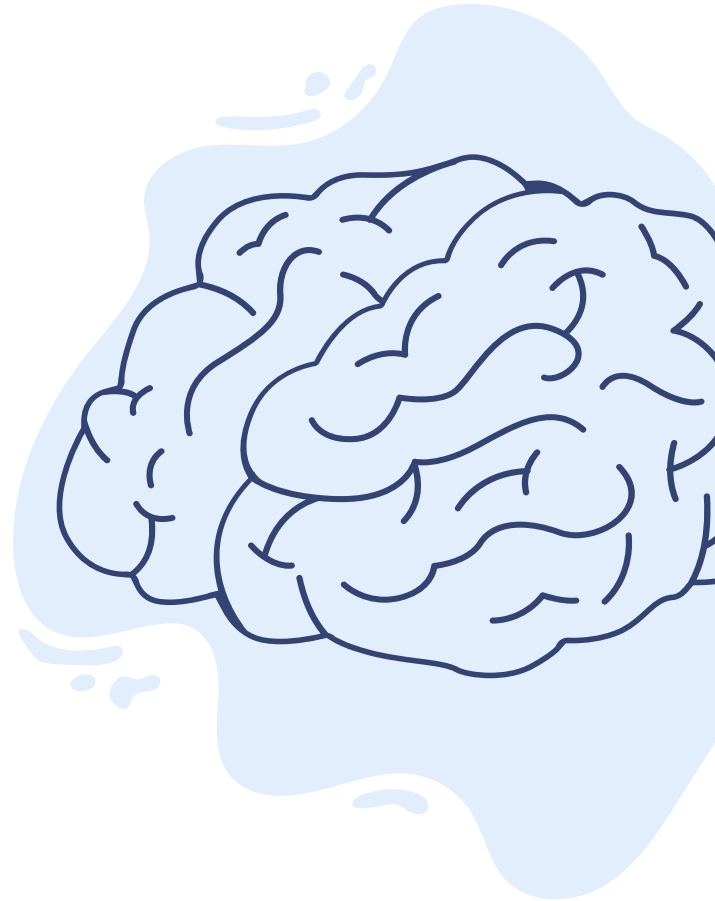
3 Convolution, 2 Feedforward + Softmax



VGG16 Model

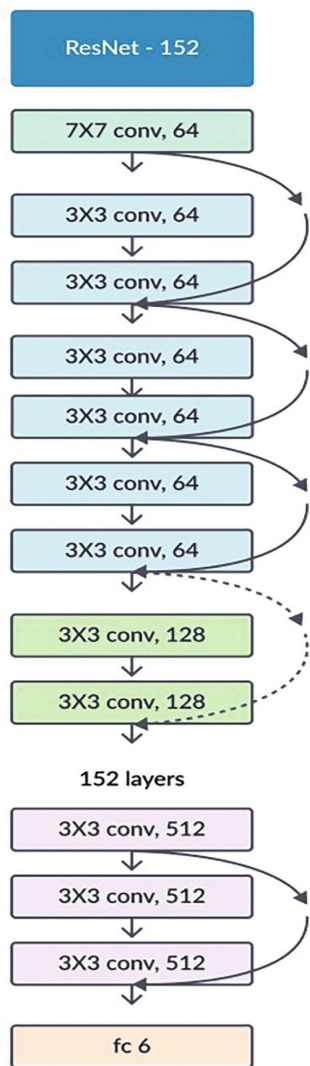
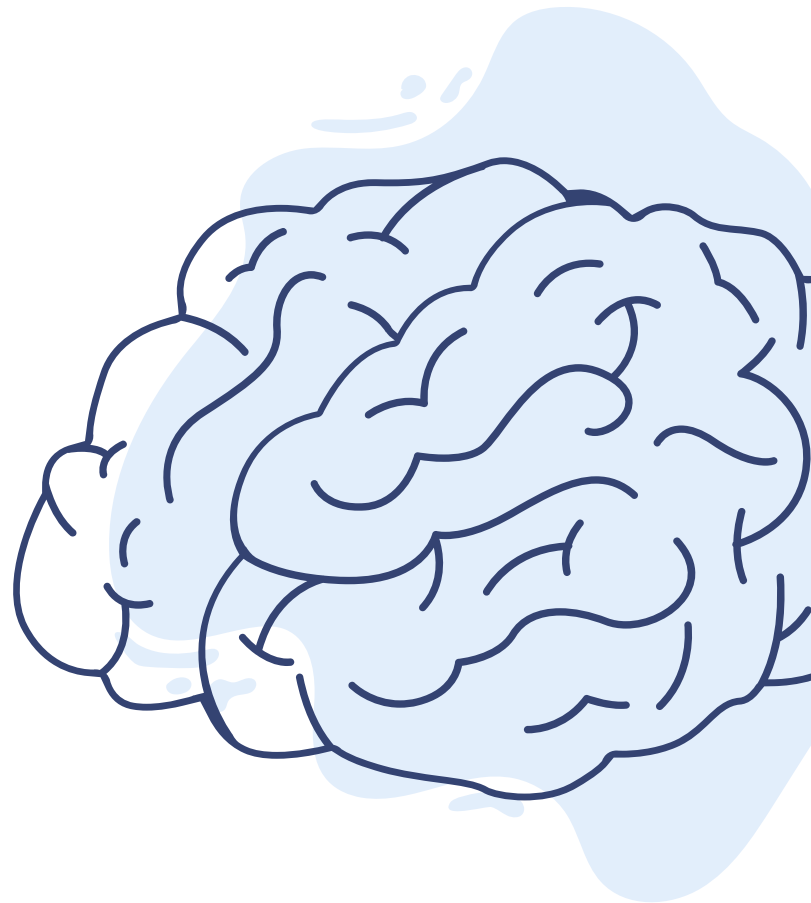


For our case, we use the same Convolution Layers but changed the feedforward layers and softmax.



RESNET152 Model

For our case, only the
softmax is changed





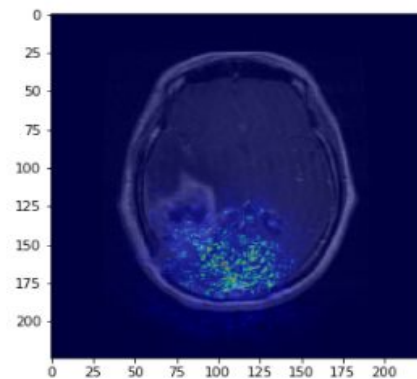
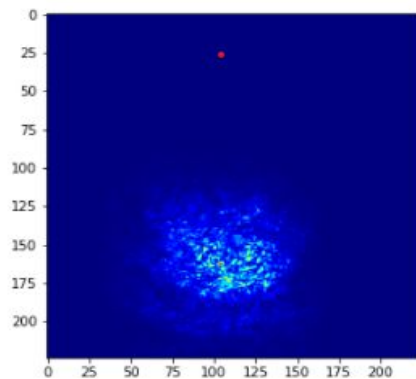
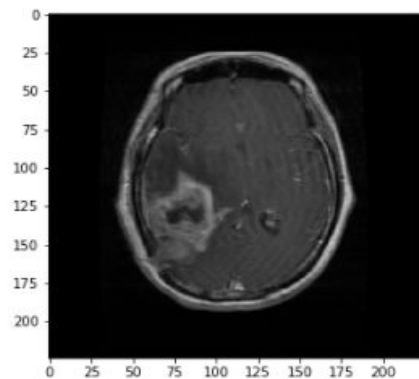
Key Takeaways

Model Performance

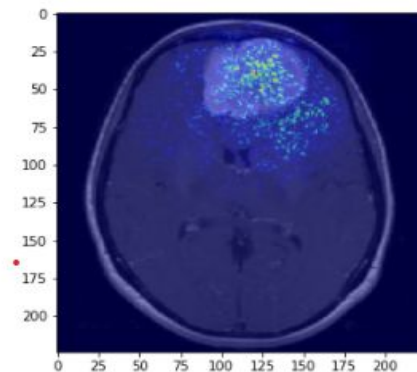
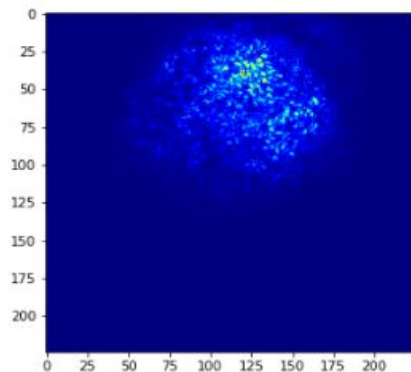
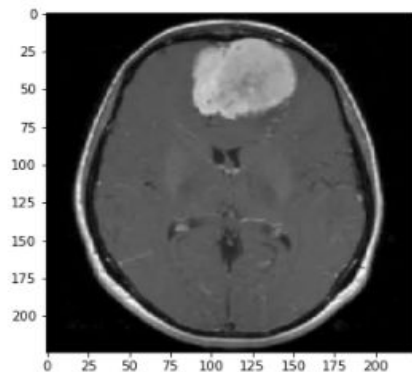
3 Convolution - 2 Feedforward + Softmax	97.5%
VGG16	96.5%
VGG16 - Last Convolution Trained	98%
ResNet (152)	95%
ResNet (152) - Last 2 Convolution Trained	97%

Gradient Activation Maps - VGG16

Glioma

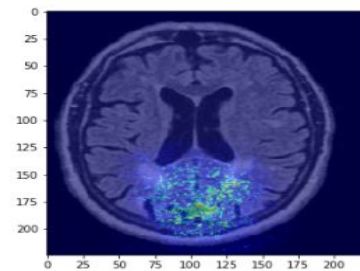
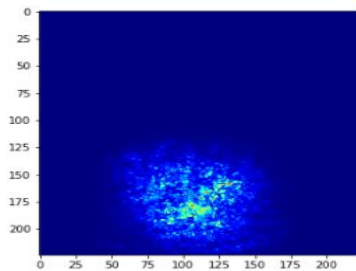
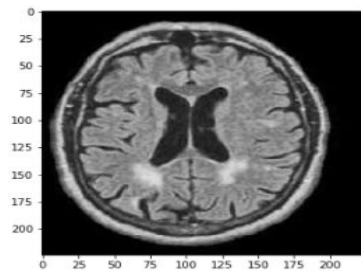


Meningioma

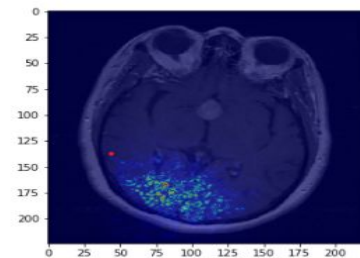
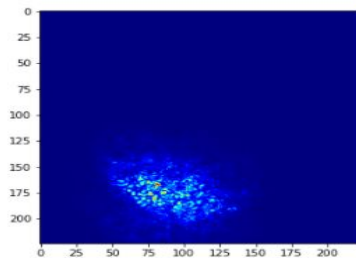
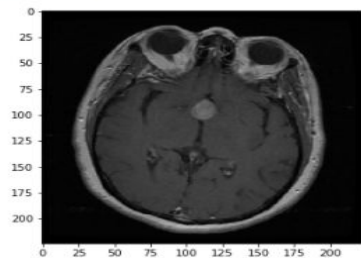


Gradient Activation Maps - Not so good

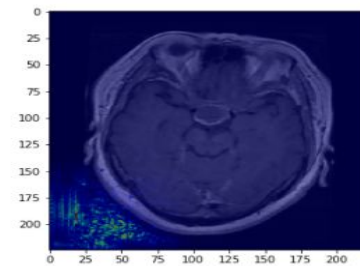
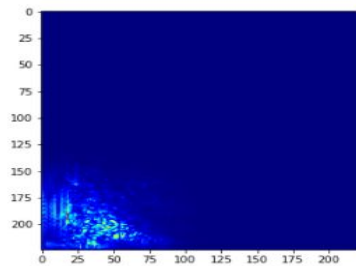
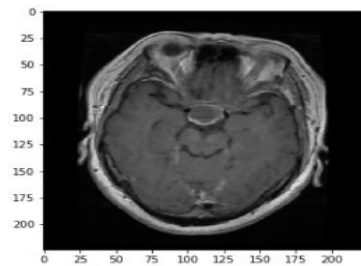
No Tumor



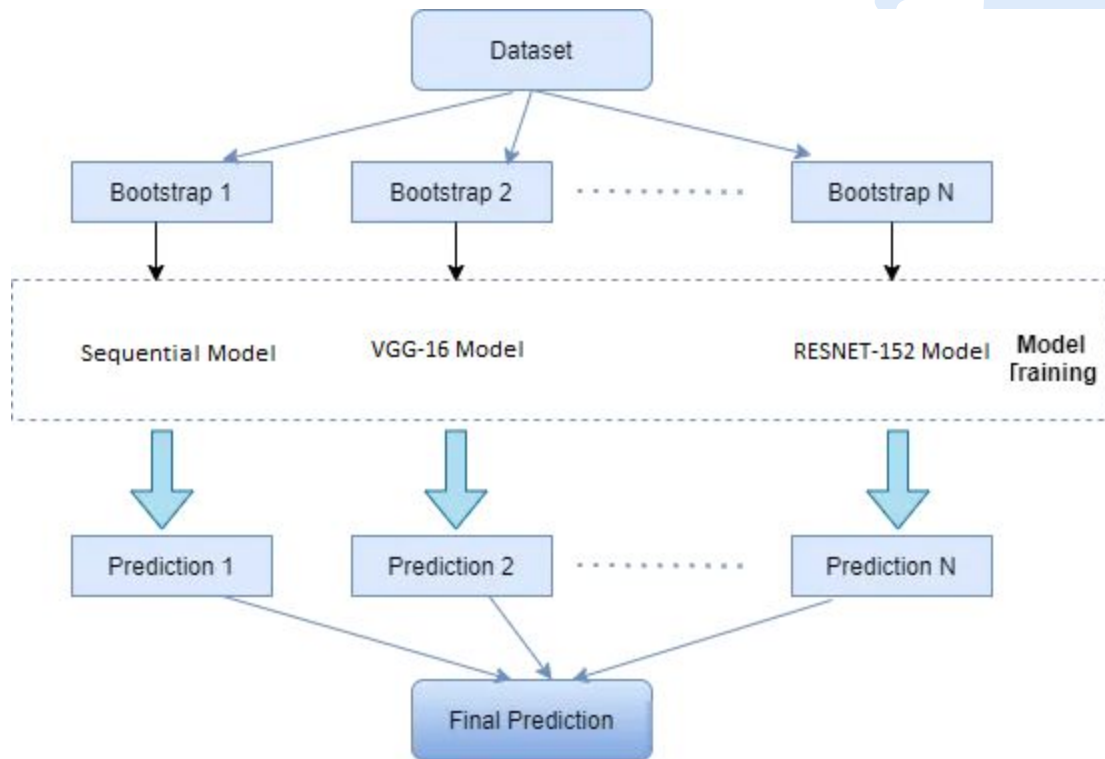
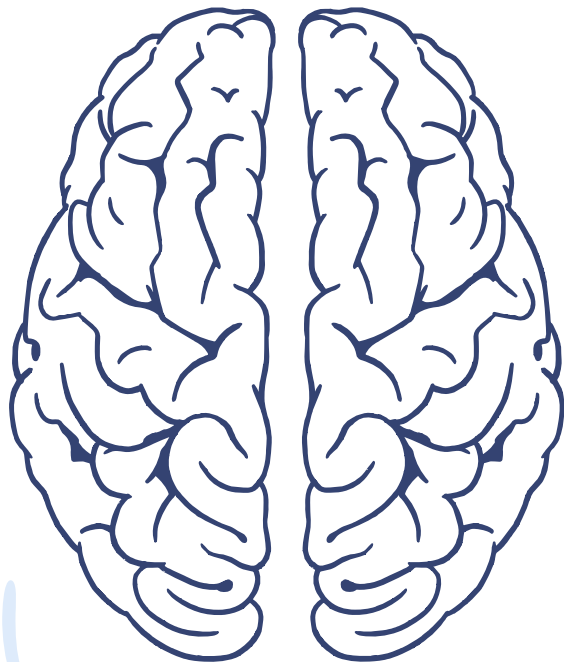
Pituitary



Pituitary



Next Steps - Ensemble Methods





Thank you!
Questions?