Brain Tumor Classification

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

24,530

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

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

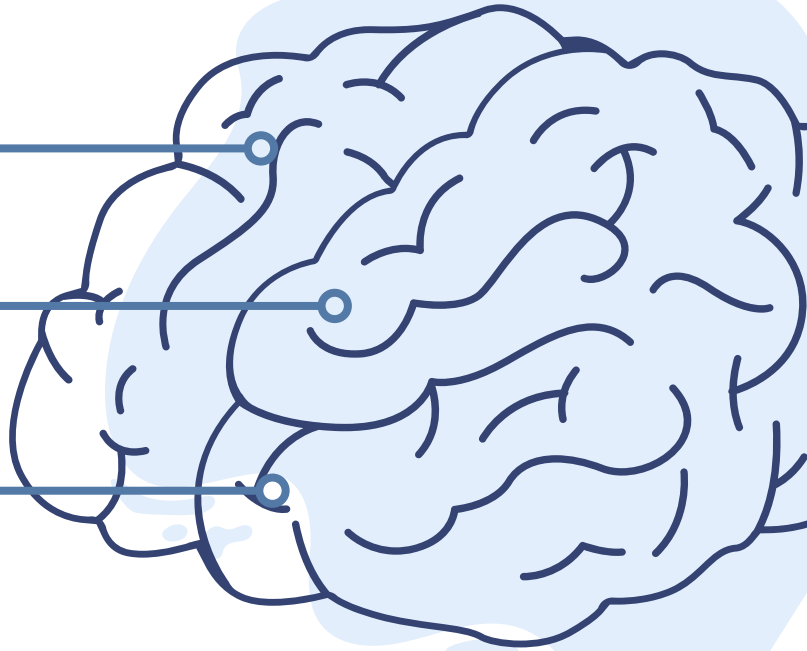
06 NEXT STEPS

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

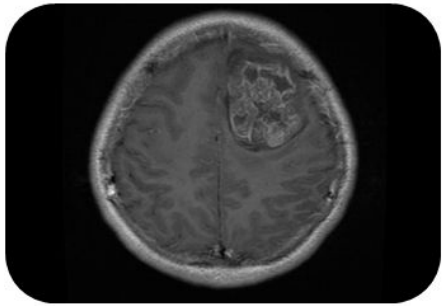
Topic of rapidly growing interest

5,000+

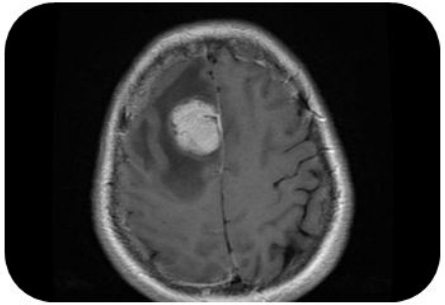
Research papers already published on the topic this year

Dataset

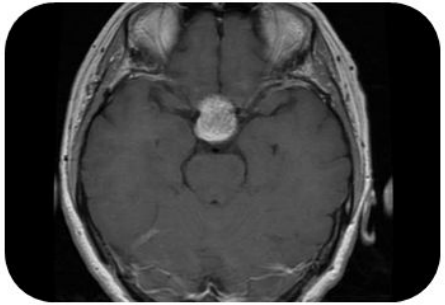
About the Dataset Used



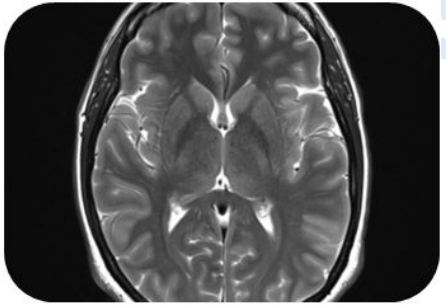
Glioma



Meningioma



Pituitary Tumor



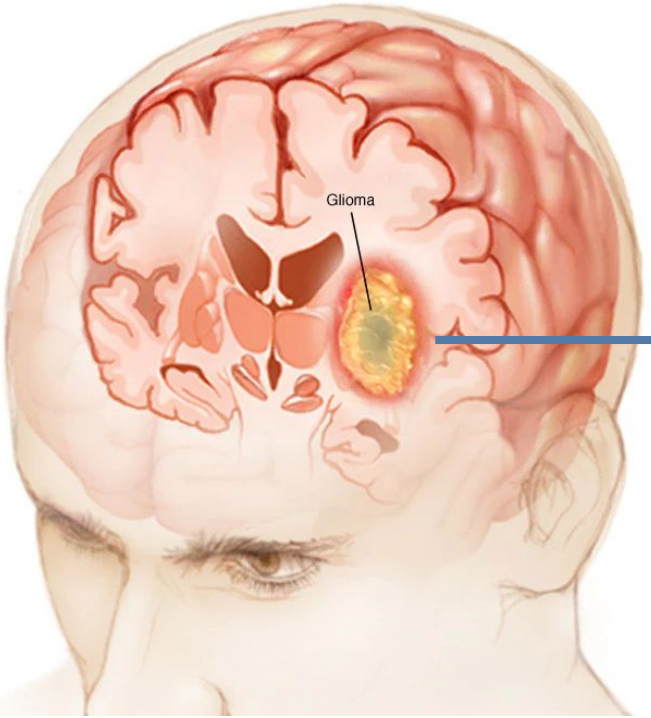
No Tumor

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**)

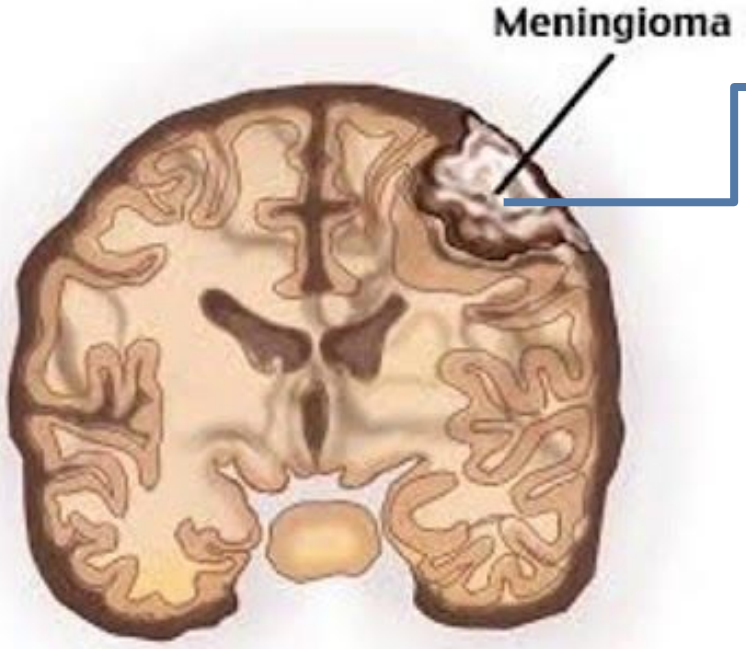
One of the **most common** types of brain tumors

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).

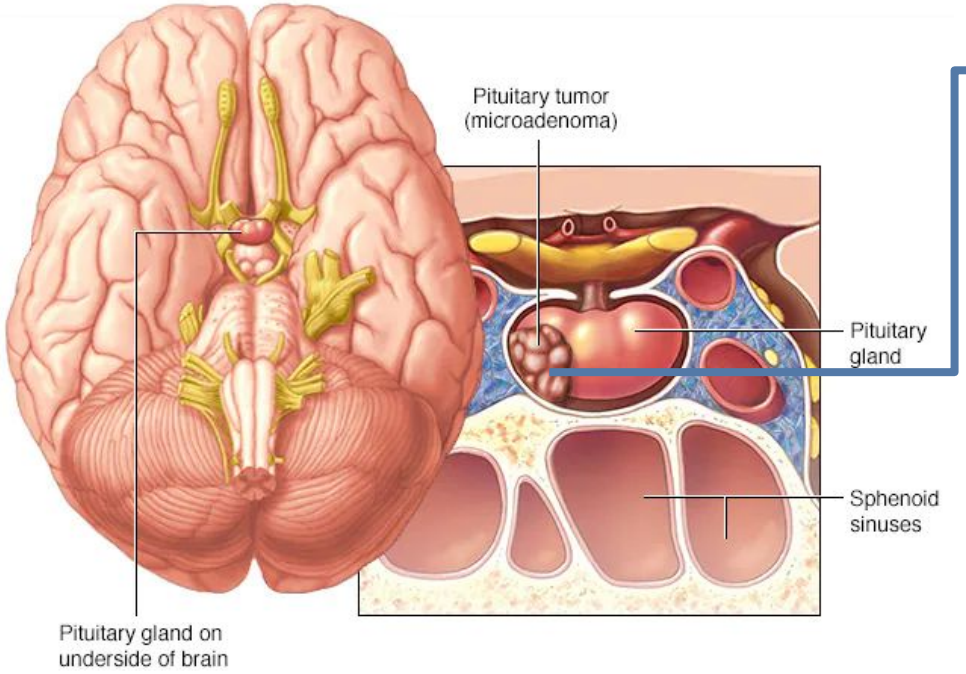
Often grow very slowly without causing symptoms

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



© MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH. ALL RIGHTS RESERVED.

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

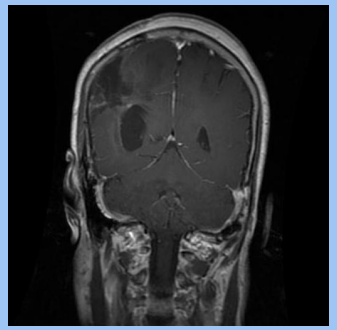
Augmentation

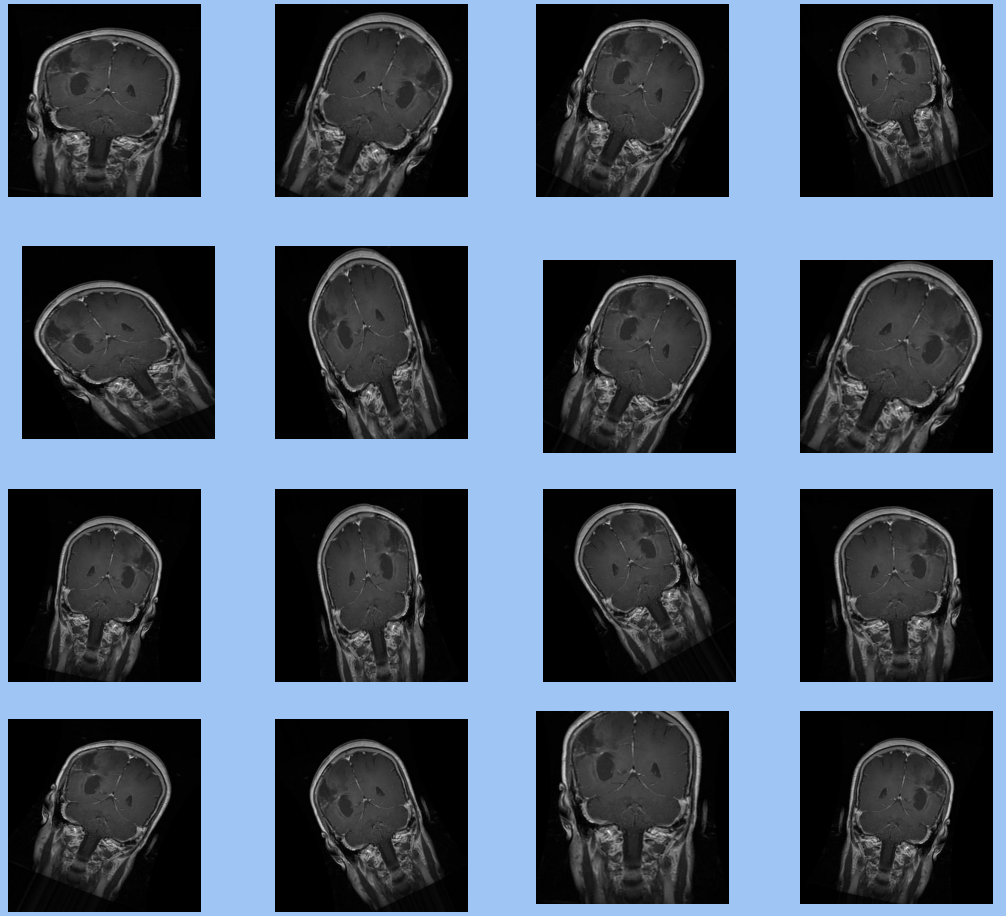
Increase diversity without collecting new data

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)
```

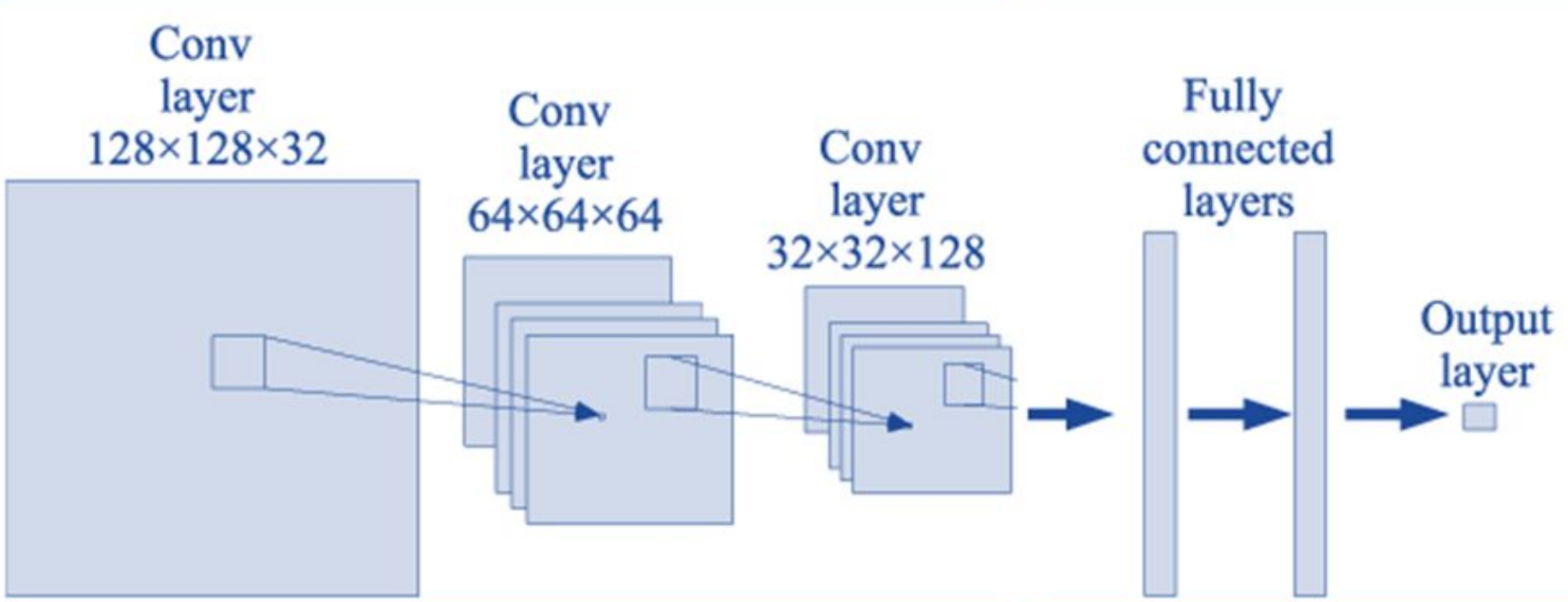
Augmented Images



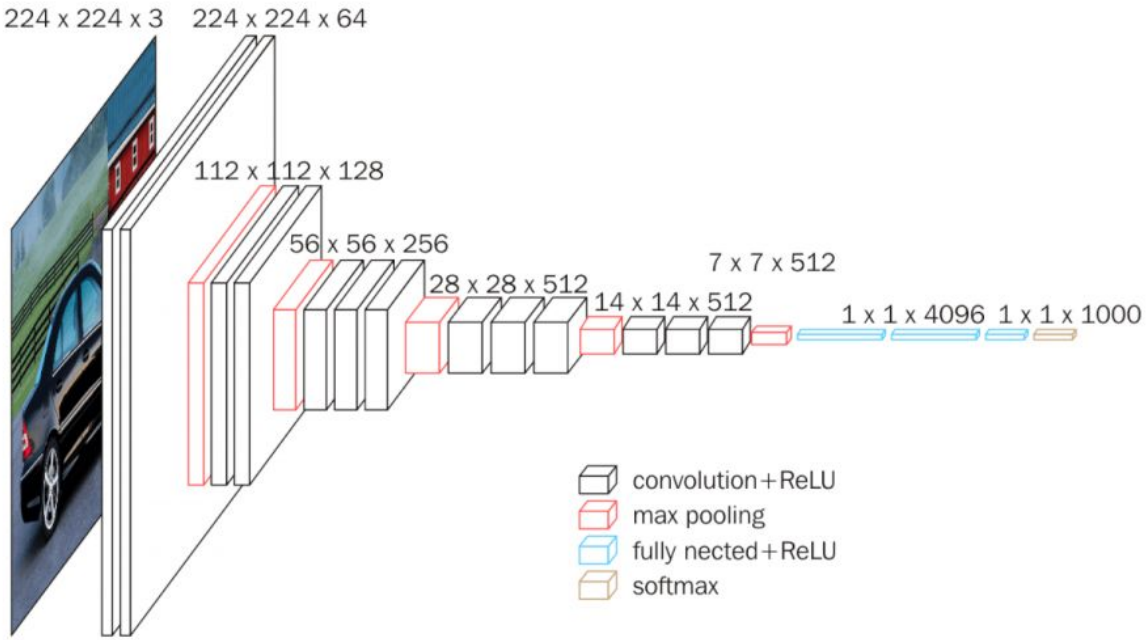


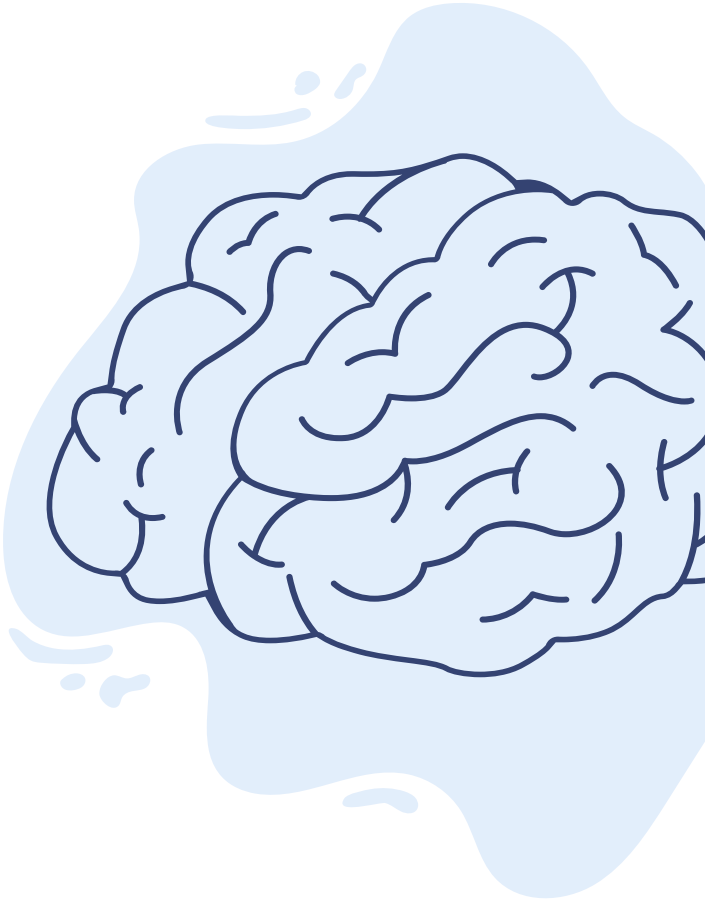
CNN Models

3 Convolution, 2 Feedforward + Softmax

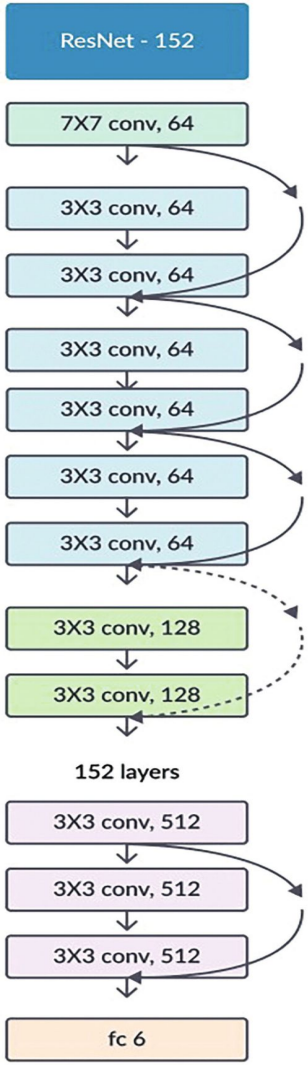


VGG16 Model



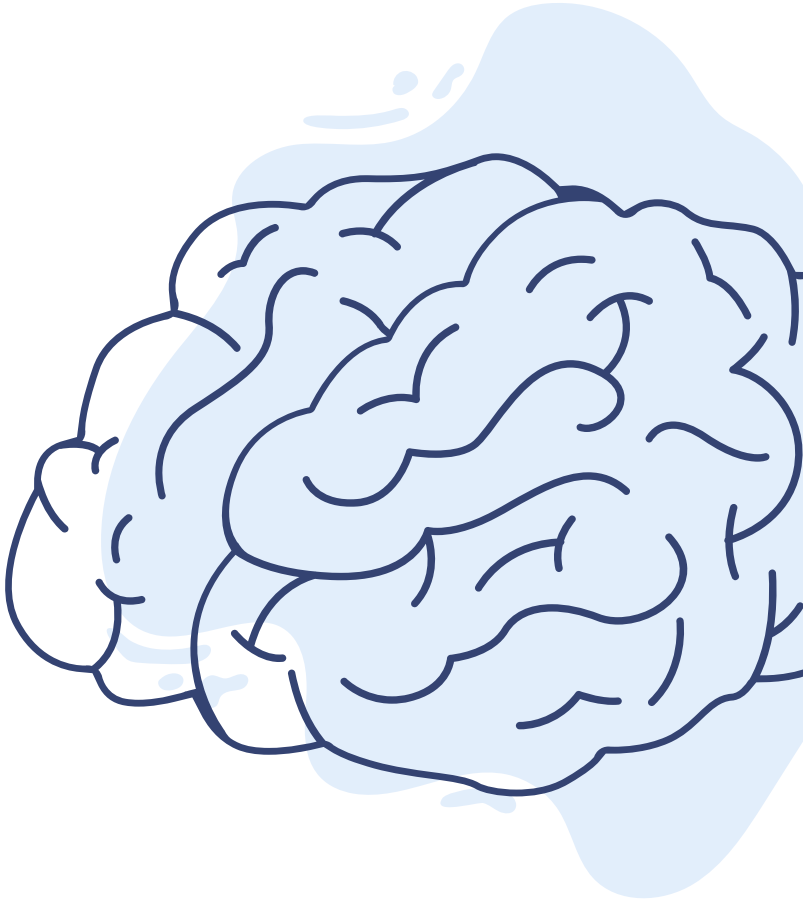


For our case, we use the same Convolution Layers but changed the feedforward layers and softmax.



RESNET152 Model

For our case, only the softmax is changed



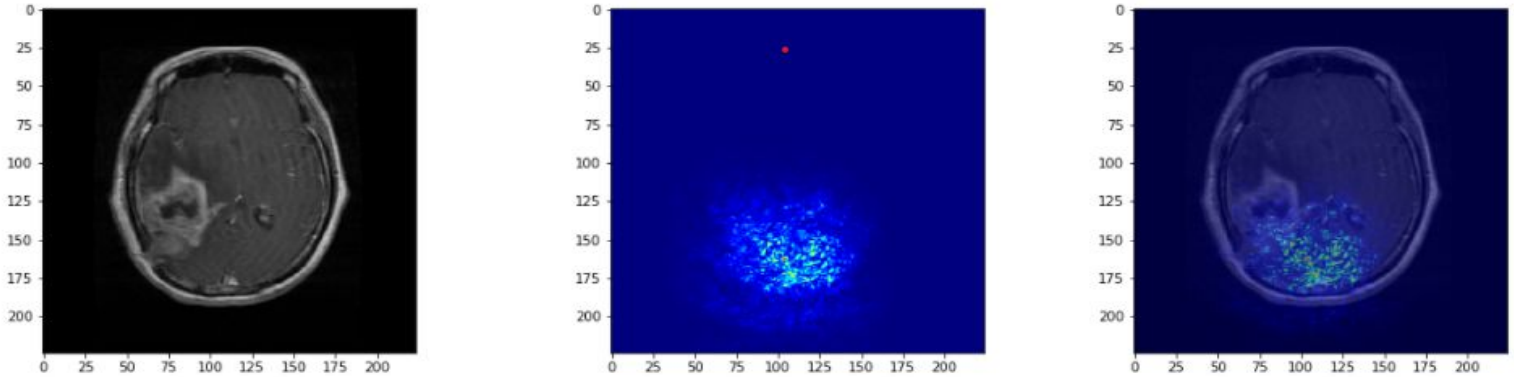
Key Takeaways

Model Performance

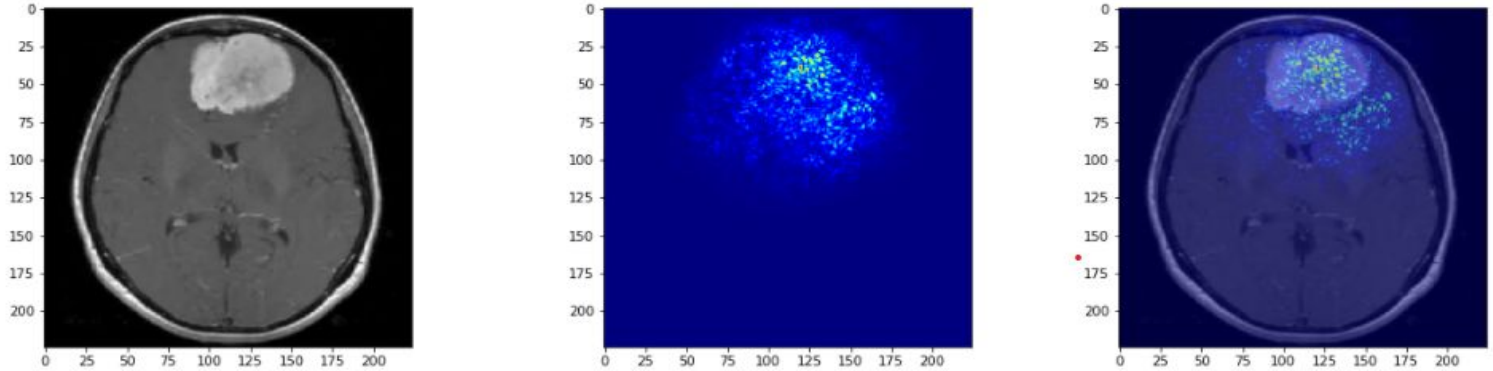
3 Convolution - 2 Feedforward + Softmax	97.5%
VGG16	96.5%
VGG16 - Last Convolution Trained	98%
ResNet (152)	95%
ResNet (152) - Last 2 Convolution Trained	97%

Gradient Activation Maps - VGG16

Glioma

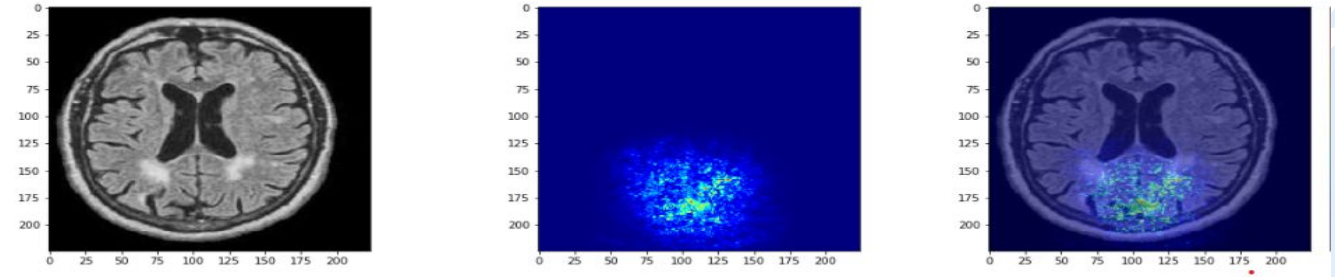


Meningioma

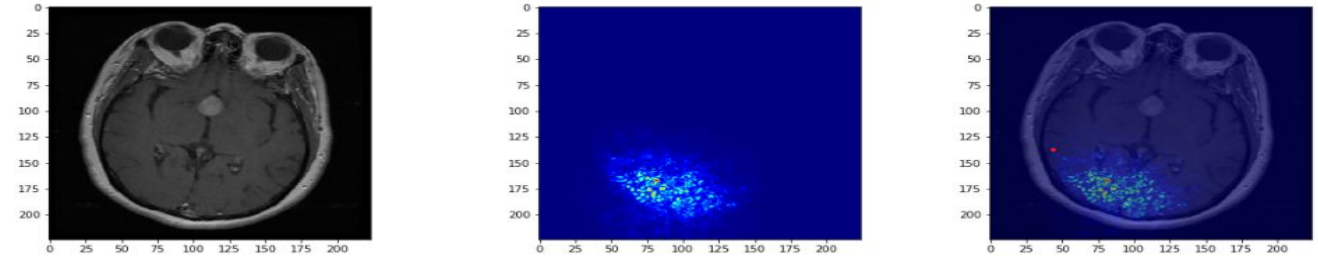


Gradient Activation Maps - Not so good

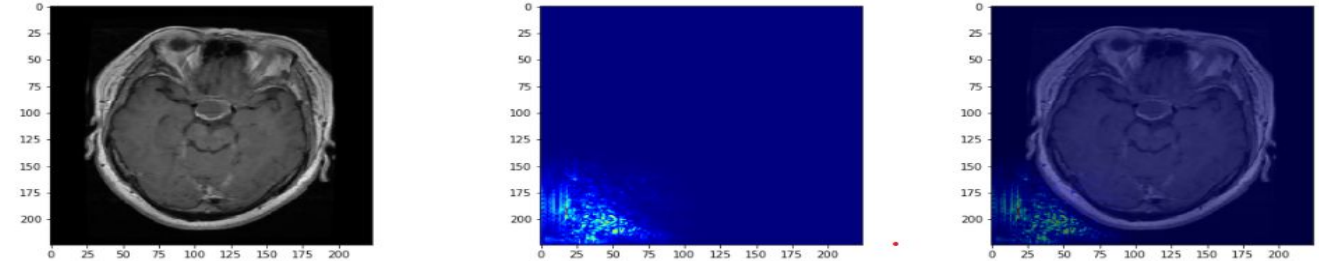
No Tumor



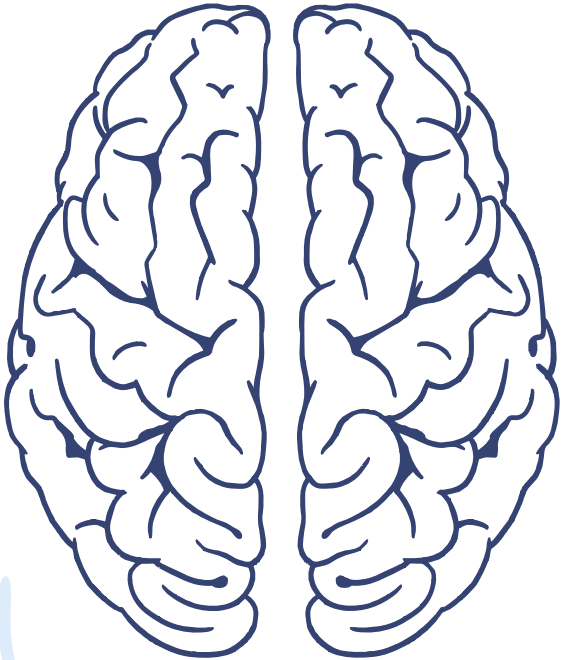
Pituitary

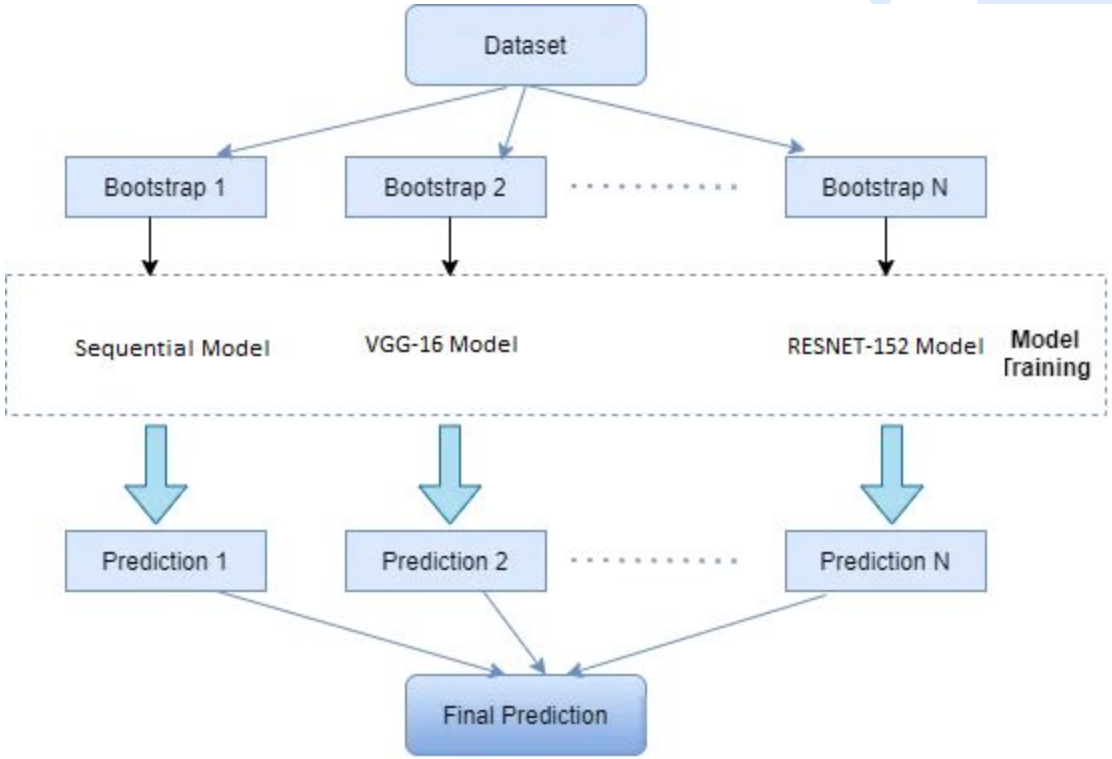


Pituitary



Next Steps - Ensemble Methods





Thank you!
Questions?