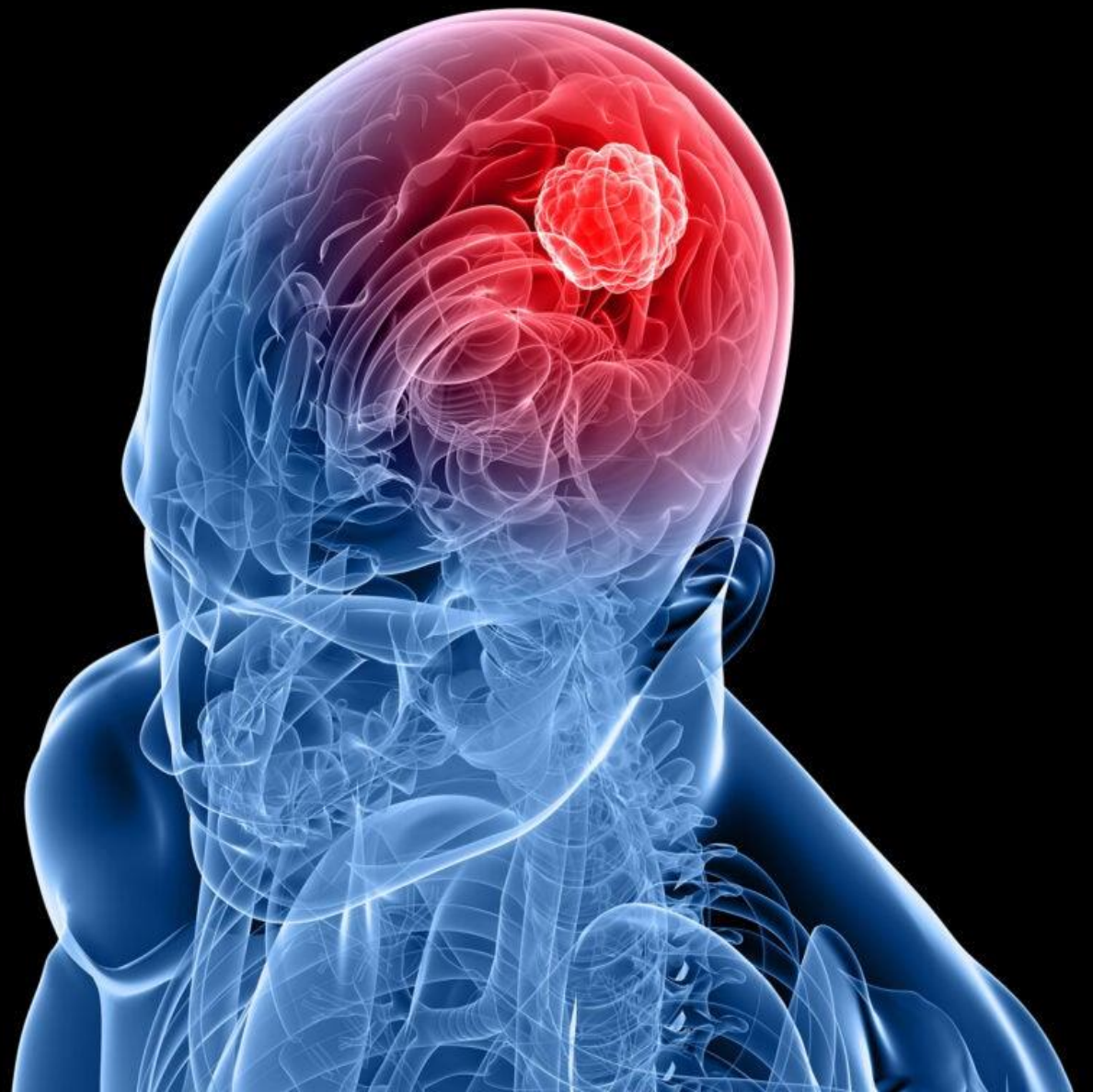
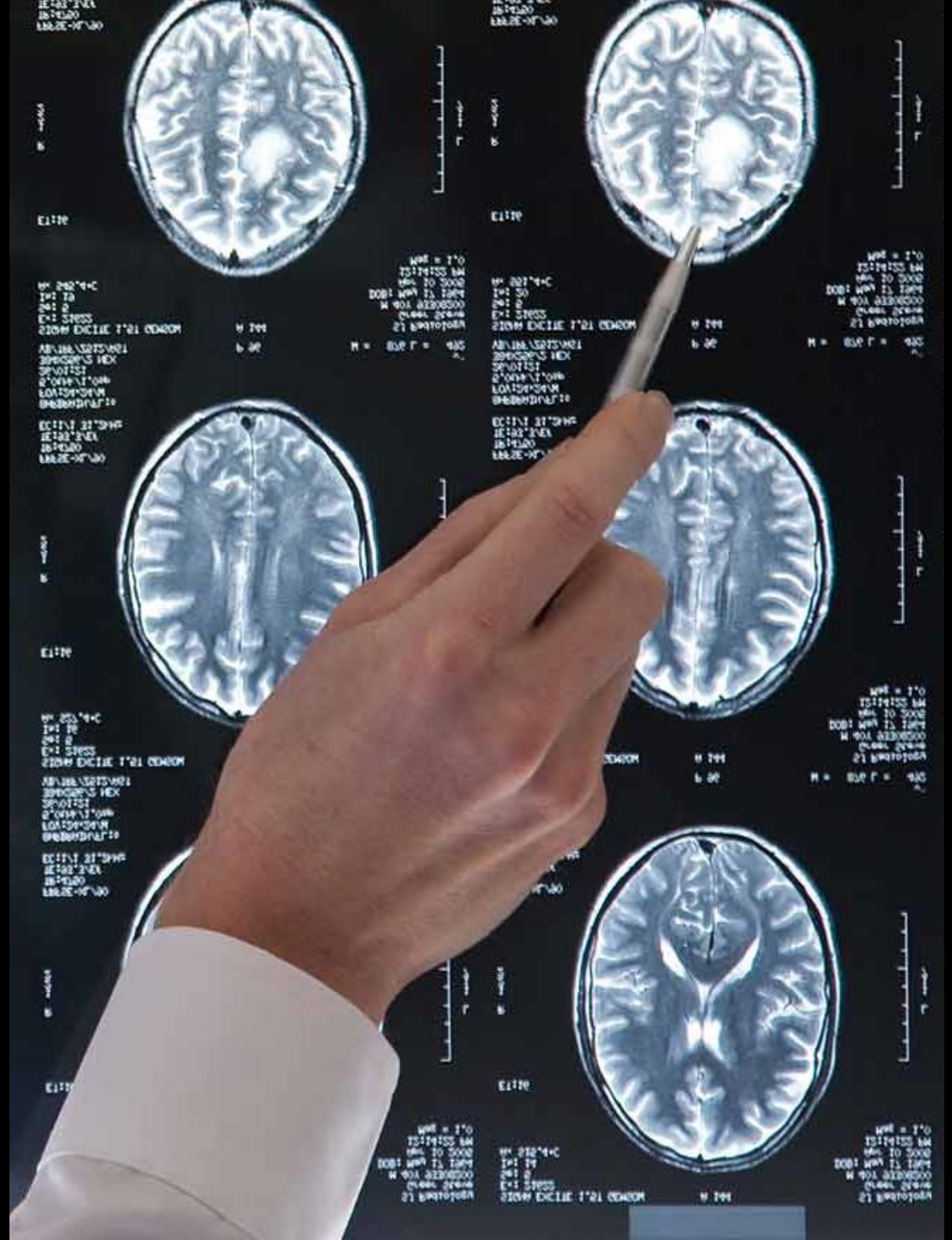
Brain Tumor Classification



Annie Hsu
Mentor: Jeff Hevrin

Springboard



Brain Tumor

- #10 leading cause of death
- 5-year survival rate is 36%
- Review MRI scans is time consuming and prone to error

Can machine learning help in classifying the brain tumors from MRI scans?

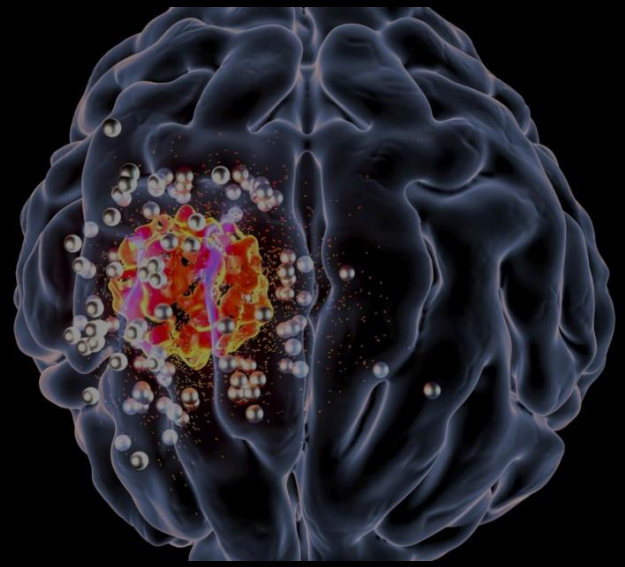
Data source

Dataset was taken from Kaggle.com

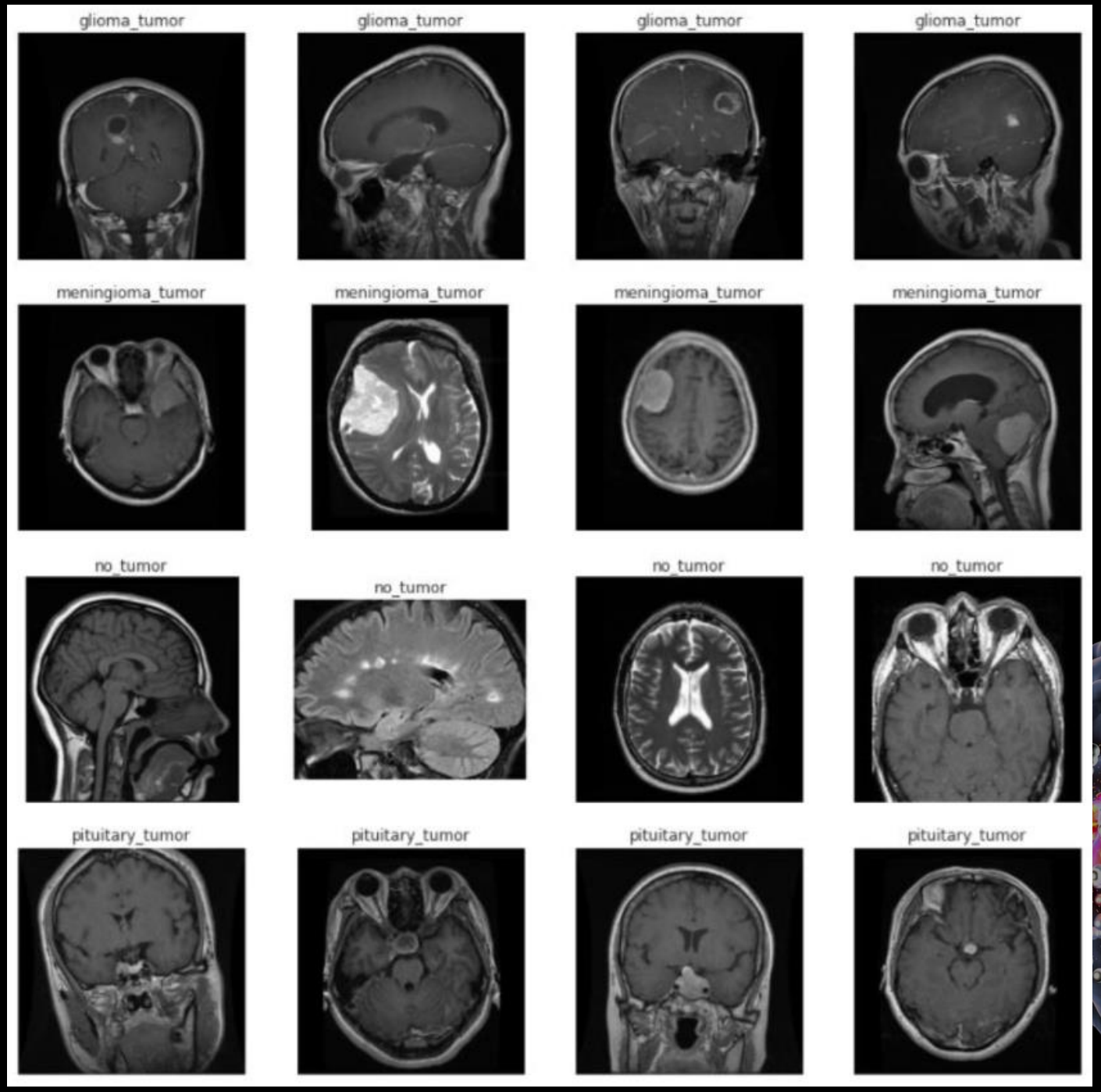
- Training: 2870 MRI brain images

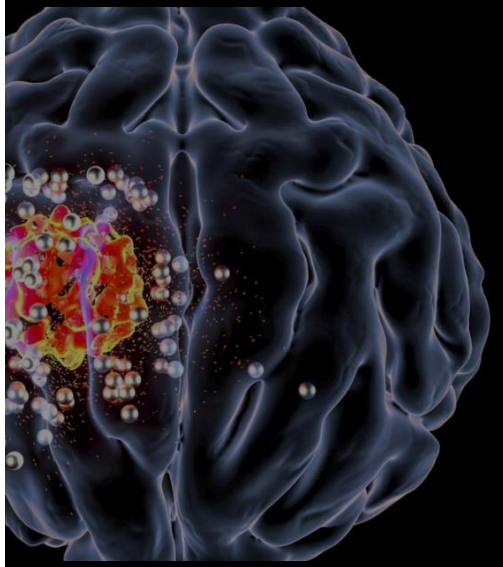
  20% for validation

- Testing: 394 images
- 4 classes: Glioma tumor
  Meningioma tumor
  Pituitary tumor
  No tumor

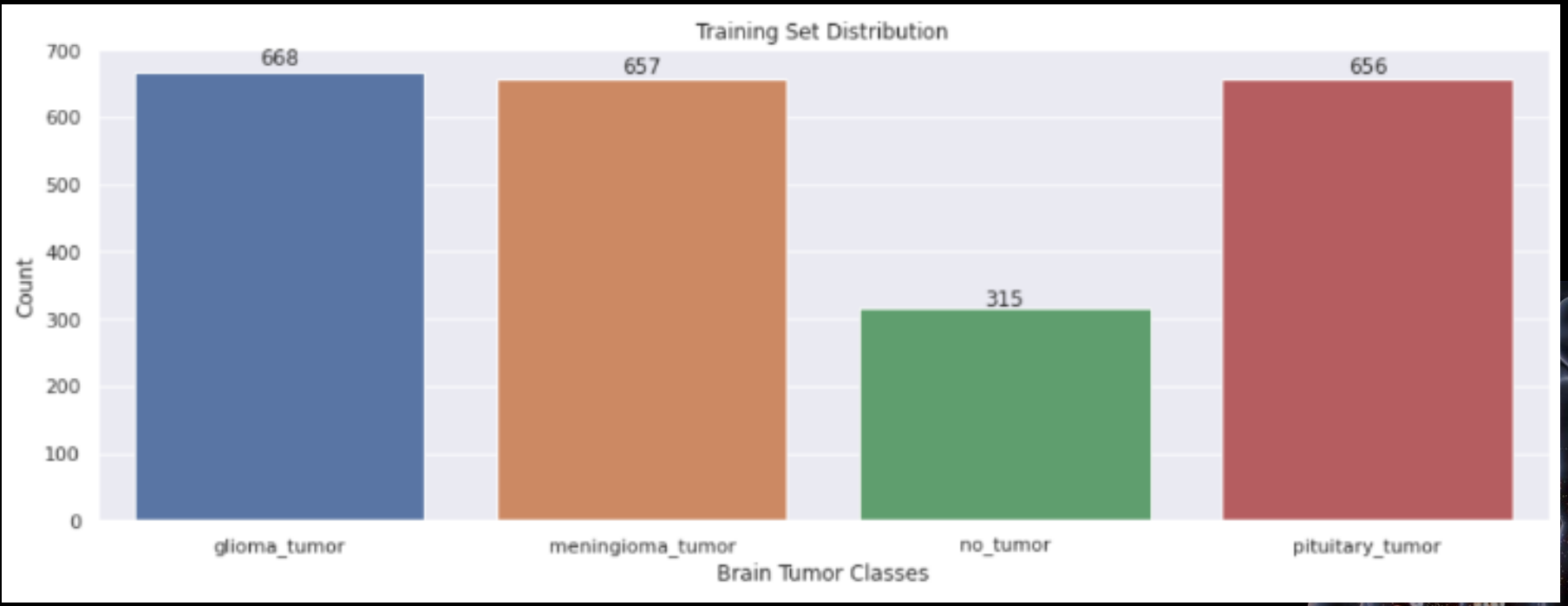


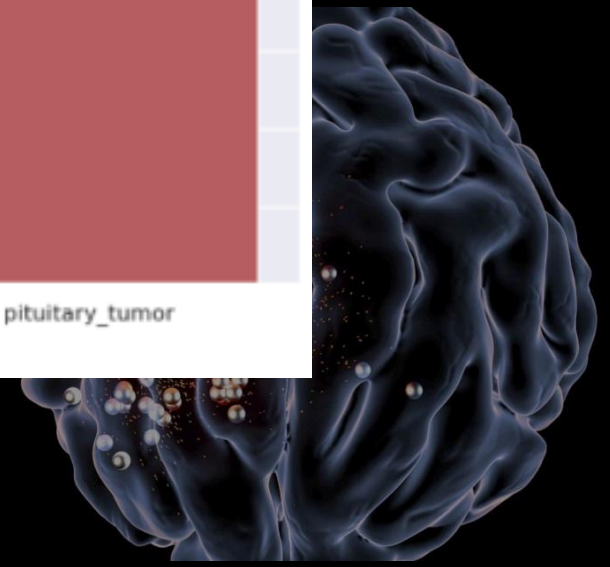
Sample images





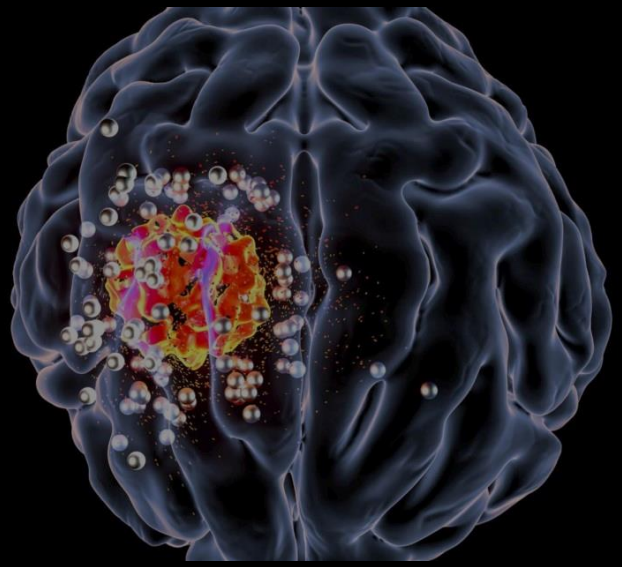
Class distribution in training set



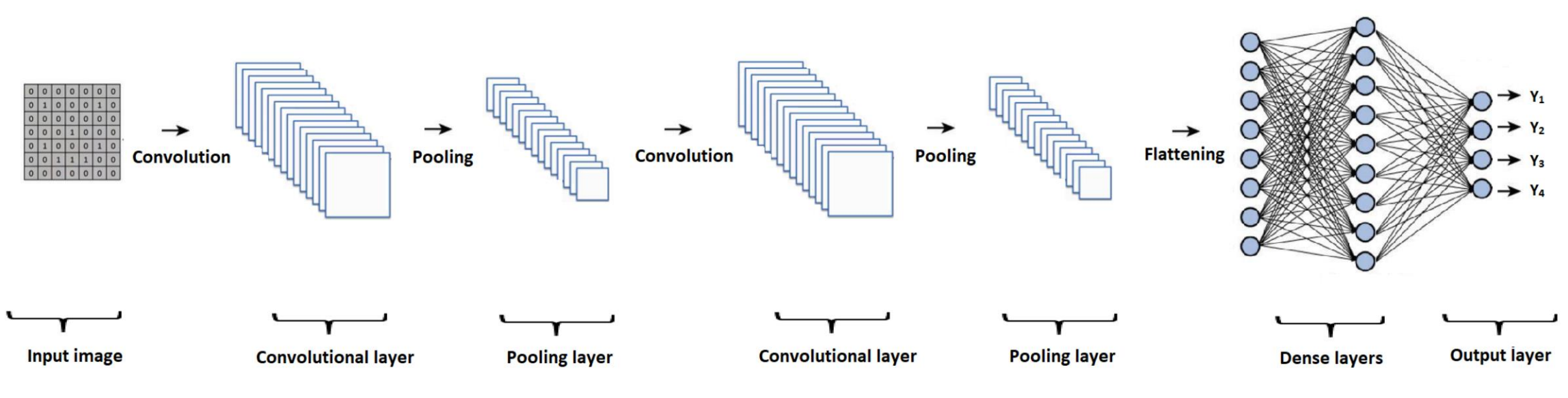


Models

1. Baseline model
2. EfficientNet-B1
3. EfficientNet-B1 with image pre-processing

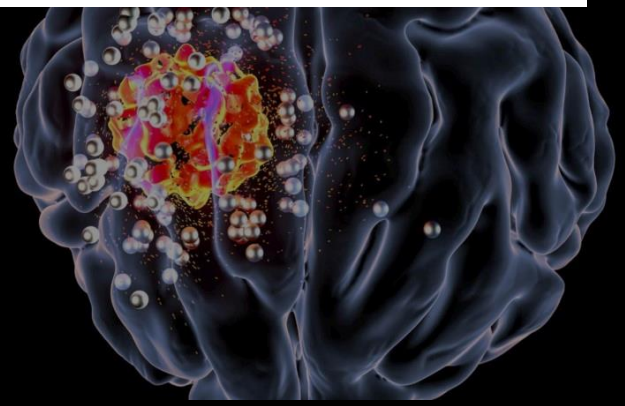


Baseline model

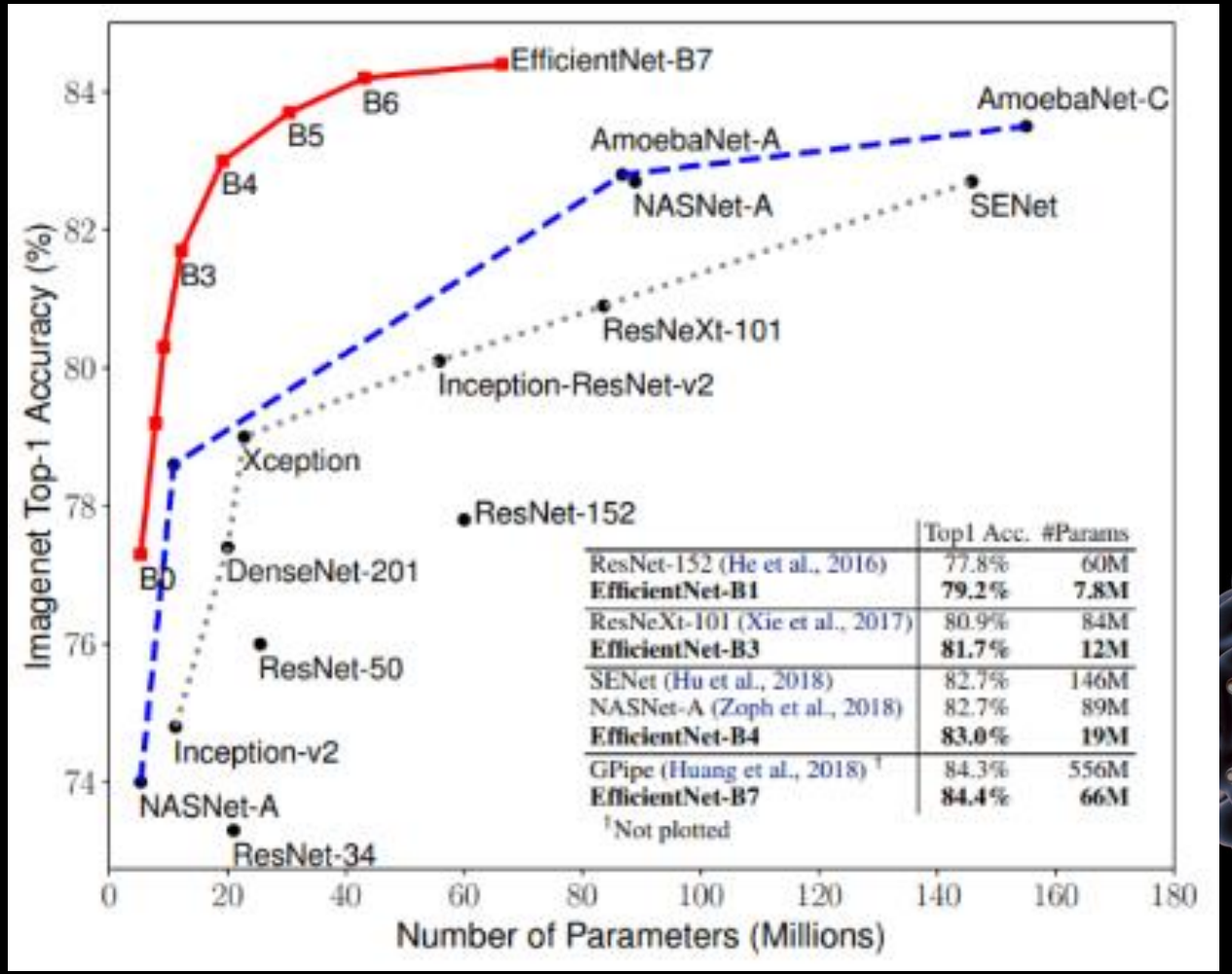


Learning rate: 1e-3
Epochs: 10

Training accuracy: 99.43%
Validation accuracy: 89.20%
Testing accuracy: 68.53%

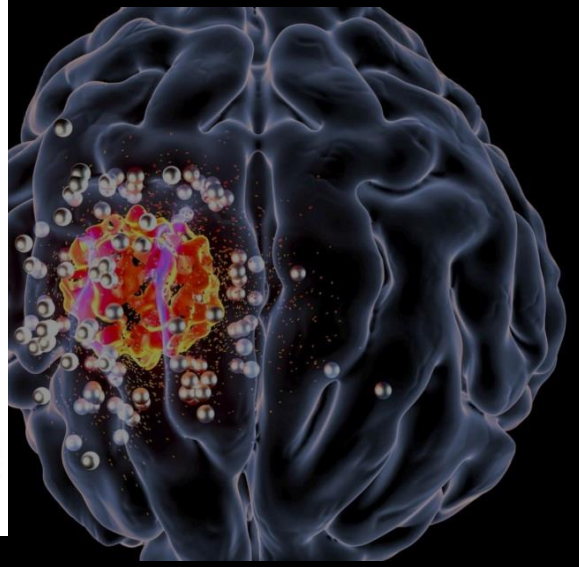


EfficientNet Models



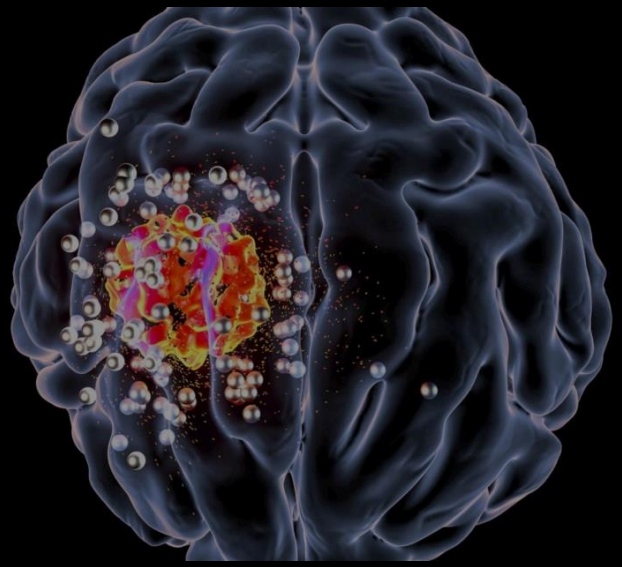
	Top1 Acc.	#Params
ResNet-152 (He et al., 2016)	77.8%	60M
EfficientNet-B1	**79.2%**	**7.8M**
ResNeXt-101 (Xie et al., 2017)	80.9%	84M
EfficientNet-B3	**81.7%**	**12M**
SENet (Hu et al., 2018)	82.7%	146M
NASNet-A (Zoph et al., 2018)	82.7%	89M
EfficientNet-B4	**83.0%**	**19M**
GPipe (Huang et al., 2018) †	84.3%	556M
EfficientNet-B7	**84.4%**	**66M**

†Not plotted



EfficientNet-B1 model

- Image Augmentation
- Compute class weight
- Build and train model
- Fine-tune model



EfficientNet-B1 model

- Image Augmentation
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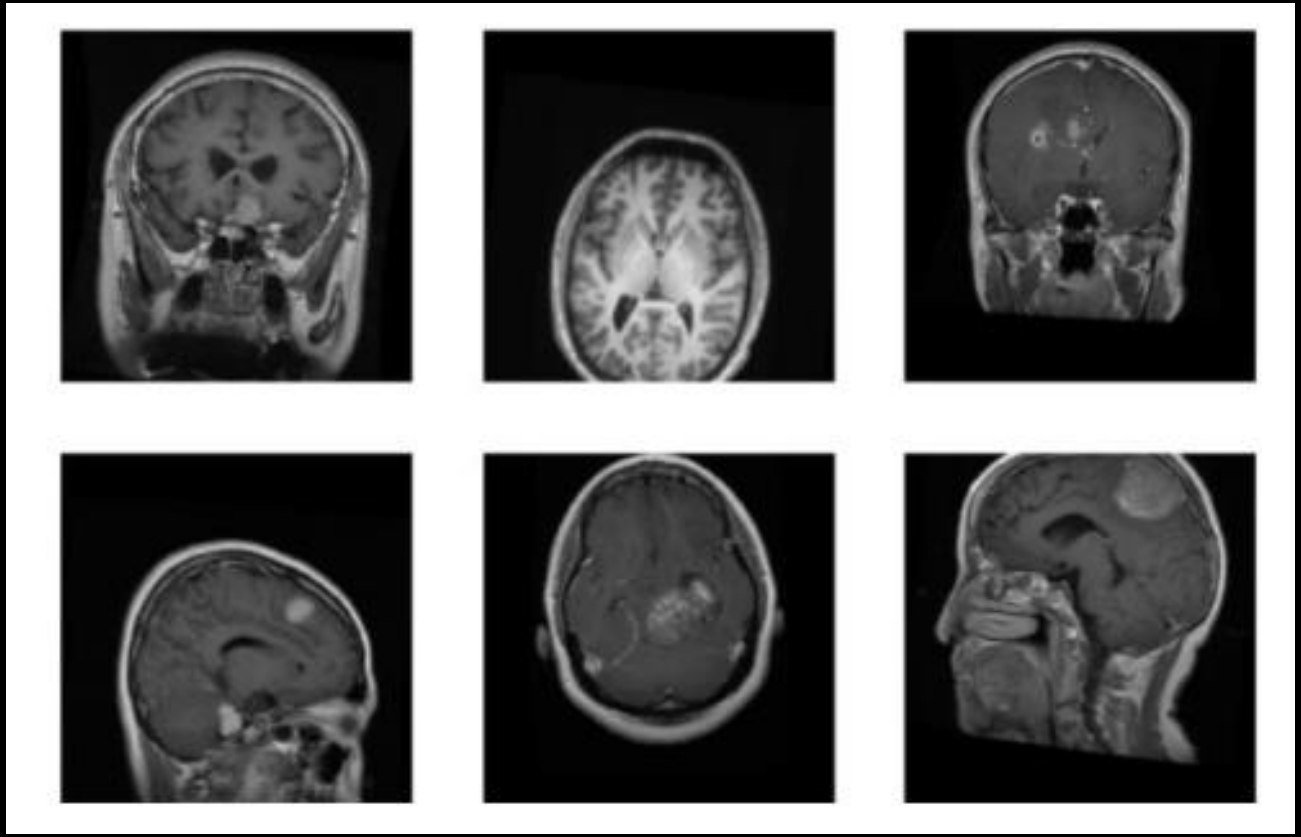
Keras ImageDataGenerator



EfficientNet-B1 model

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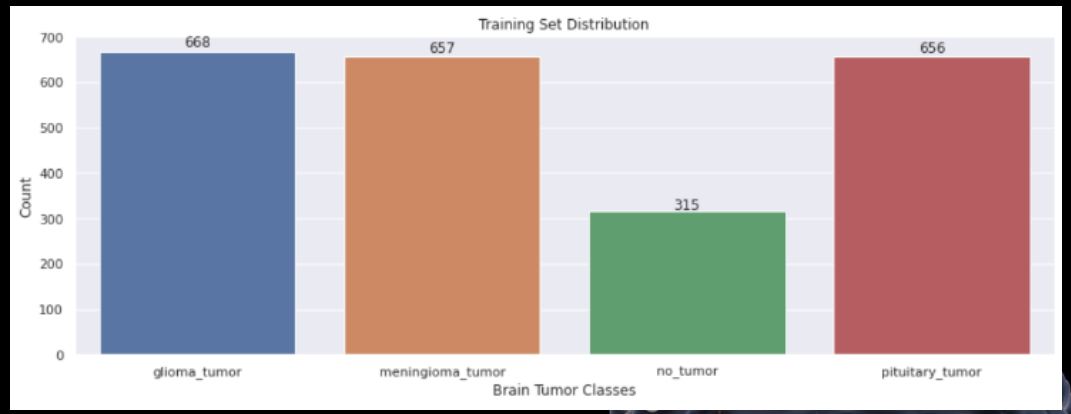
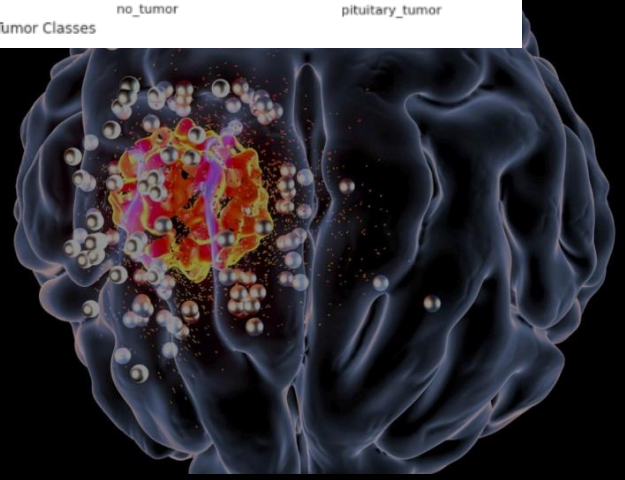




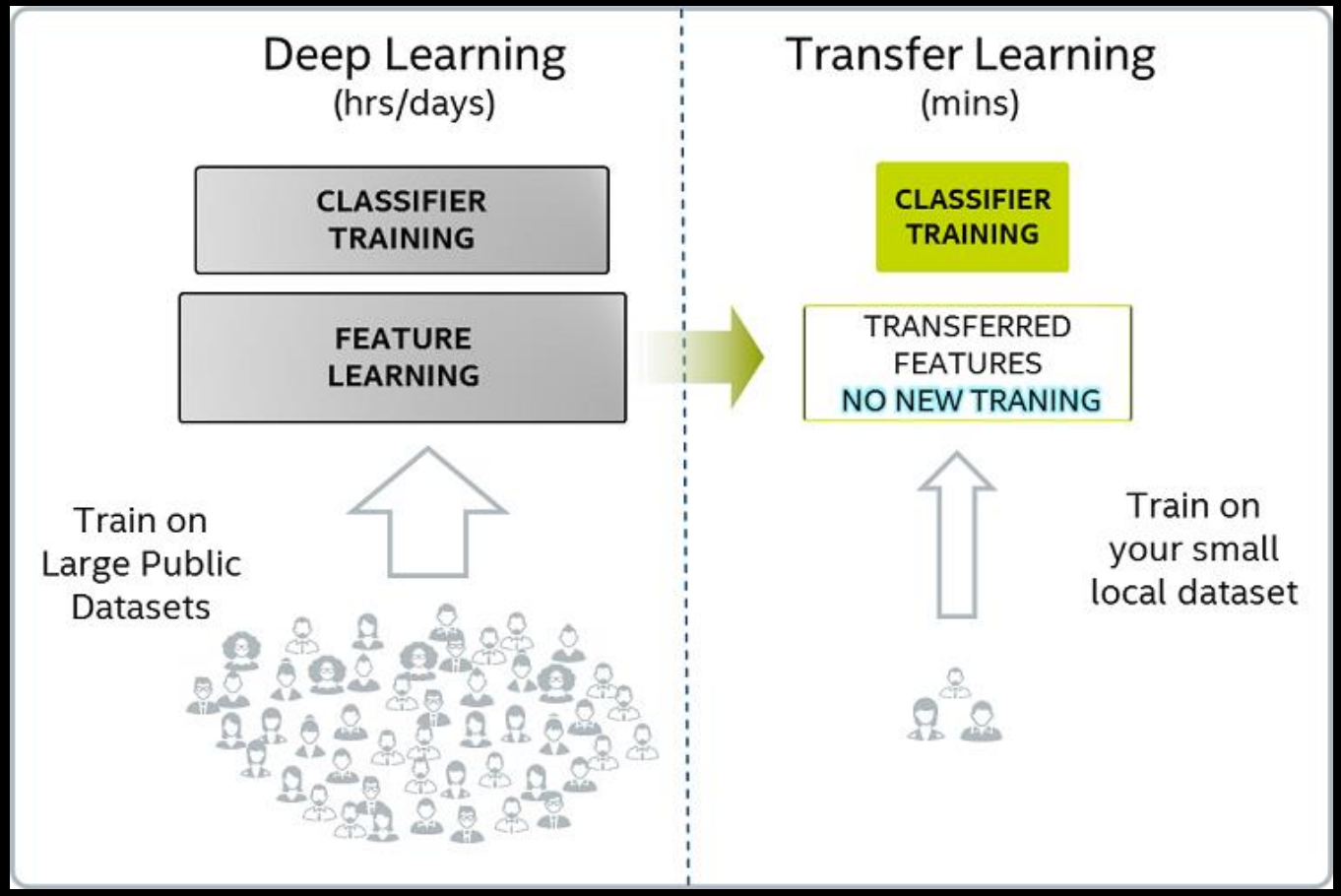
EfficientNet-B1 model

- Image Augmentation
- Compute class weight
- Build and train model
- Fine-tune model

Freeze base model
Learning rate: 1e-3
Epochs: 10

Training accuracy: 85.85%
Validation accuracy: 76.61%
Testing accuracy: 59.90%

EfficientNet-B1: 339 layers and 7,836,239 parameters

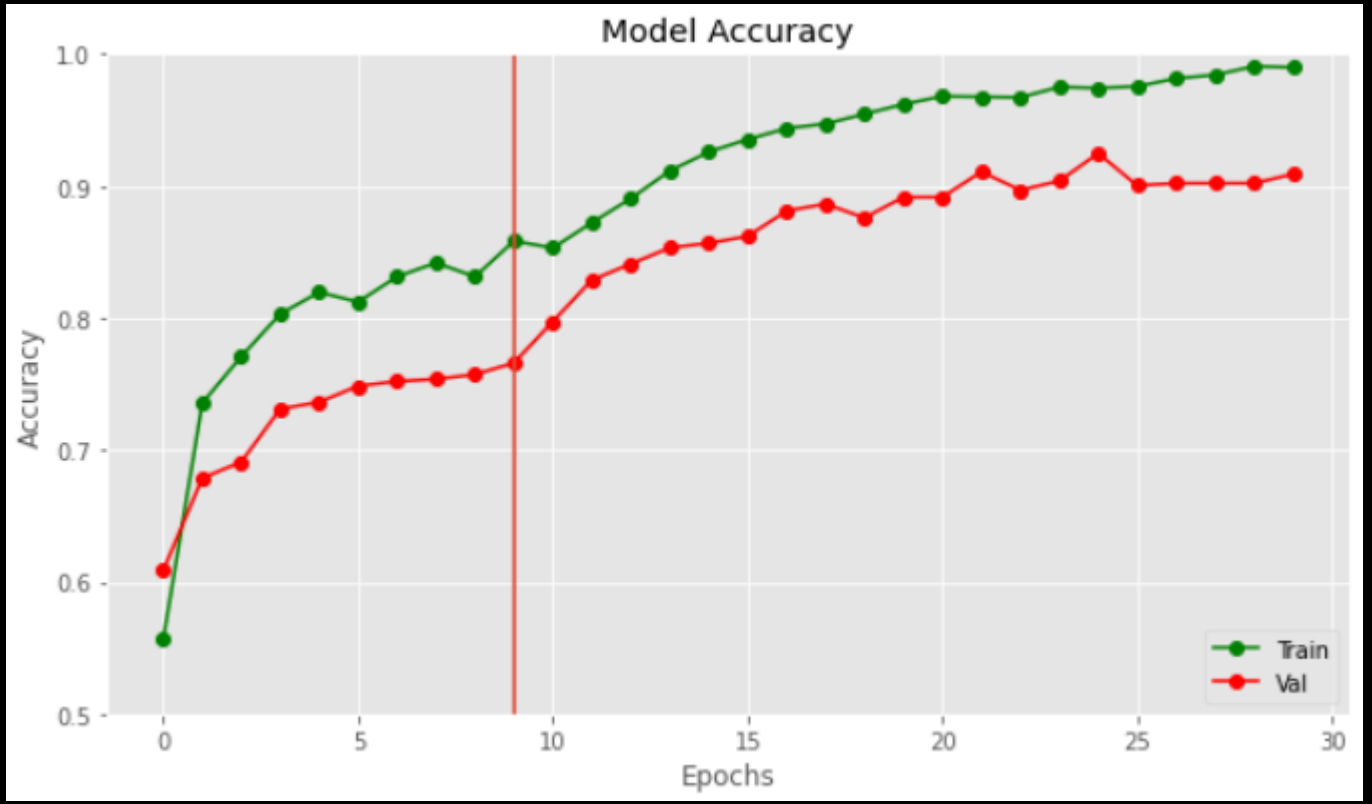


EfficientNet-B1 model

- Image Augmentation
- Compute class weight
- Build and train model
- Fine-tune model

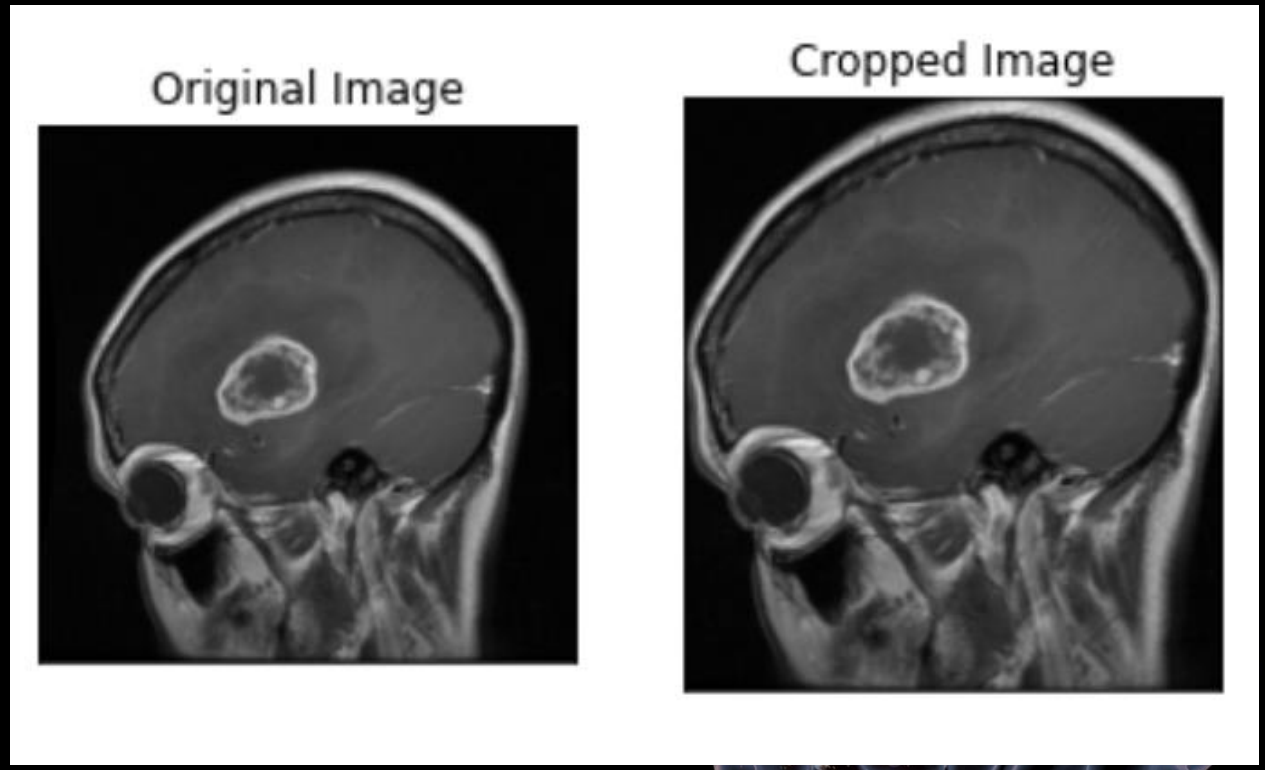
Unfreeze base model
Learning rate: 1e-5
Epochs: 50

Training accuracy: 99.00%
Validation accuracy: 90.92%
Testing accuracy: 77.66%



EfficientNet-B1 model With Image Pre-processing

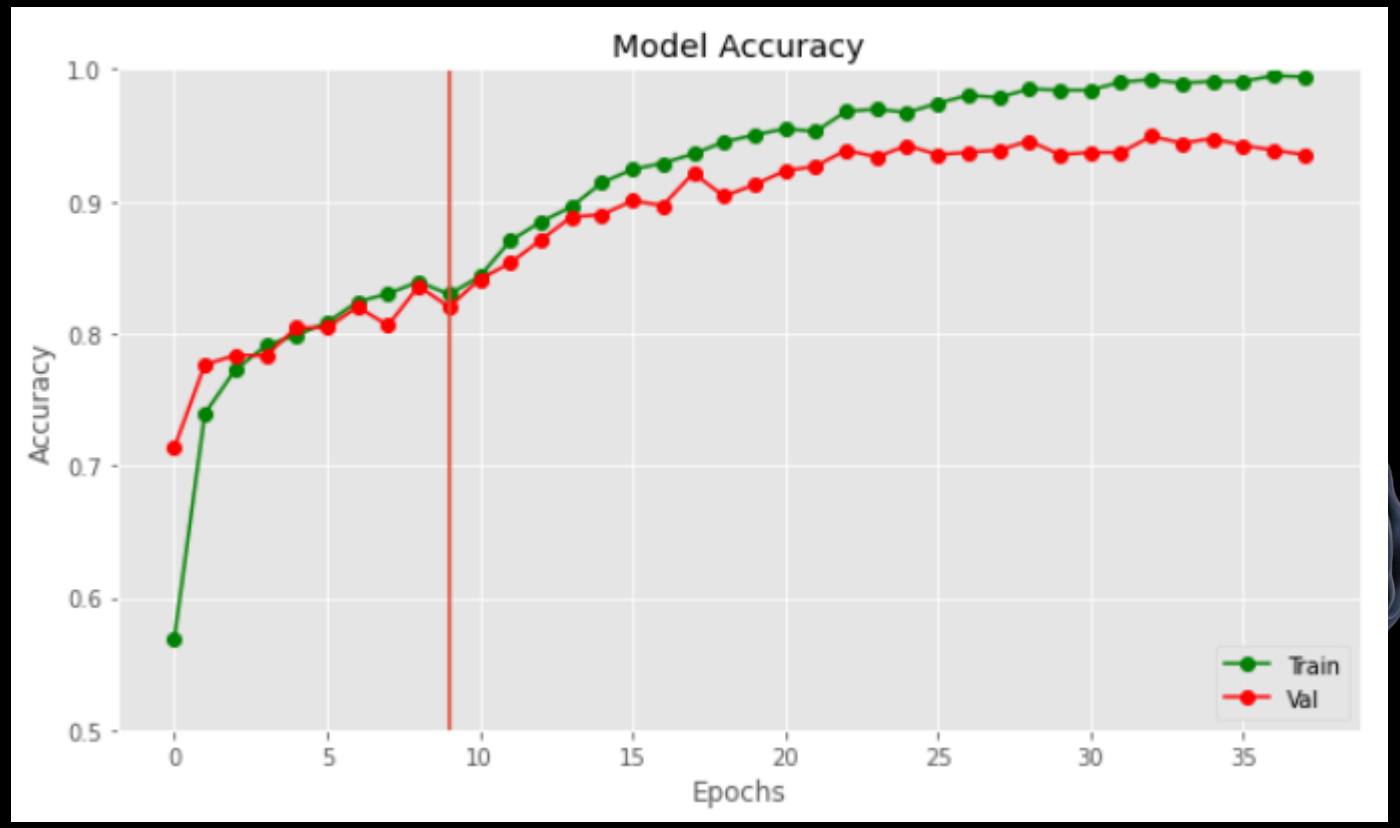
- Image Pre-processing
- Image Augmentation
- Compute class weight
- Build and train model
- Fine-tune model



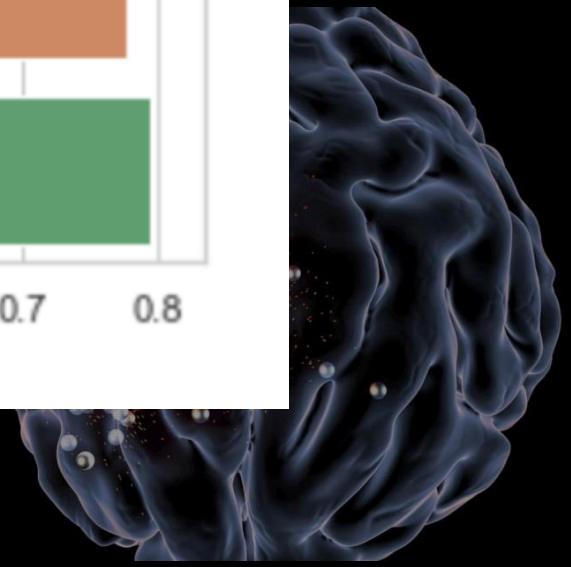
EfficientNet-B1 model With Image Pre-processing

After fine-tuning
Learning rate: 1e-5
Epochs: 50

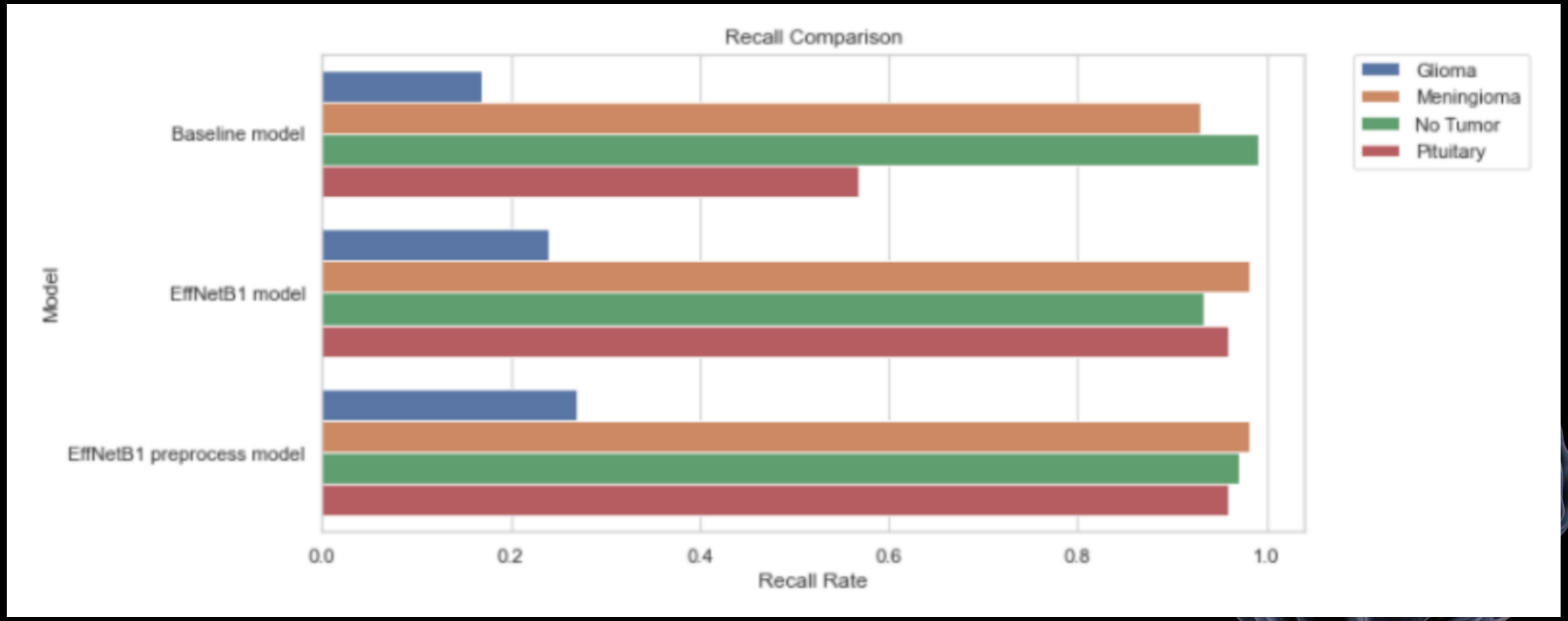
Training accuracy: 99.43%
Validation accuracy: 93.54%
Testing accuracy: 79.44%



Analysis – Test accuracy



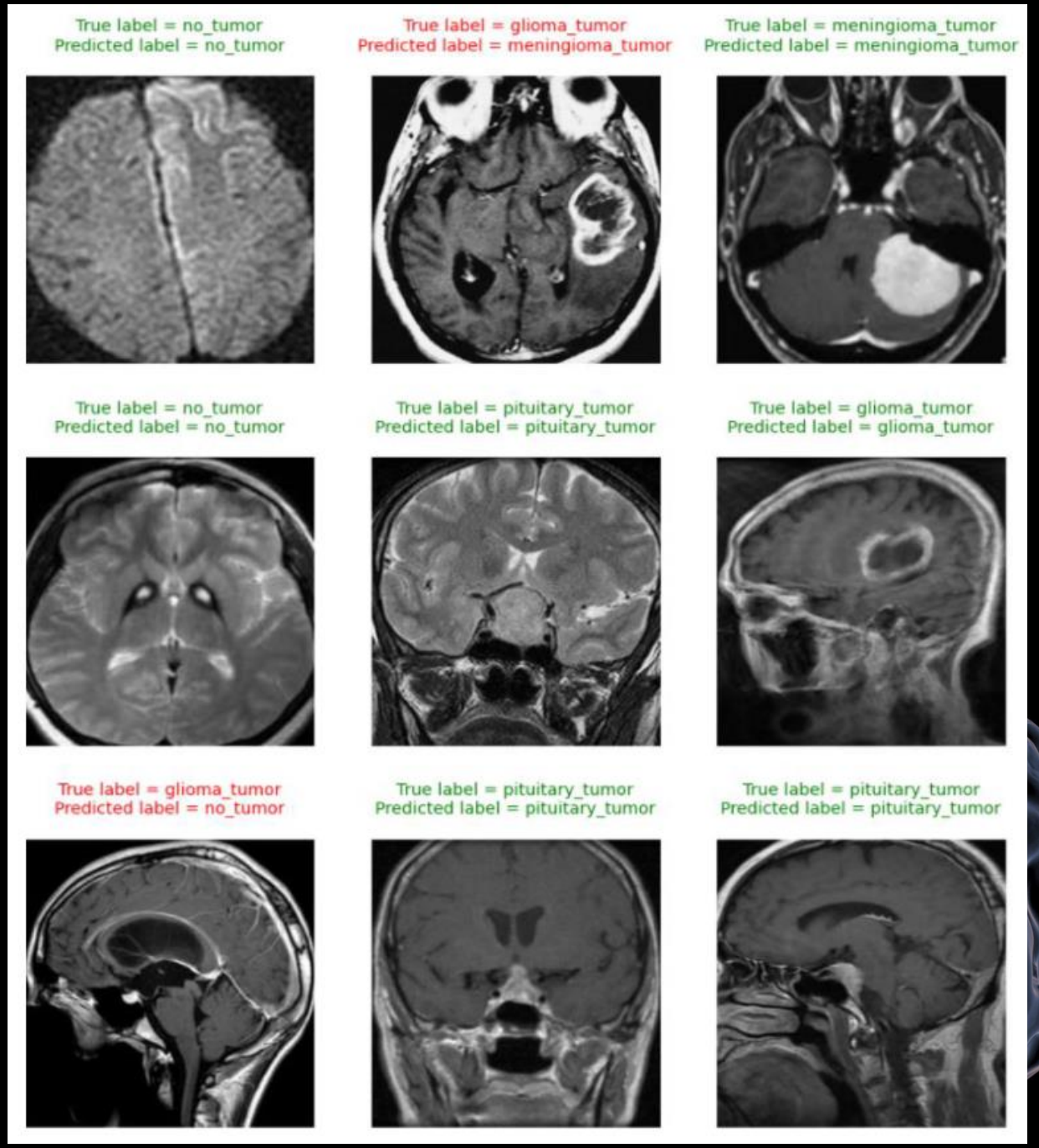
Analysis – Recall rates



Confusion Matrix

	0	1	2	3
0	27	50	21	2
1	0	113	0	2
2	0	3	102	0
3	0	0	3	71

0: Glioma Tumor
1: Meningioma Tumor
2: No Tumor
3: Pituitary Tumor



Analysis – Precision rates