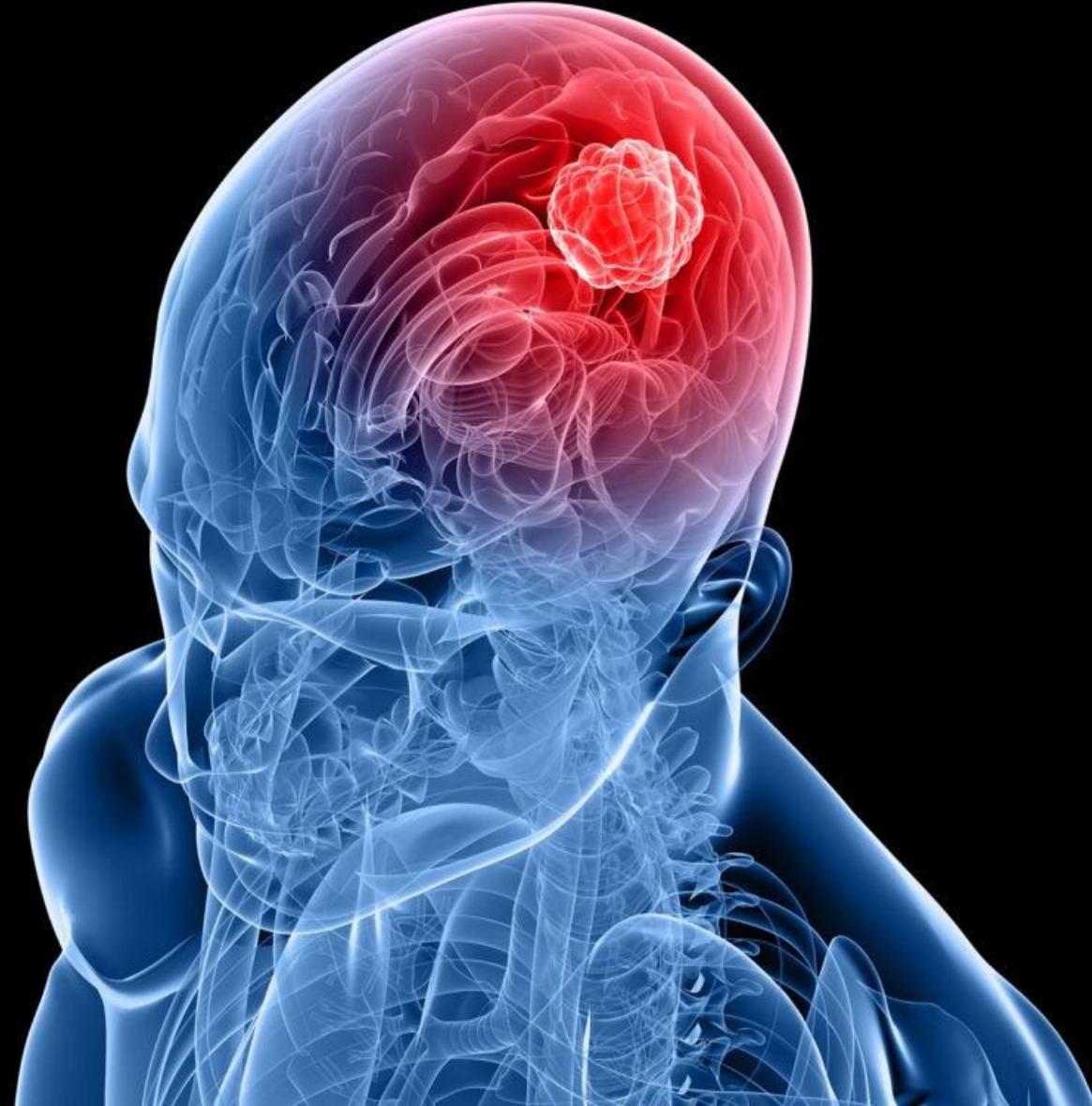


Brain Tumor Classification

Annie Hsu

Mentor: Jeff Hevrin



Brain Tumor

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

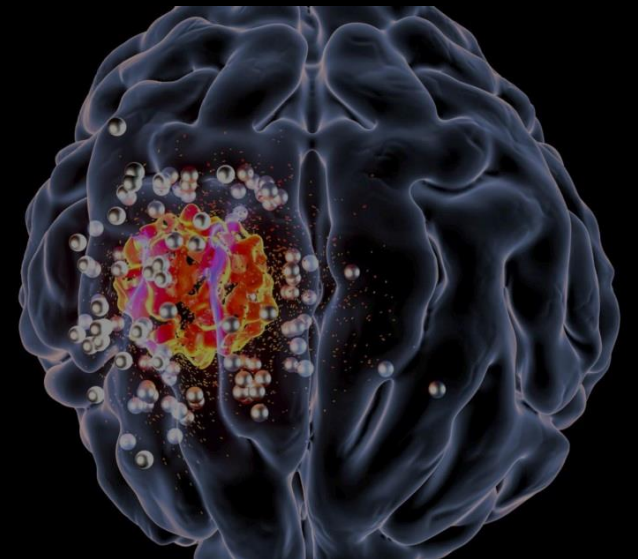
Can machine learning help in classifying the brain tumors from MRI scans?



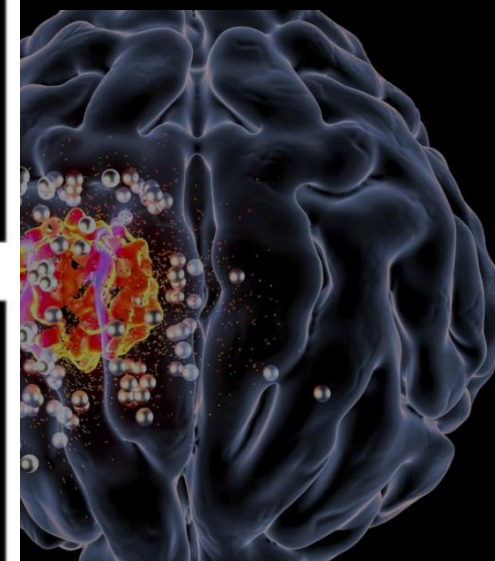
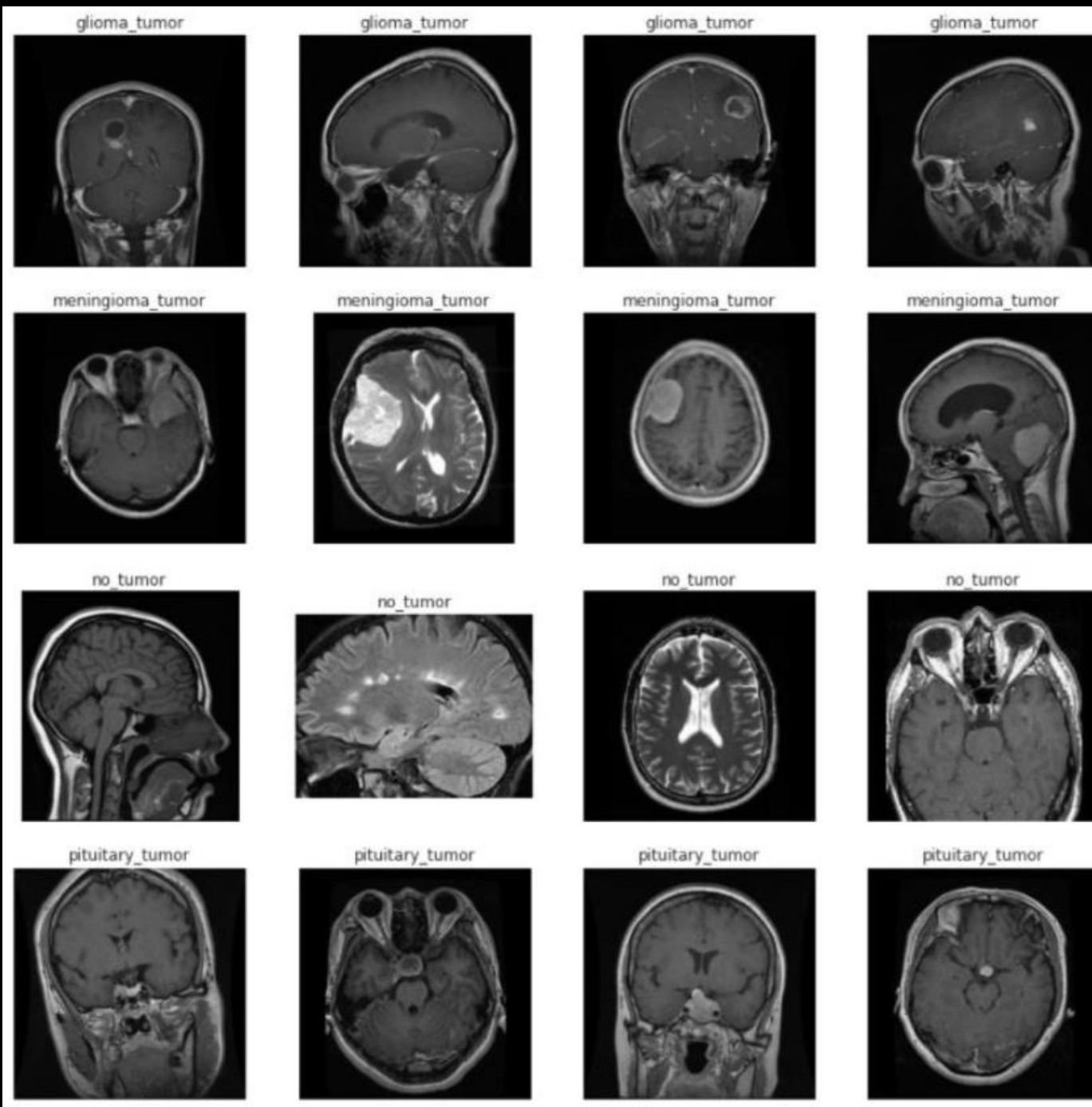
Data source

Dataset was taken from Kaggle.com

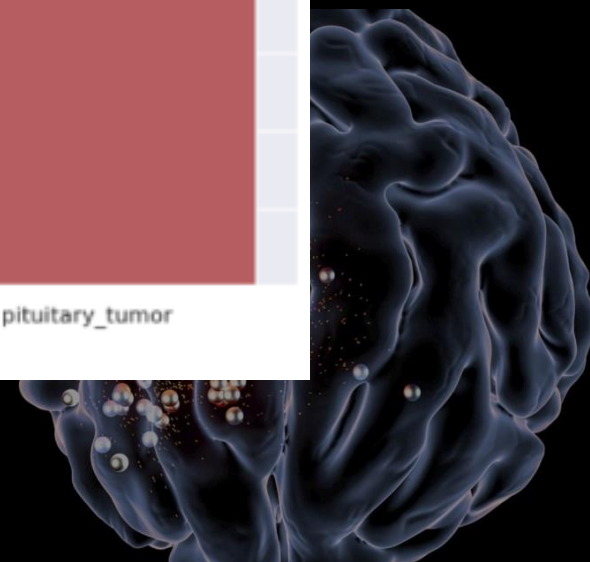
- Training: 2870 MRI brain images
20% for validation
- Testing: 394 images
- 4 classes: Glioma tumor
Meningioma tumor
Pituitary tumor
No tumor



Sample images

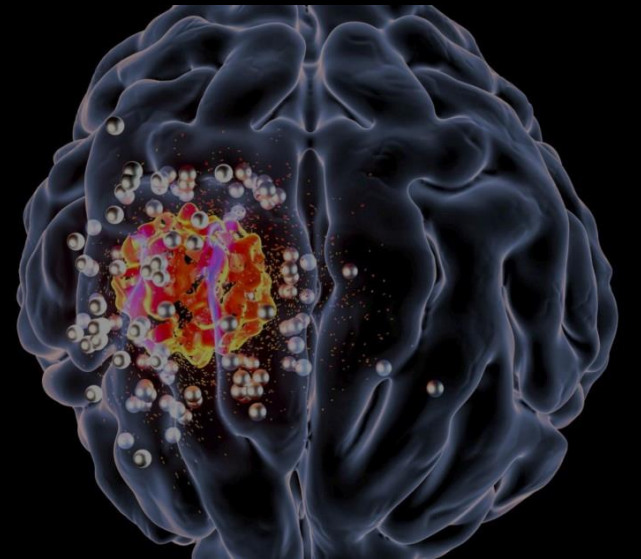


Class distribution in training set

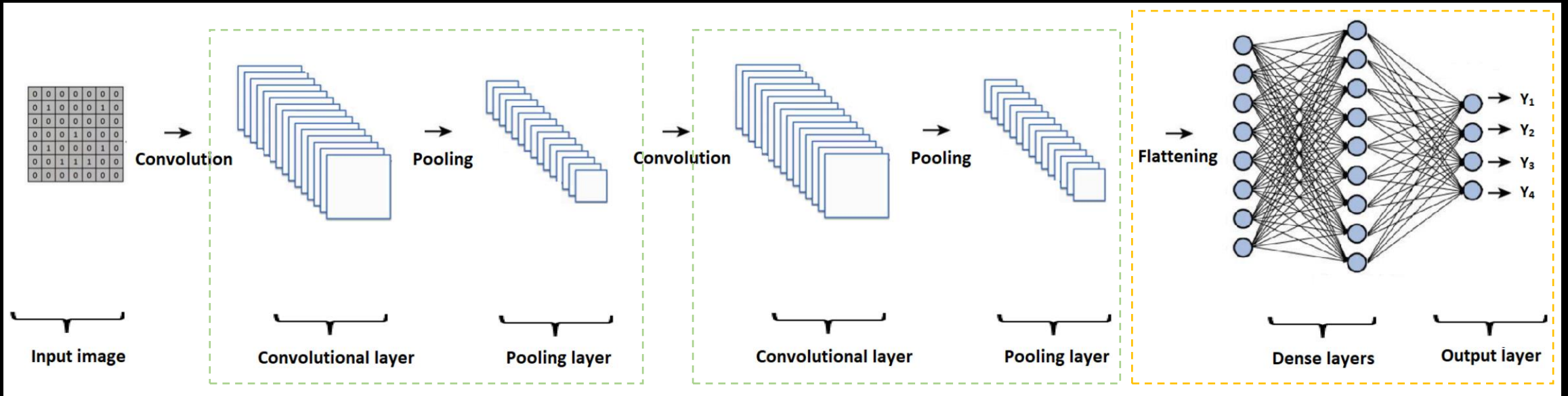


Models

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



Baseline model



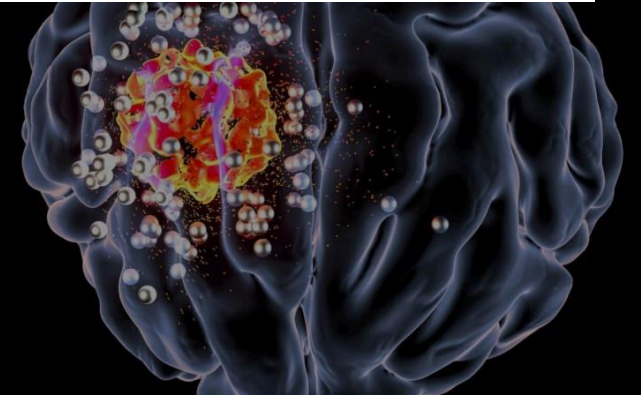
Learning rate: 1e-3

Epochs: 10

Training accuracy: 99.43%

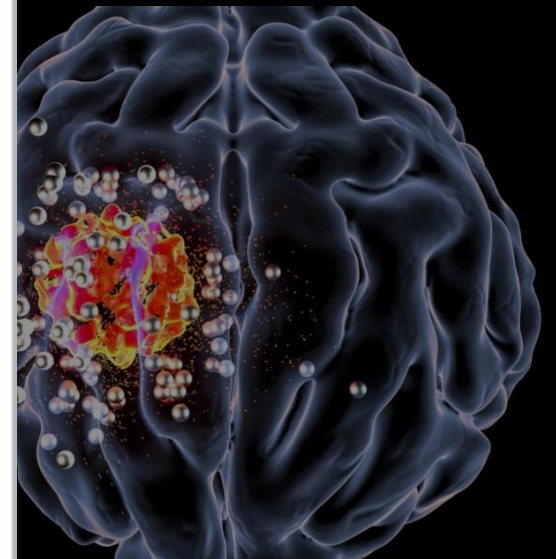
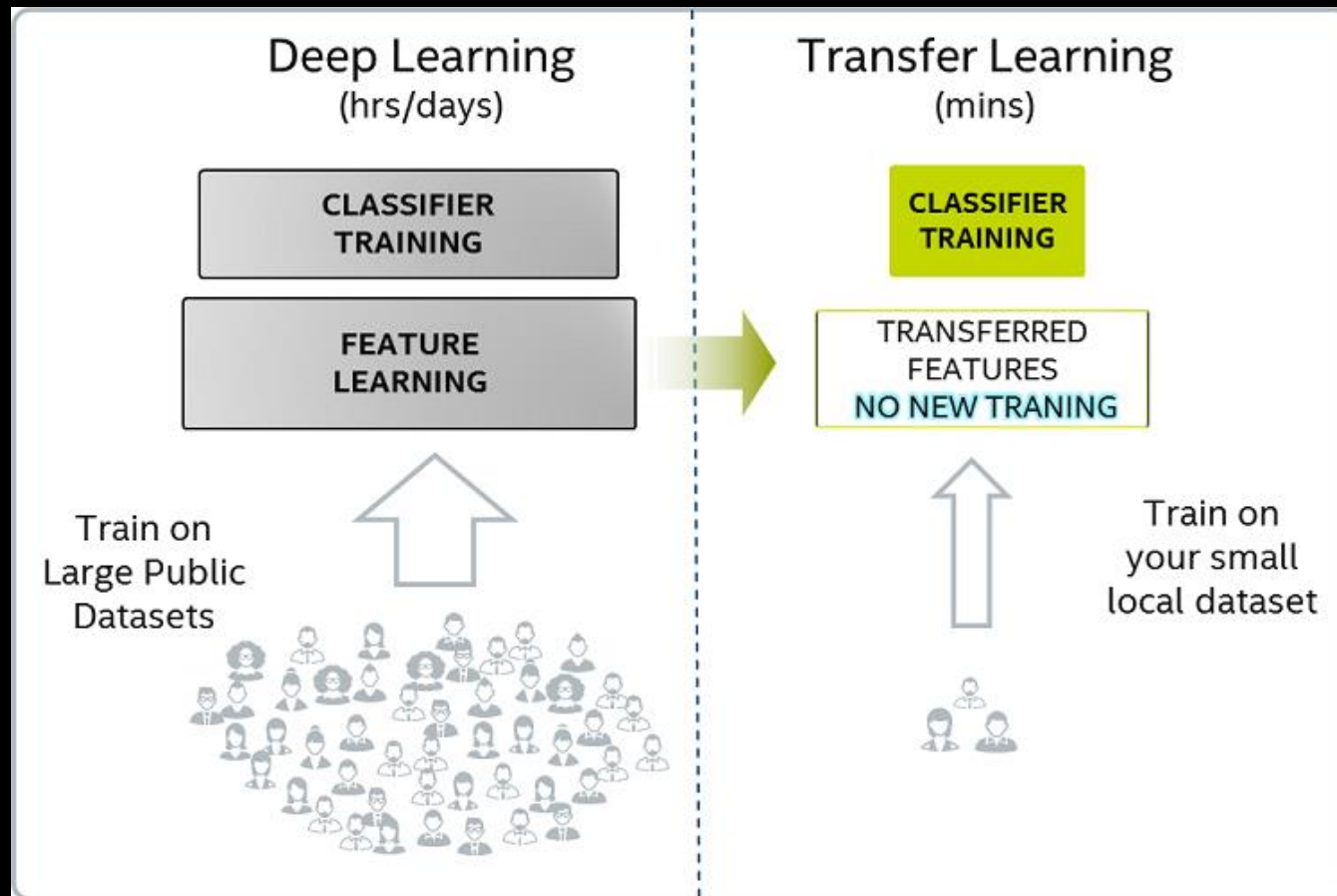
Validation accuracy: 89.20%

Testing accuracy: 68.53%

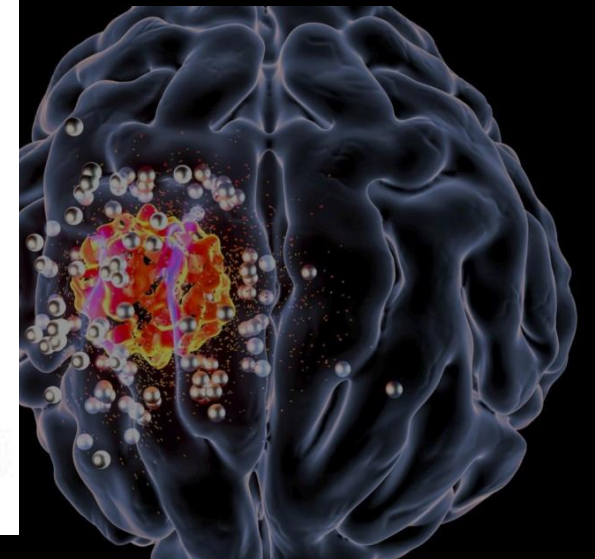
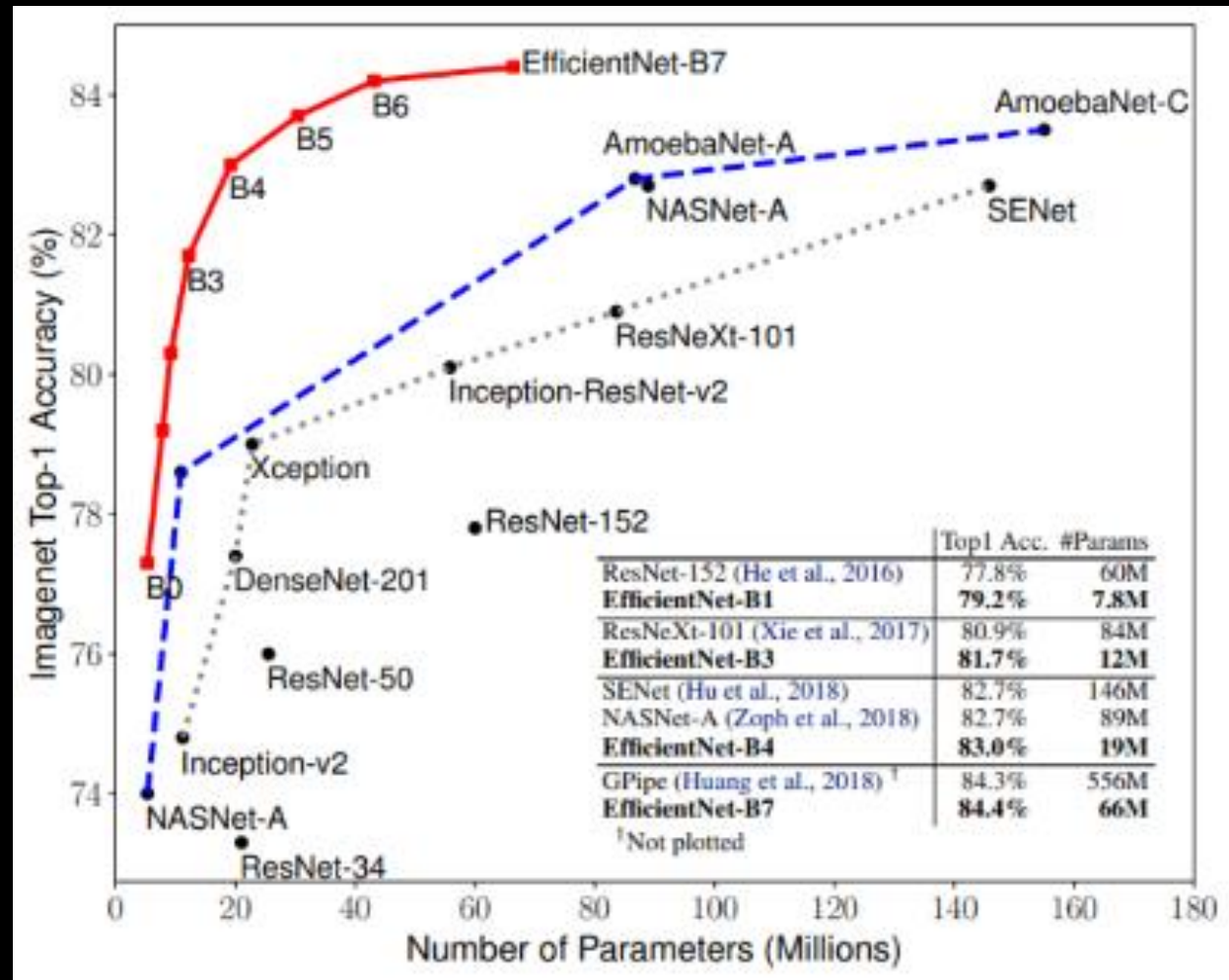


Transfer Learning

- Reuse of a pre-trained model on a new problem

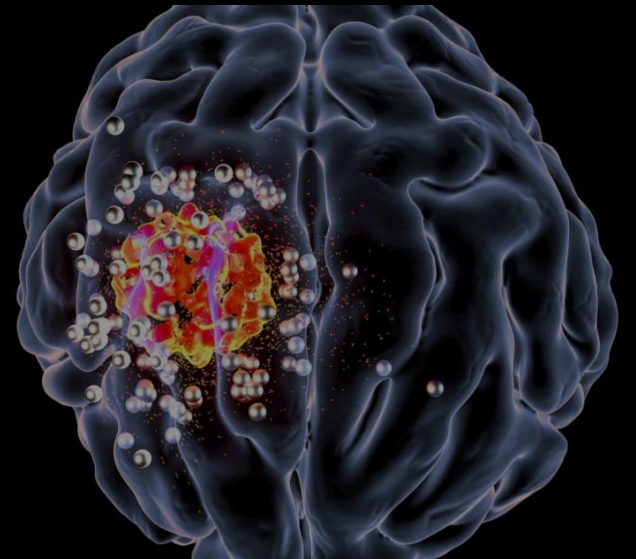


EfficientNet Models



EfficientNet-B1 model

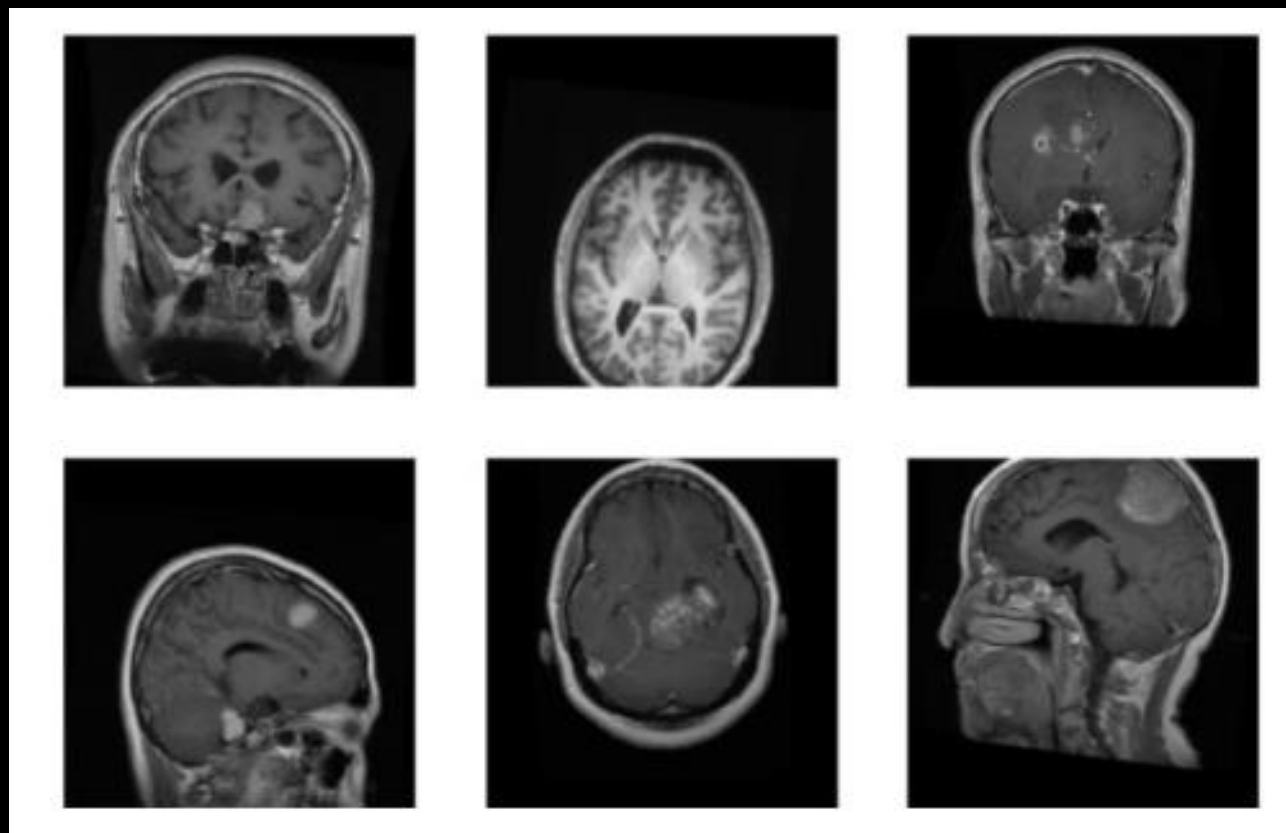
- Image Augmentation
- Compute class weight
- Build and train model
- Fine-tune model



EfficientNet-B1 model

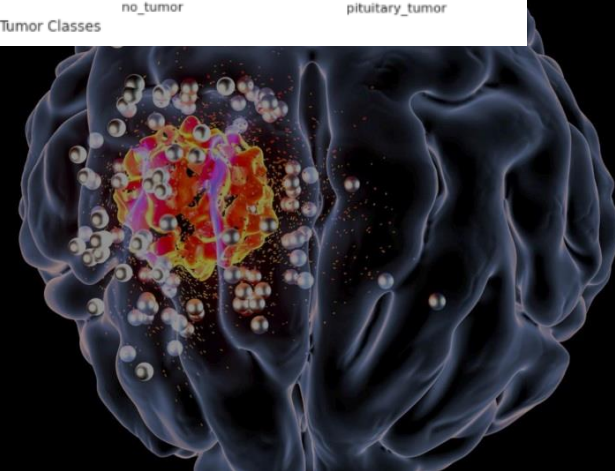
- Image Augmentation
- Compute class weight
- Build and train model
- Fine-tune model

Keras ImageDataGenerator



EfficientNet-B1 model

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



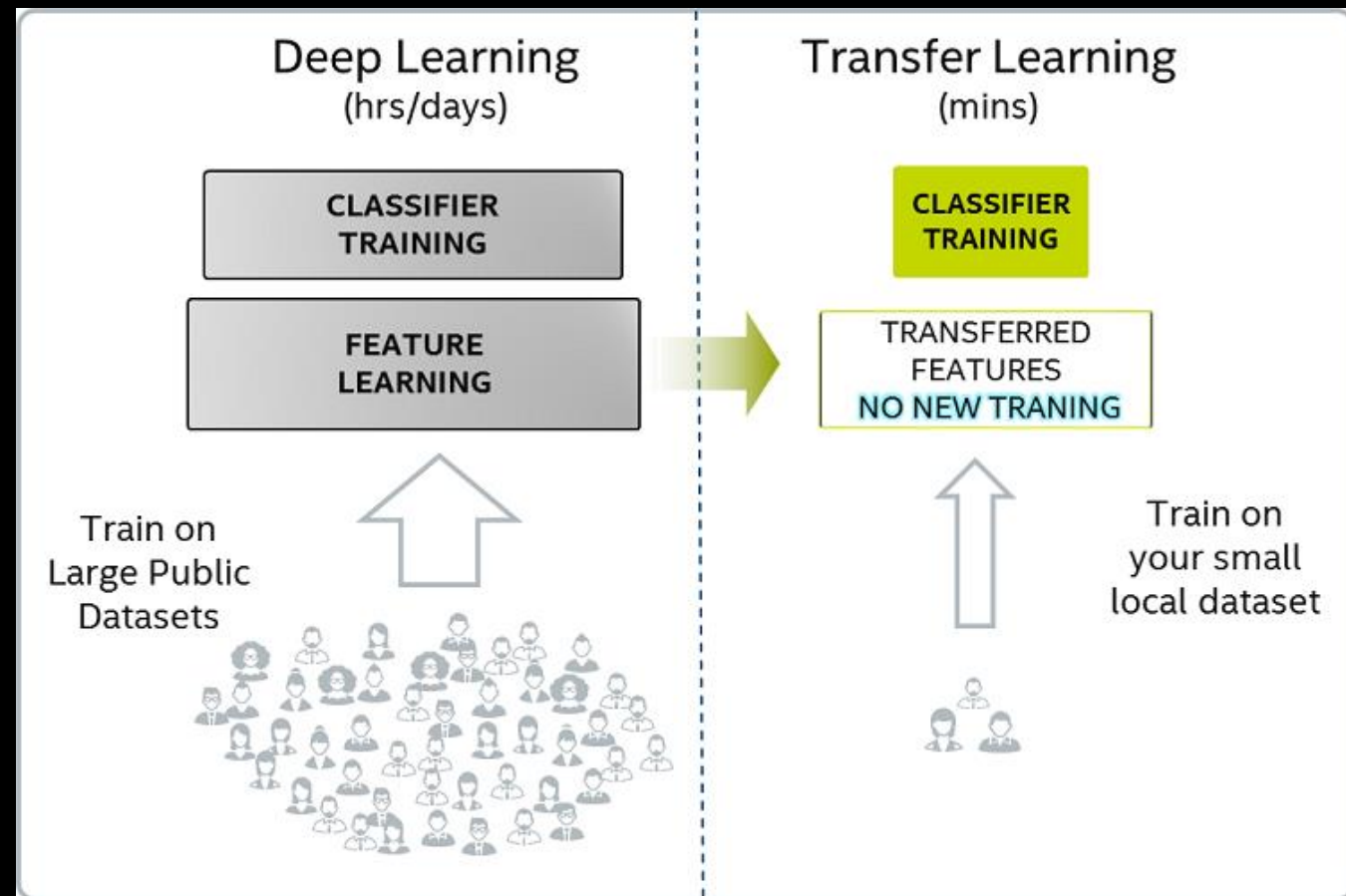
EfficientNet-B1 model

- 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

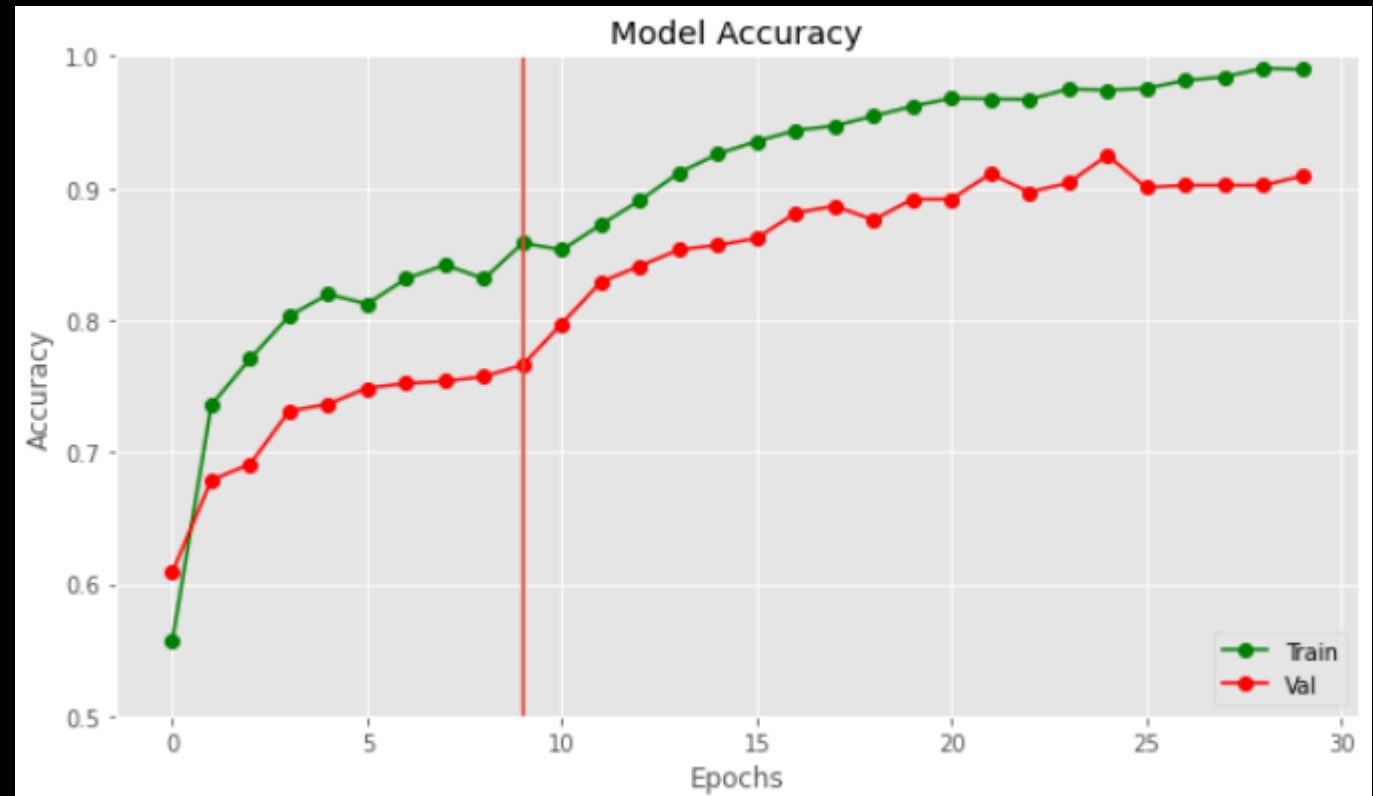
Learning rate: 1e-5

Epochs: 50

Training accuracy: 99.00%

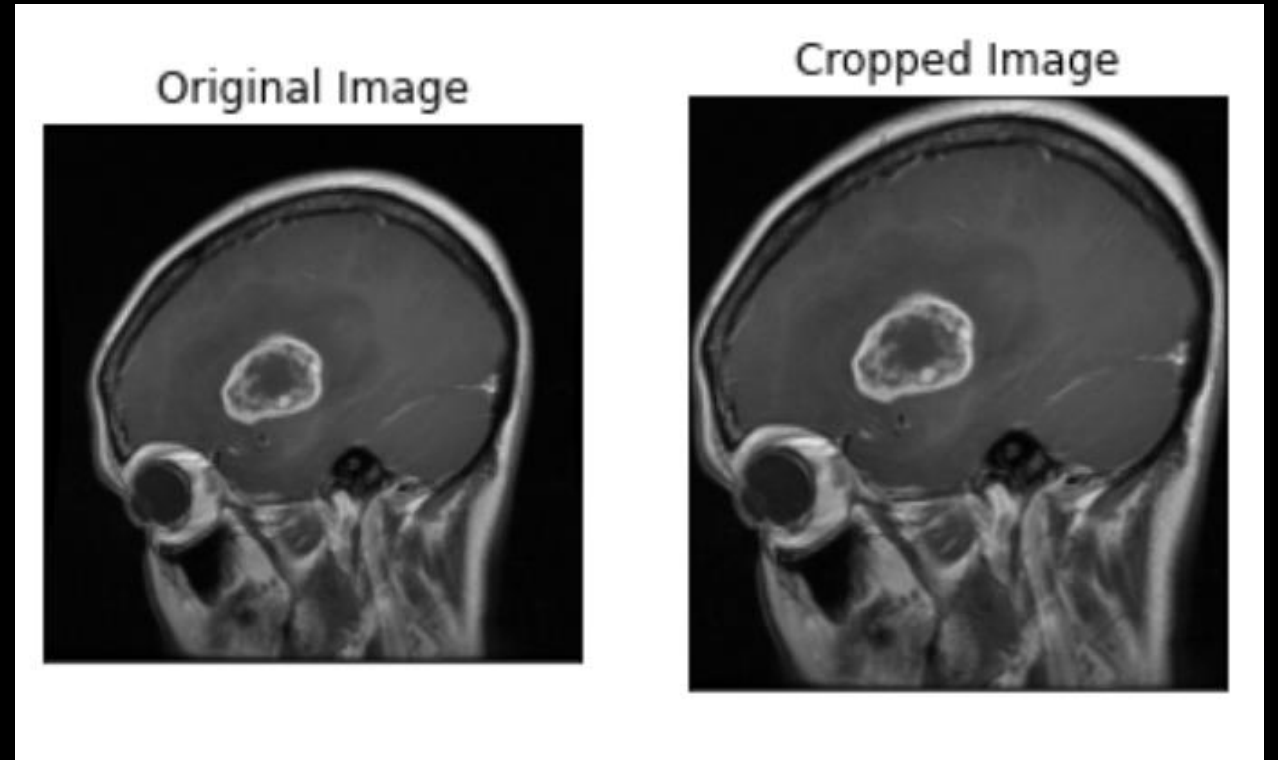
Validation accuracy: 90.92%

Testing accuracy: 77.66%



EfficientNet-B1 model With Image Pre-processing

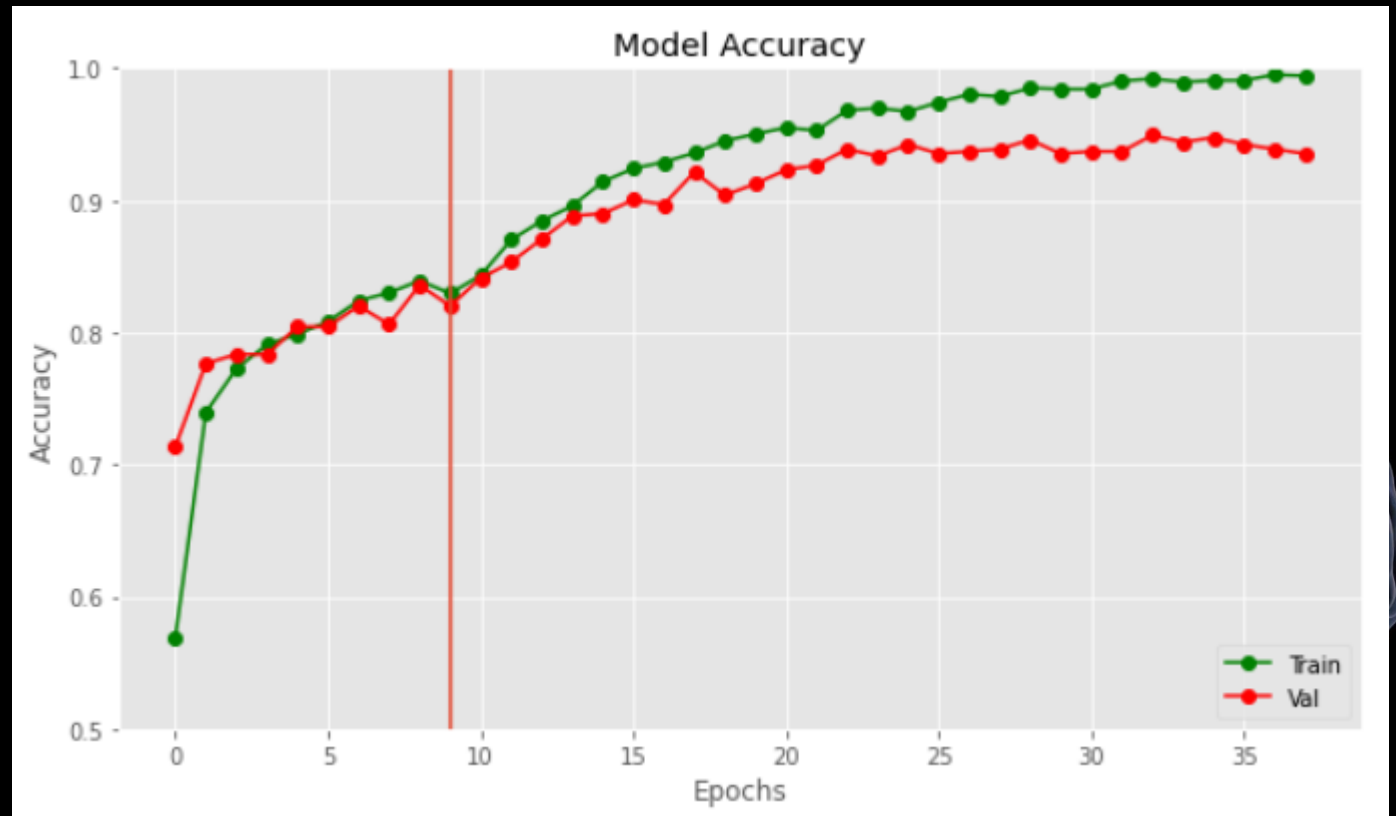
- Image Pre-processing
- Image Augmentation
- Compute class weight
- Build and train model
- Fine-tune model



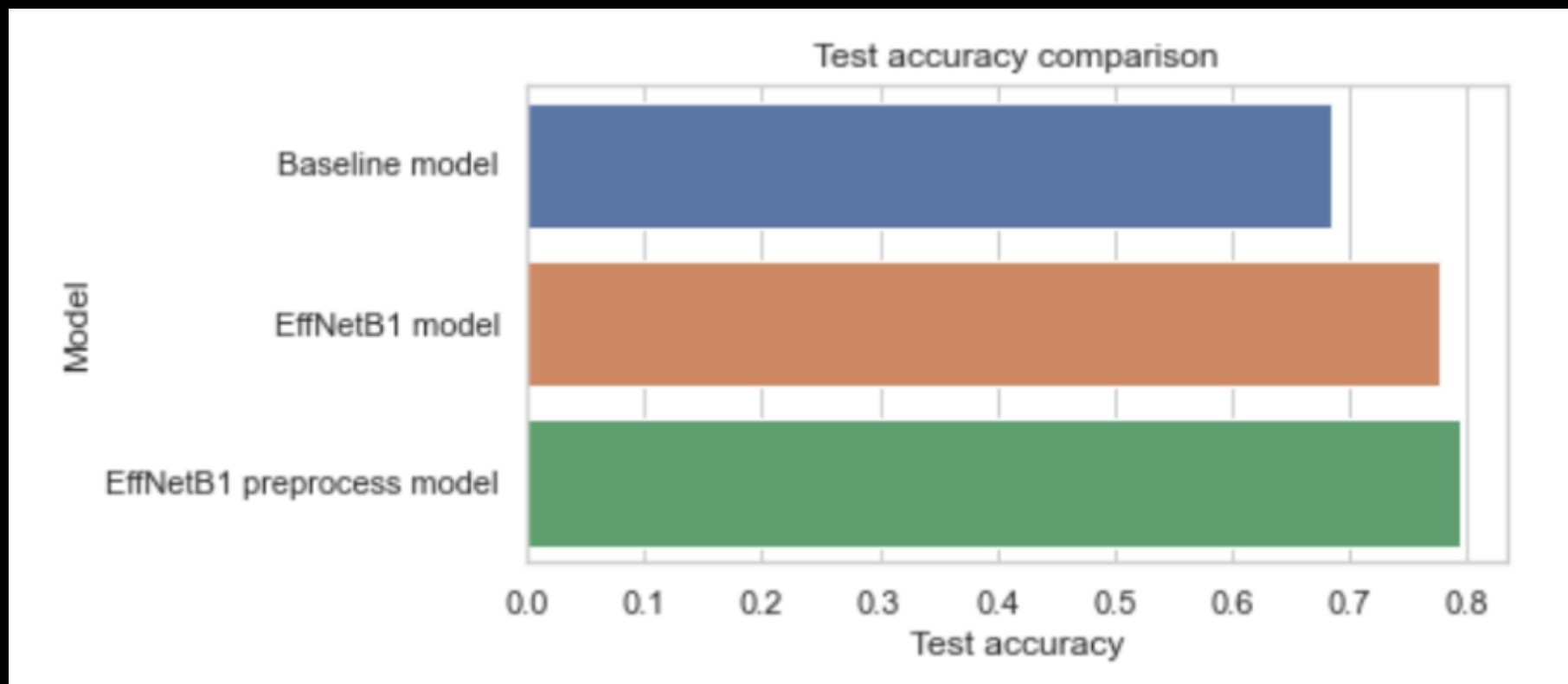
EfficientNet-B1 model With Image Pre-processing

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

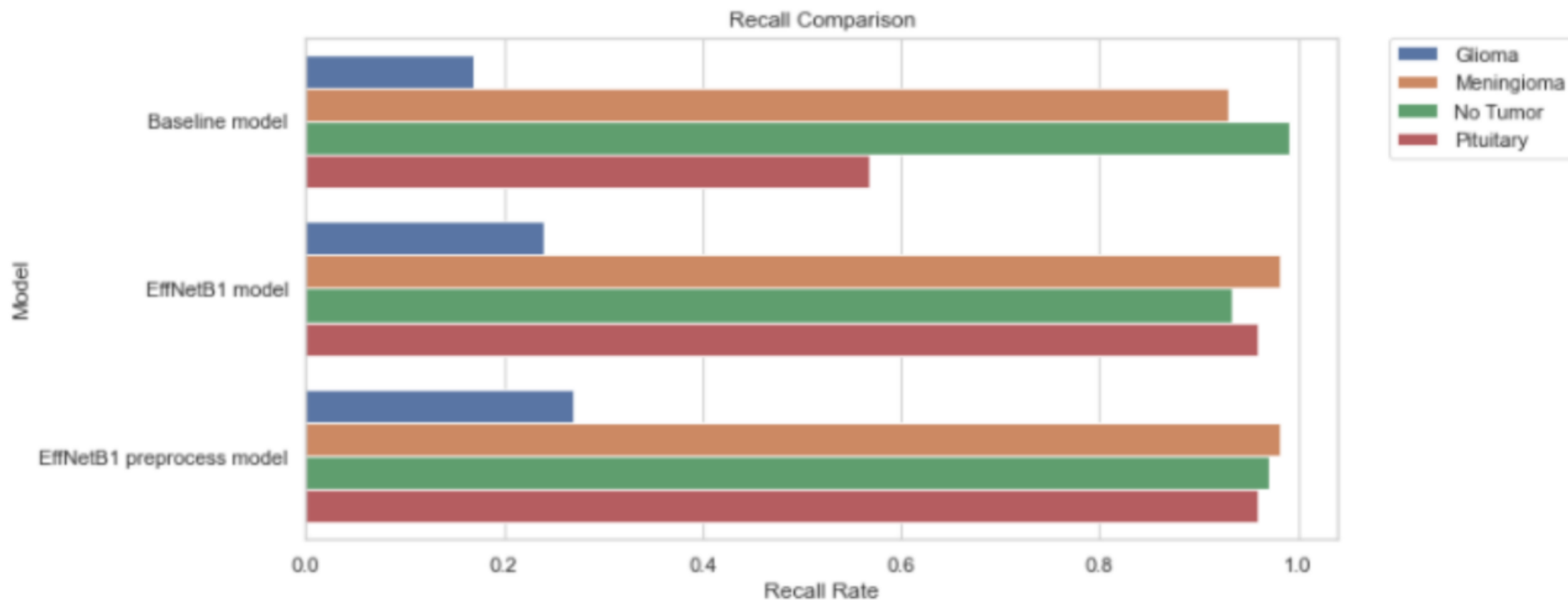
Training accuracy: 99.43%
Validation accuracy: 93.54%
Testing accuracy: 79.44%



Analysis – Test accuracy



Analysis – Recall rates



Confusion Matrix

True
Labels

Predicted Labels

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

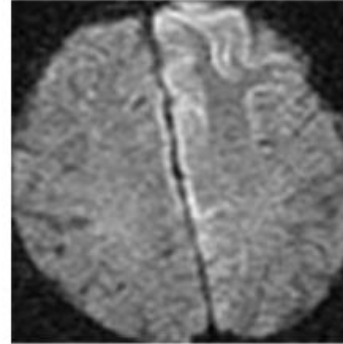
0: Glioma Tumor

1: Meningioma Tumor

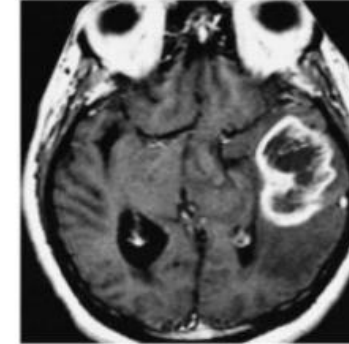
2: No Tumor

3: Pituitary Tumor

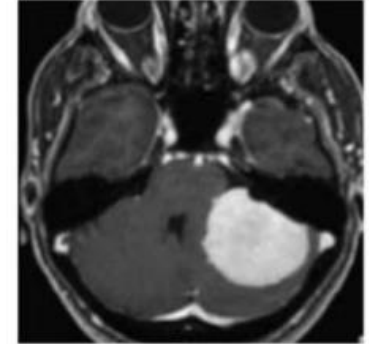
True label = no_tumor
Predicted label = no_tumor



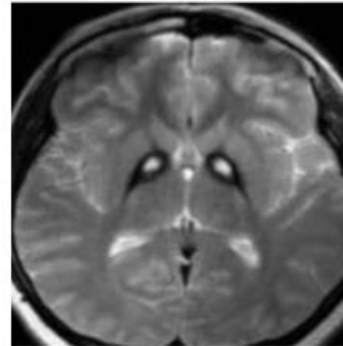
True label = glioma_tumor
Predicted label = meningioma_tumor



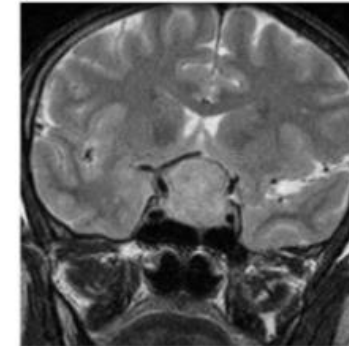
True label = meningioma_tumor
Predicted label = meningioma_tumor



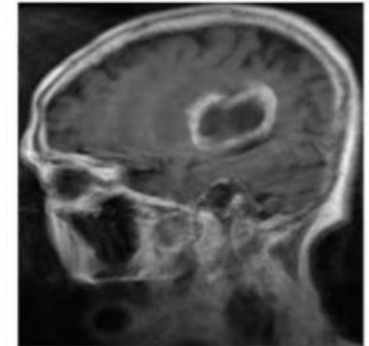
True label = no_tumor
Predicted label = no_tumor



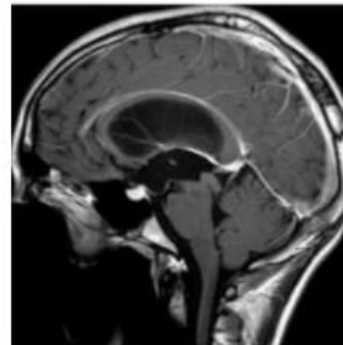
True label = pituitary_tumor
Predicted label = pituitary_tumor



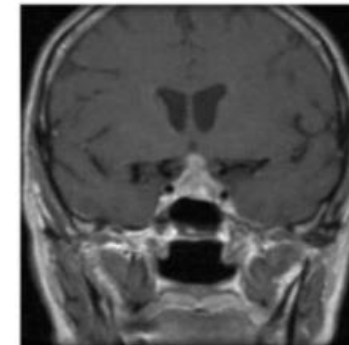
True label = glioma_tumor
Predicted label = glioma_tumor



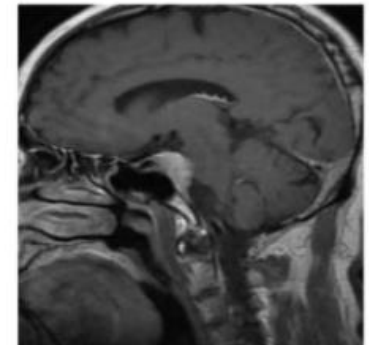
True label = glioma_tumor
Predicted label = no_tumor



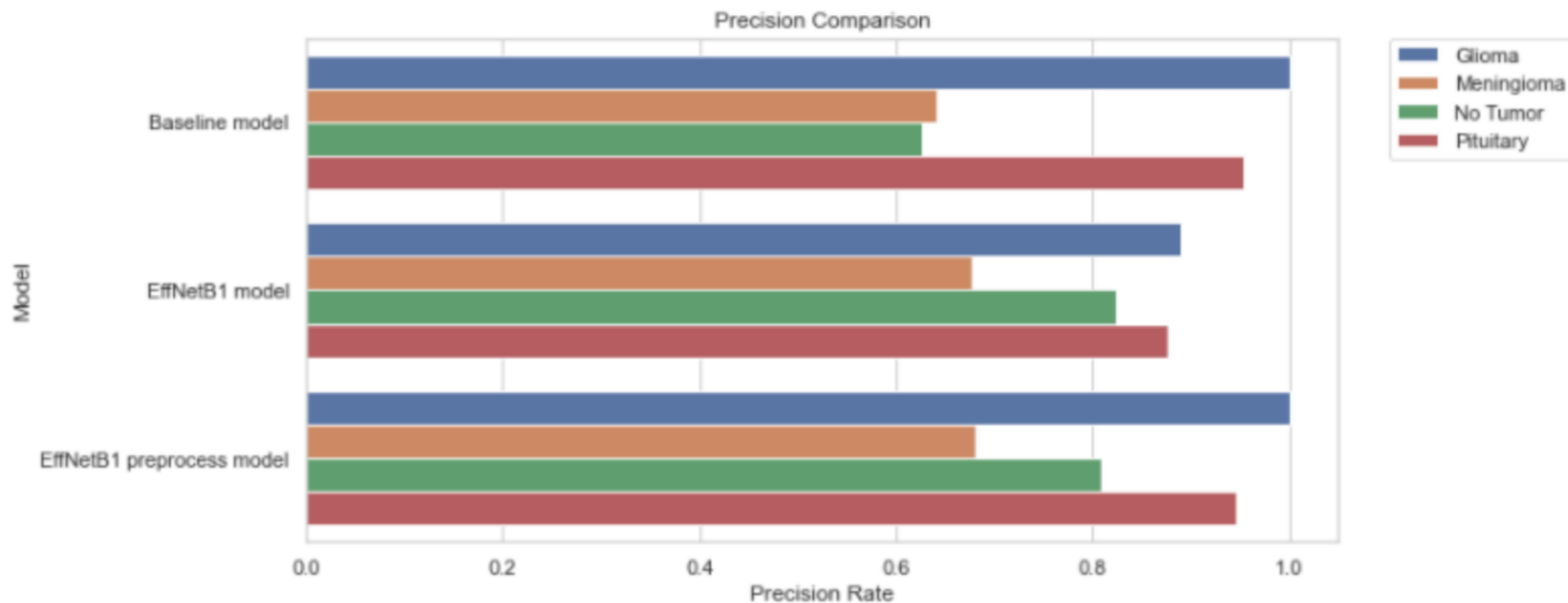
True label = pituitary_tumor
Predicted label = pituitary_tumor



True label = pituitary_tumor
Predicted label = pituitary_tumor



Analysis – Precision rates



Conclusion & Future work

- 3rd model with image pre-processing
- Improve recall rate: get more training data
- Try other pretrained CNN models as base models
- Explore other image preprocessing methods

