MRI TUMOR CLASSIFICATION

THE ERDŐS INSTITUTE SUMMER 2023 DATASCIENCE BOOTCAMP

STATISTICS

5-Year
Relative Survival

33.8%

2013–2019

Adapted from:
https://seer.cancer.gov/statfacts/html/brain.html

STATISTICS

700,000

AMERICANS
are living with a primary brain tumor

94,390

AMERICANS
will receive a primary brain tumor diagnosis in 2023

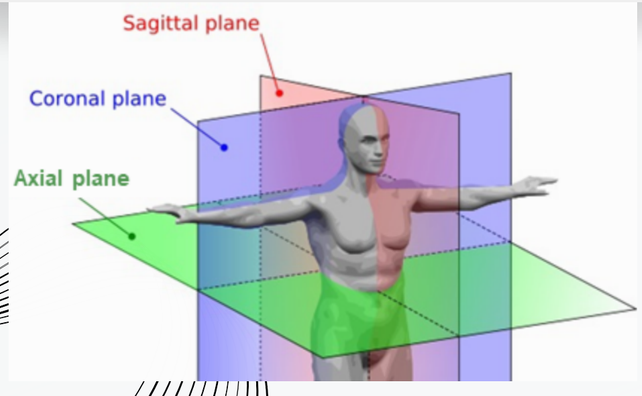
18,990

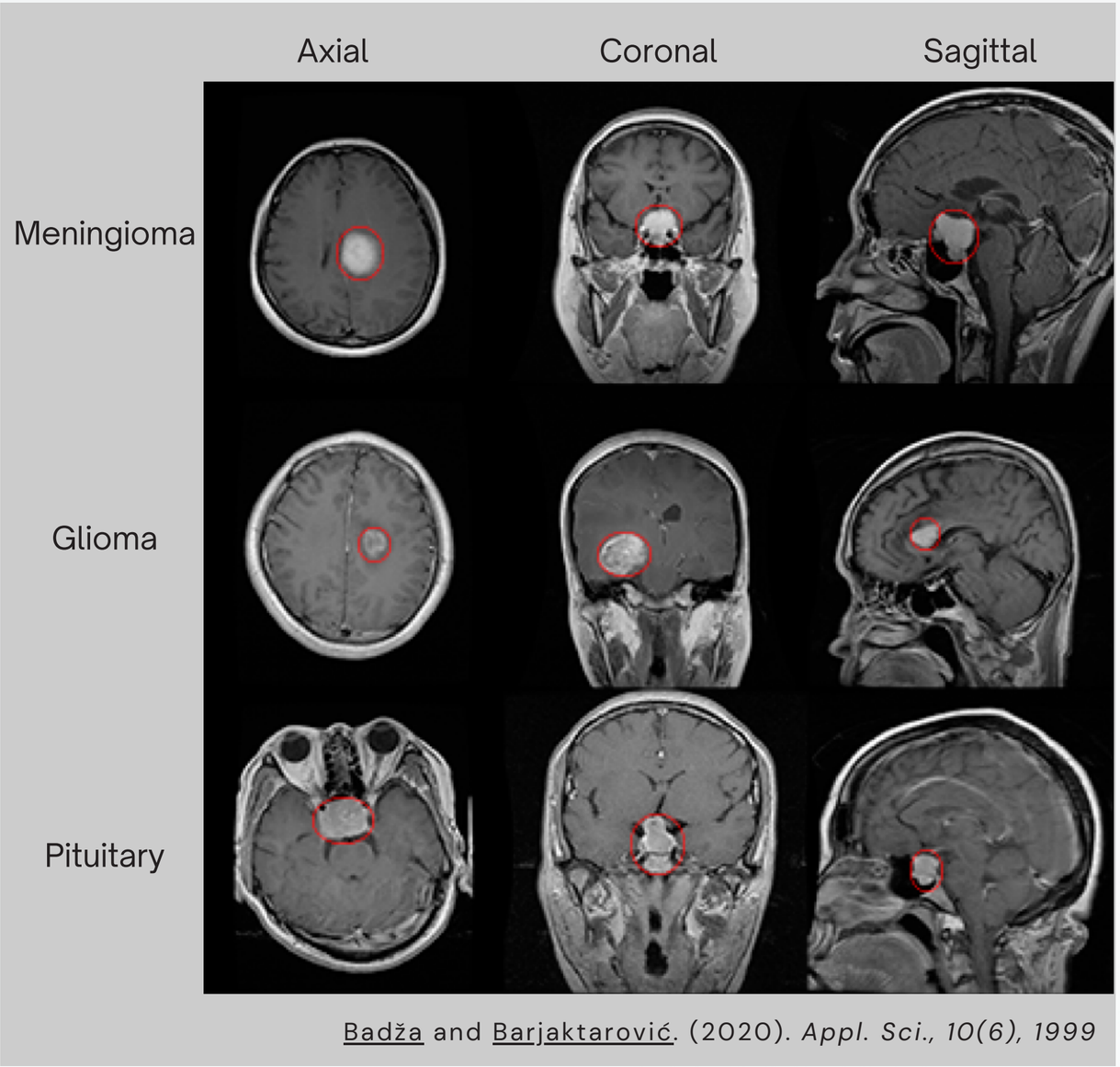
AMERICANS
will die from a malignant brain tumor in 2023

Adapted from:
https://braintumor.org/brain-tumors/about-brain-tumors/brain-tumor-facts/

DATA

- Data was taken from https://www.kaggle.com/datasets/sartajbhuvaji/brain-tumor-classification-mri
- It consists of a series of MRI brain scans from patients with a glioma tumor, a meningioma tumor, a pituitary tumor, or no tumor
- The training set consists of 2870 images and the test set consists of 394 images
- The data consists of a mix of coronal, sagittal, and axial images





Badža and Barjaktarović. (2020). *Appl. Sci., 10(6), 1999*

GOALS AND OBJECTIVES

Objective n° 1

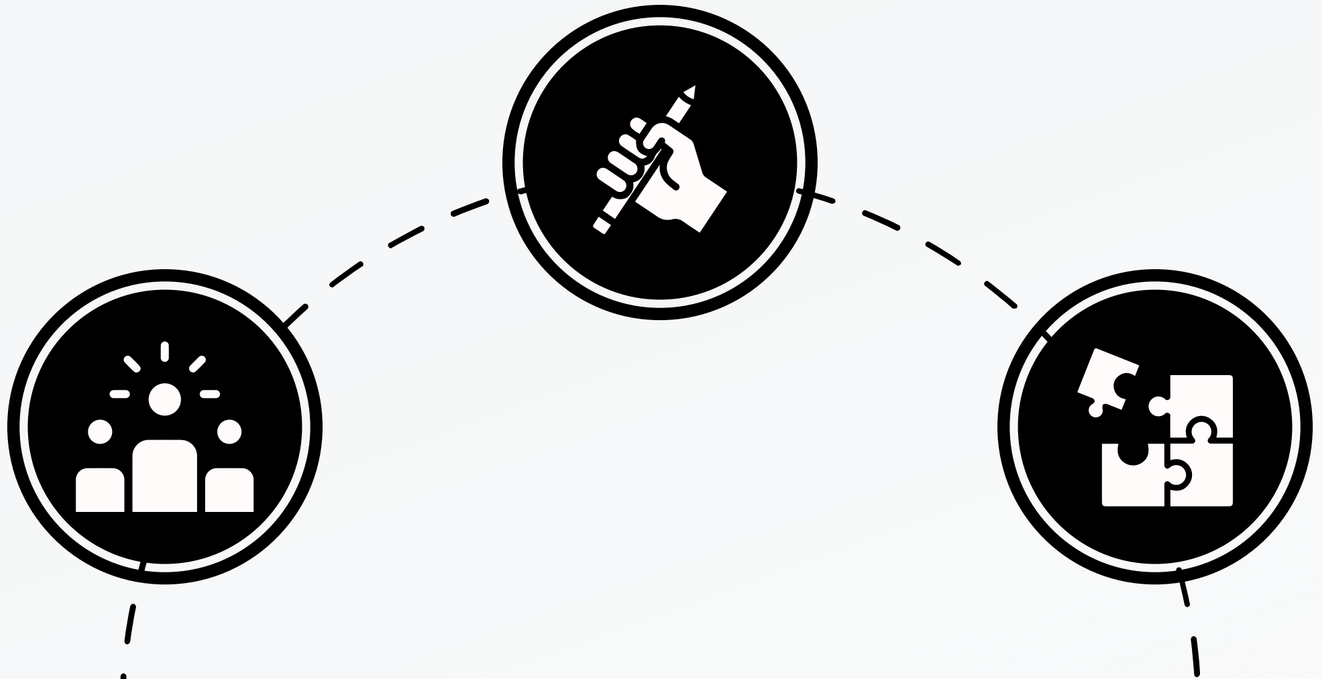
Can we classify brain tumors using MRI data?
-Benign or malignant

Objective n° 2

If so, can we accurately classify among four classes: glioma, pituitary, meningioma, and no-tumor control?

Objective n° 3

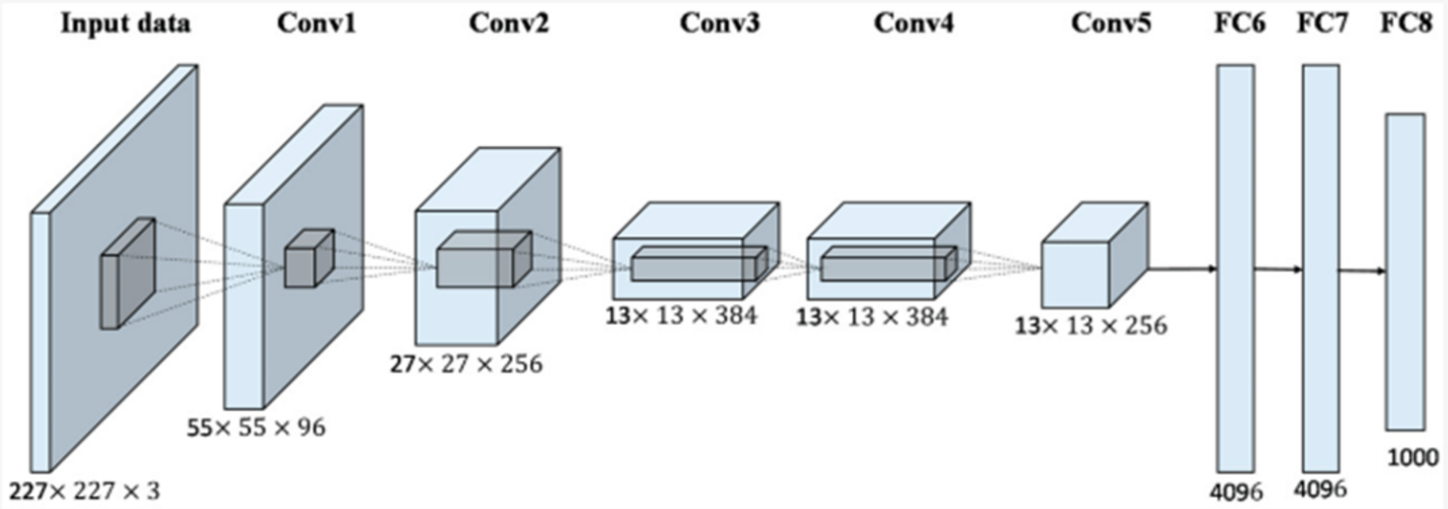
Could we establish which model holds higher precision, recall, and accuracy?



ALEXNET

Model architecture:

- The AlexNet Architecture was first proposed by Krishevsky, Sutskever, & Hinton in 2017
- It consists of five 2D Convolutional Layers, each with a Max Pooling layer in between, and followed by three fully connected layers



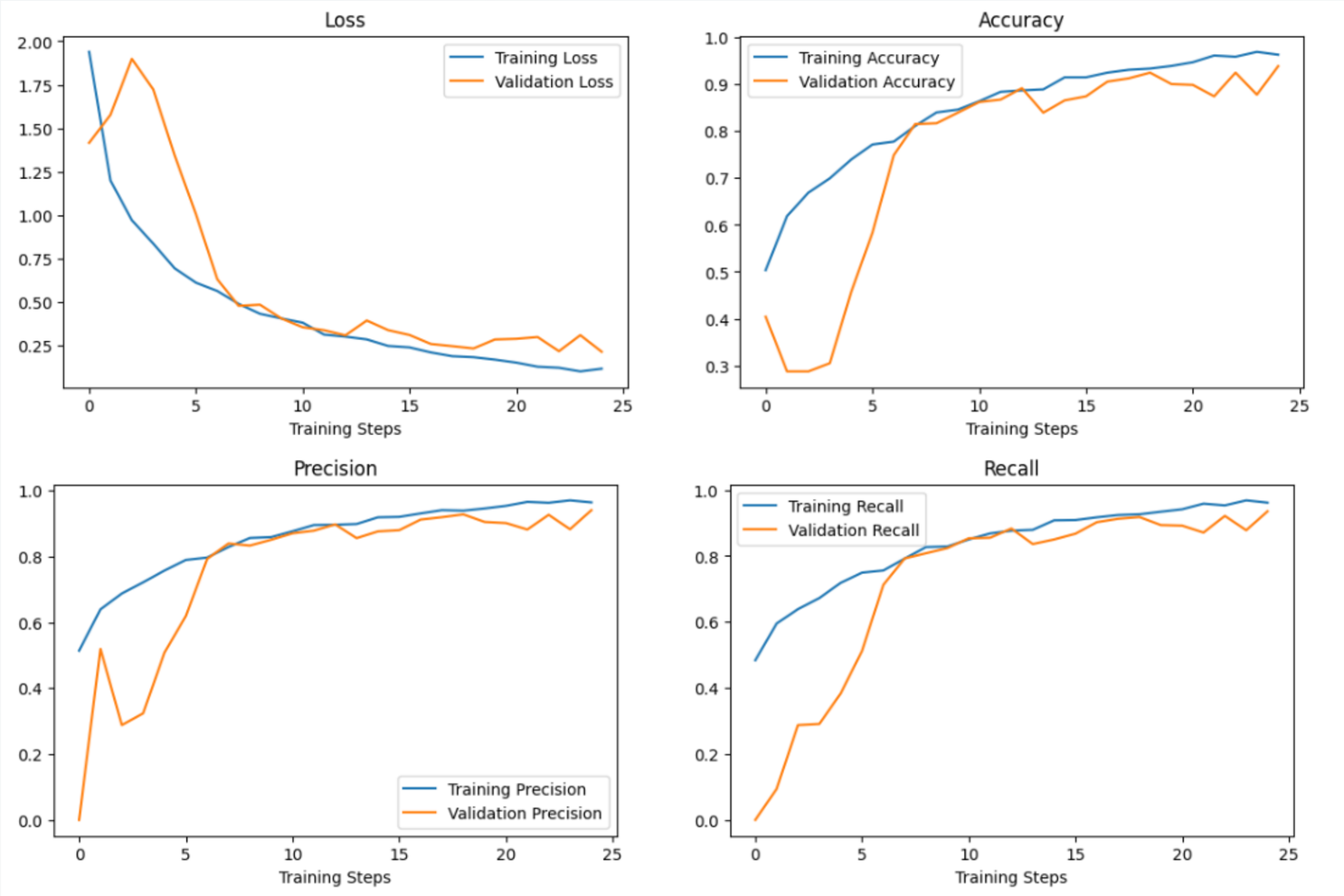
Krizhevsky, A.; Sutskever, I.; Hinton, G.E. ImageNet classification with deep convolutional neural networks. Adv. Neural Inf. Process. Syst. (NIPS) 2012, 25, 1097–1105.

ALEXNET

Model specifics:

- Loss function defined as Categorical Cross Entropy.
- Used Stochastic Gradient Descent as the optimizer with a learning rate of 0.001.
- Considered accuracy, precision, and recall metrics.
- Trained across 25 epochs.

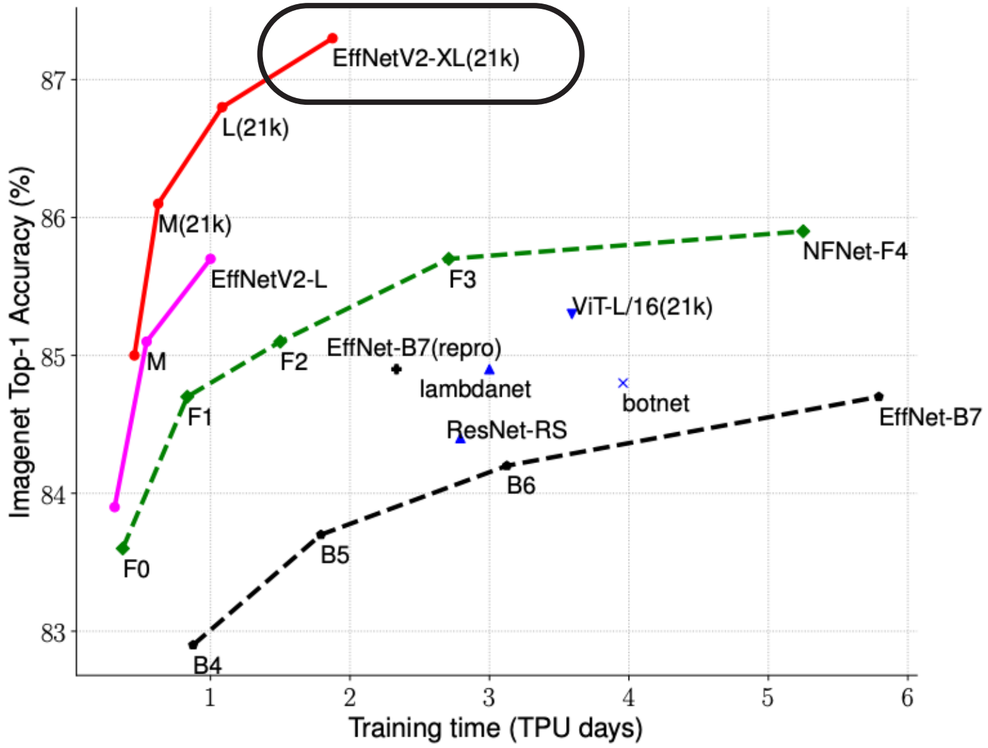
EVALUATION: ALEXNET



The maximum accuracy score on the validation set is 93.9%

WHY DID WE CHOOSE: EFFICIENTNET V2?

We can use transfer learning to use the weights of this efficient convolutional neural network that has been trained on 24M parameters.



(a) Training efficiency.

	EfficientNet (2019)	ResNet-RS (2021)	DeiT/ViT (2021)	EfficientNetV2 (ours)
Top-1 Acc.	84.3%	84.0%	83.1%	83.9%
Parameters	43M	164M	86M	24M

(b) Parameter efficiency.

Mingxing Tan and Quoc V. Le (2021). "EfficientNetV2: Smaller Models and Faster Training", *ICML*

WHY DID WE CHOOSE: EFFICIENTNET V2?

We can use transfer learning to use the weights of this efficient convolutional neural network that has been trained on 24M parameters.

Data collection and data augmentation.

Image rotation and translation, prevents overfitting and increases performance.

STEP 1

Define model and train model on Google Colab Pro using a T4 GPU.

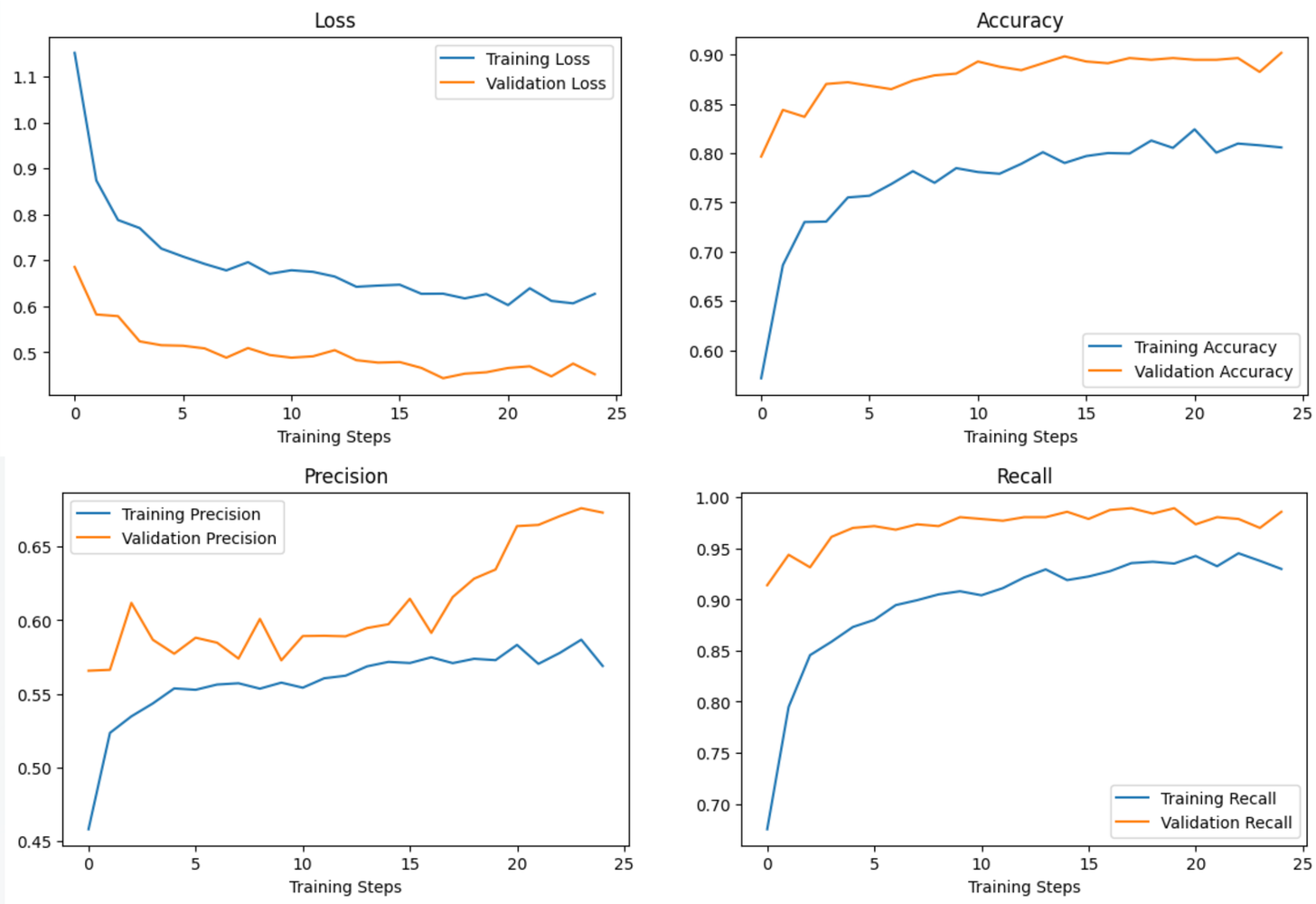
Evaluate model metrics: accuracy, precision, and recall.

STEP 2

Tune hyperparameters:
-Loss function: categorical cross entropy
-Learning rate: 0.001-0.005,
-Optimizers: SGD and Adam
-Epochs: 5 -> 10 -> 25

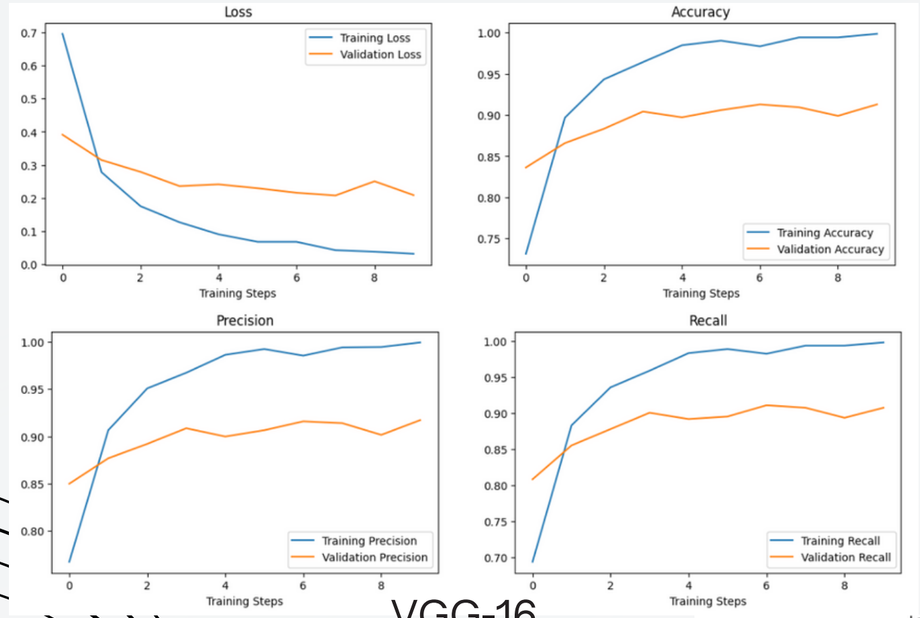
STEP 3

EVALUATION: EFFICIENTNET V2

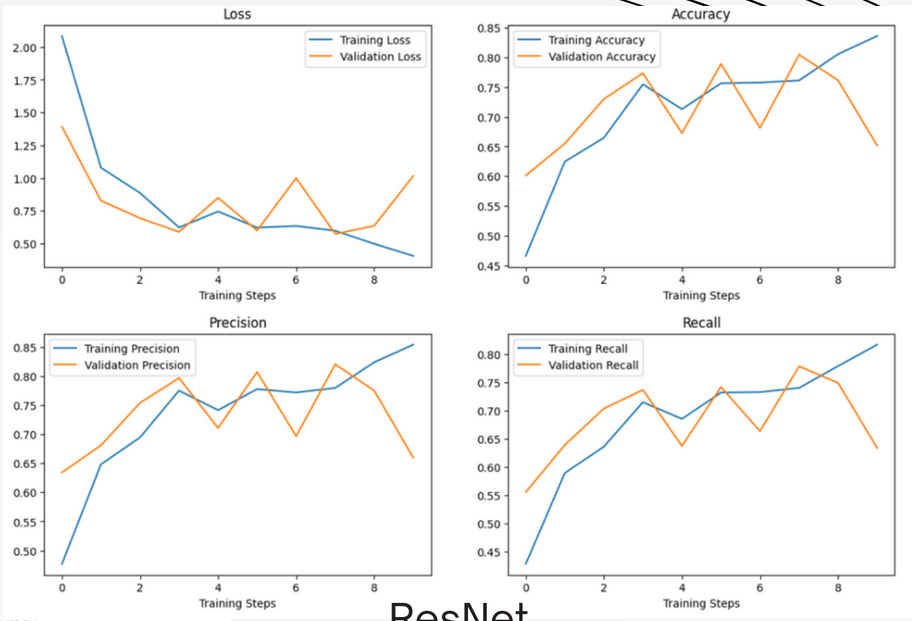


Maximum **accuracy** on the validation dataset was: **90.18%**, whereas the **precision** and the **recall** were: **67.31%** and **98.60%**, respectively.

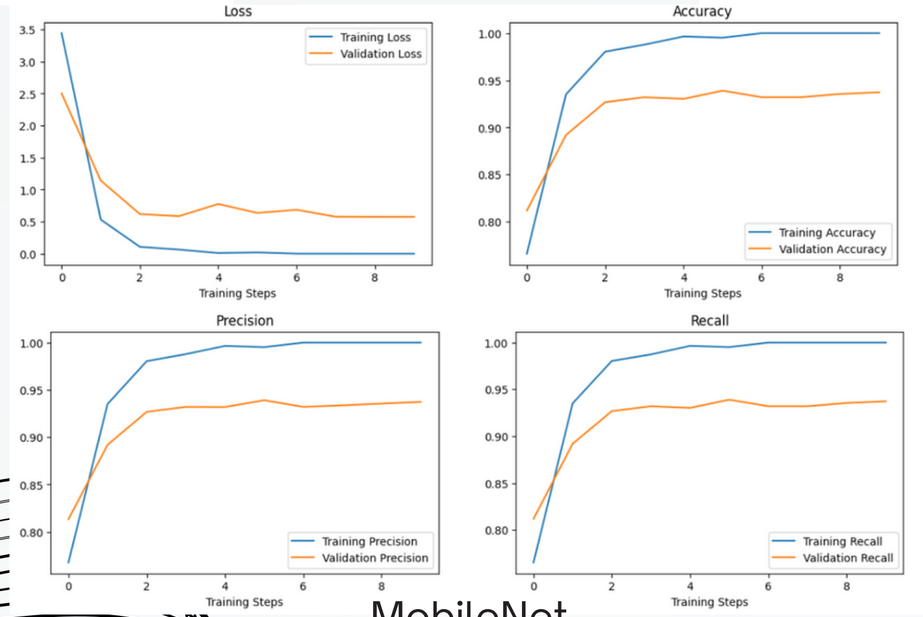
OTHER MODELS



VGG-16



ResNet



MobileNet

FUTURE DIRECTIONS

Testing and validation on an larger more diverse Imaging data set

LARGER DATASET

A clinician friendly, real time and cost saving way for radiologist and MRI technologists to assist in diagnosis

IMPLEMENTION

Further optimization and refinement of model to improve precision

MODEL ENHANCEMENT

OUR TEAM

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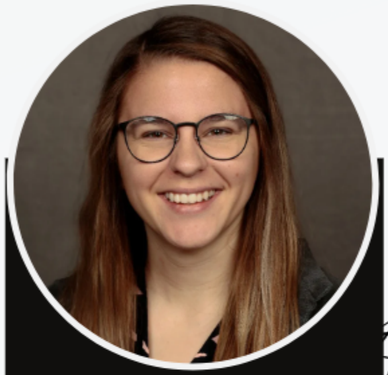

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THANKS FOR WATCHING