TUMOR TRACE

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Problem Statement

- This project aims to address these challenges by leveraging Artificial Intelligence (AI), specifically deep learning techniques, to automate the detection and classification of breast tumors in MRI scans.
- By integrating AI-based models like VGG16, ResNet50, and ResNet18, the project seeks to enhance diagnostic accuracy, reduce manual effort, and support radiologists with reliable predictions for distinguishing between benign and malignant tumors.

Data Set

- The dataset used in this project is specifically curated for breast tumor detection and classification using MRI images. It is divided into three subsets: training, validation, and testing.

- The training set is used to teach the model patterns associated with benign (non-cancerous) and malignant (cancerous) tumors. The validation set helps in fine-tuning hyperparameters and monitoring the model’s performance during training, while the test set evaluates the model’s ability to generalize to new, unseen data.

Preprocessing

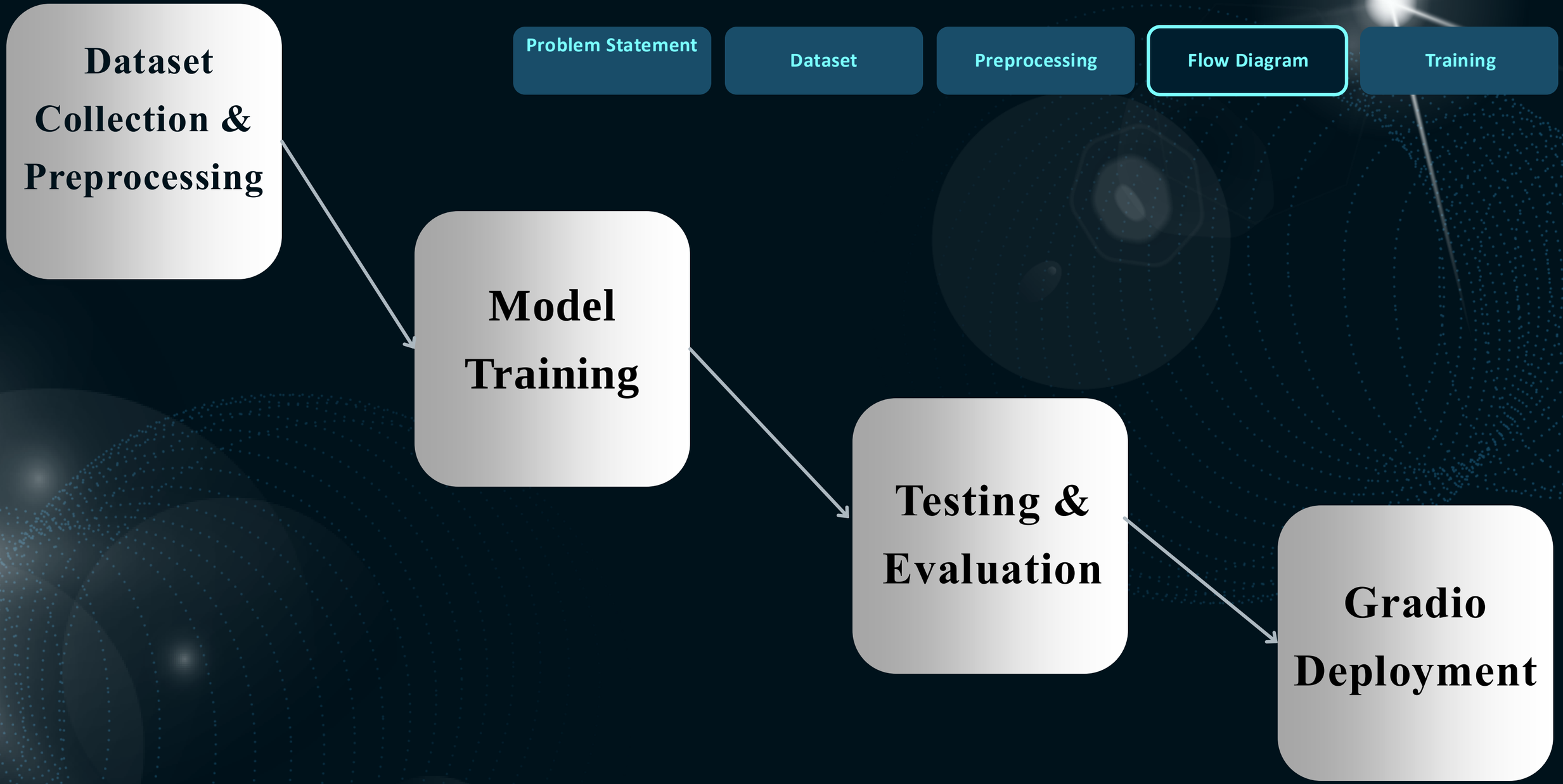
Involves several steps to prepare the MRI images for effective training and ensure consistency in the dataset. All images are resized to a uniform dimension of 224x224 pixels to standardize input size. Normalization is applied using ImageNet's mean and standard deviation to scale pixel values and facilitate faster model convergence.

Data Augmentation:

- Random horizontal and vertical flips with a 50% probability.
- Random rotations within a range of -20° to +20°.
- Color jitter to adjust brightness, contrast, saturation, and hue.

Preprocessing

- Sobel edge detection is applied to highlight significant boundaries in the images.
- Feature Extraction:
- Histogram of Oriented Gradients (HOG): Captures structural and shape information.
- Local Binary Pattern (LBP): Encodes local texture features.
- Mean Binary Pattern (MBP): Evaluates pixel patterns based on the mean intensity of a local window.
- Median Binary Pattern: Encodes patterns using the median intensity of a local window.
- Variance Binary Point: Uses variance within a local window to compute binary patterns.
- Mean-Median-Variance (MMV): Combines mean, median, and variance thresholds to extract comprehensive binary patterns.


Dataset Collection & Preprocessing
Model Training
Testing & Evaluation
Gradio Deployment

Model Initialization

- Selected deep learning models (VGG16, ResNet50, ResNet18).
- Modified the model architecture for binary classification (Benign vs. Malignant).
- Freeze feature extraction layers to train only the classifier layers.

Data Loading & Batching

- Load preprocessed training data in batches using PyTorch DataLoader.
  Batch size is taken as 32.

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Model Training

- Trained the model using CrossEntropyLoss as the loss function.
- Used optimizers like Adam ,SGD to minimize the loss.
- Performed backpropagation to update the model weights.

```
Epoch 23/50
Epoch 24/50: 100%|██████████| 639/639 [02:39<00:00,  4.01batch/s]
Train Accuracy: 99.99%
Specificity: 1.0000, Sensitivity: 0.0005, AUC: 0.8705
Precision: 0.9172, Recall: 0.7913, F1-Score: 0.8496

Test set: Average loss: 0.5942, Accuracy: 77.73%

Confusion Matrix:
[[ 295  113]
 [ 330 1251]]
Model checkpoint saved to: /kaggle/working/tumor_classification/resnet50/resnet50_epoch_23.pth
EarlyStopping counter: 19 out of 20
Epoch 24/50
Epoch 25/50: 100%|██████████| 639/639 [02:37<00:00,  4.06batch/s]
Train Accuracy: 99.99%
Specificity: 1.0000, Sensitivity: 0.0005, AUC: 0.8731
Precision: 0.9147, Recall: 0.7868, F1-Score: 0.8460

Test set: Average loss: 0.5846, Accuracy: 77.22%

Confusion Matrix:
[[ 292  116]
 [ 337 1244]]
Model checkpoint saved to: /kaggle/working/tumor_classification/resnet50/resnet50_epoch_24.pth
EarlyStopping counter: 20 out of 20
Early stopping
```

```
Test set: Average loss: 0.3625, Accuracy: 83.86%

EarlyStopping counter: 19 out of 20
Epoch 26/50: 100%|██████████| 639/639 [03:52<00:00,  2.75batch/s]
Train Accuracy: 83.13%
Specificity: 1.0000, Sensitivity: 0.0005, AUC: 0.9015
Precision: 0.9353, Recall: 0.8223, F1-Score: 0.8751

Test set: Average loss: 0.3992, Accuracy: 81.35%

EarlyStopping counter: 20 out of 20
Early stopping
```

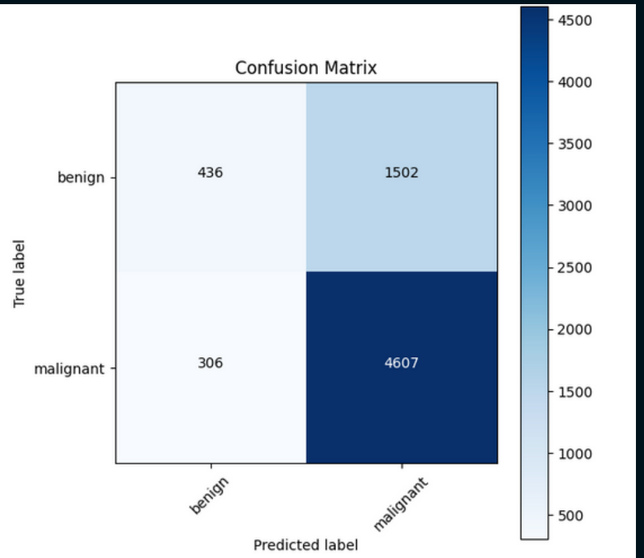
Notebook

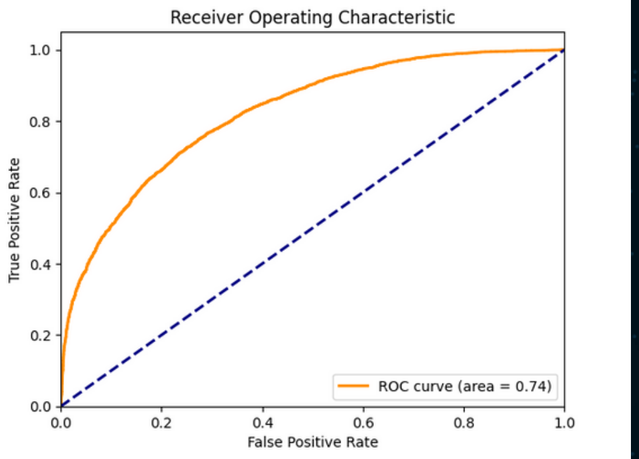
```
Epoch 24/50
Epoch 25/50: 100%|████████| 639/639 [01:22<00:00,  7.72batch/s]
Train Accuracy: 100.00%
Specificity: 0.9995, Sensitivity: 0.0000, AUC: 0.9161
Precision: 0.9298, Recall: 0.9045, F1-Score: 0.9170

Test set: Average loss: 0.4056, Accuracy: 86.98%

Confusion Matrix:
[[ 300  108]
 [ 151 1430]]
Model checkpoint saved to: /kaggle/working/tumor_classification/resnet18/resnet18_epoch_24.pth
EarlyStopping counter: 18 out of 20
```

Testing and Results

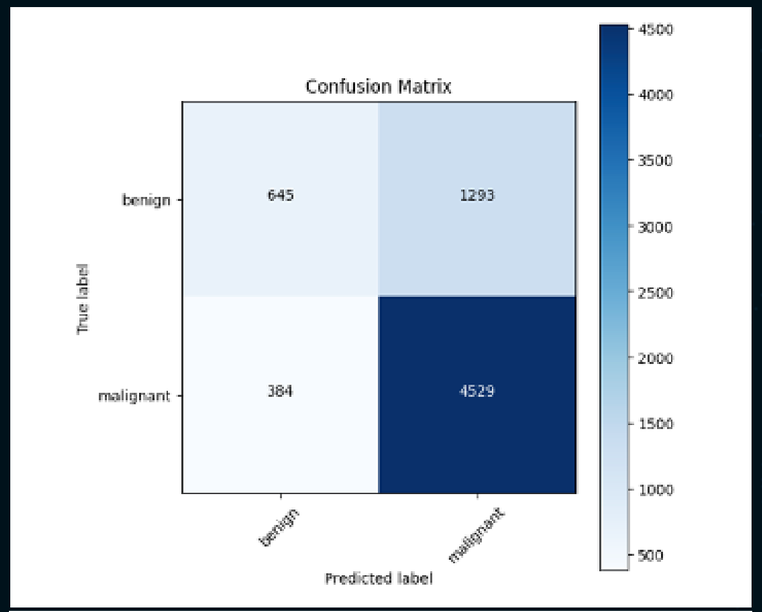


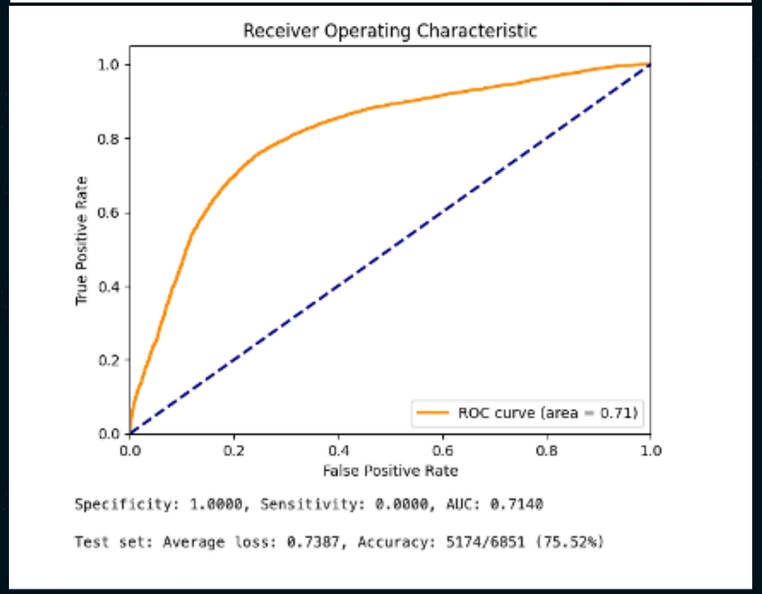


Specificity: 1.0000, Sensitivity: 0.0000, AUC: 0.7382

Test set: Average loss: 0.7913, Accuracy: 5043/6851 (73.61%)

RESENET50

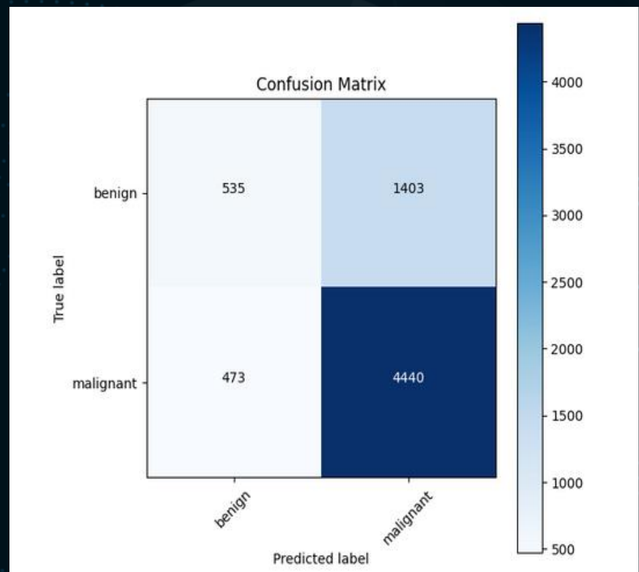


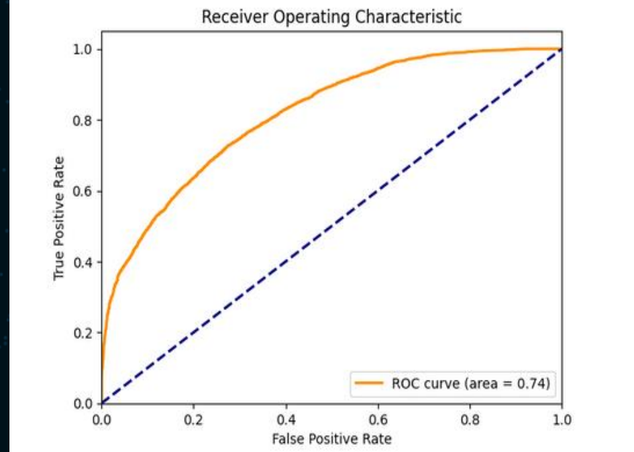


Specificity: 1.0000, Sensitivity: 0.0000, AUC: 0.7140

Test set: Average loss: 0.7387, Accuracy: 5174/6851 (75.52%)

VGG16





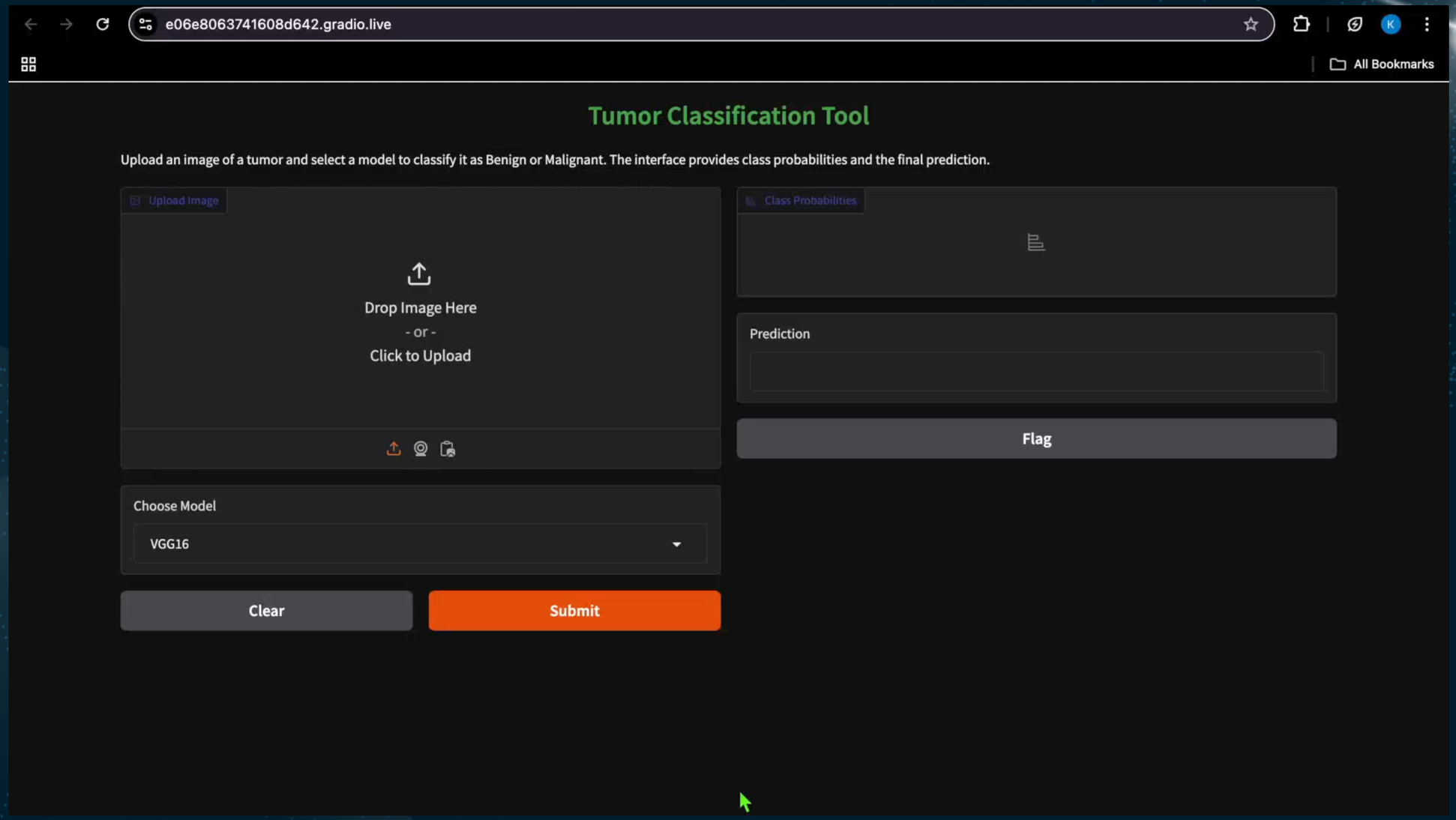
Specificity: 1.0000, Sensitivity: 0.0000, AUC: 0.7369

Test set: Average loss: 0.7441, Accuracy: 4975/6851 (72.62%)

RESENET18

GRADIO

https://drive.google.com/file/d/11ht-pzUw0-UVsDEjfrOfHMmr55l49B4F/view?usp=sharing



THANK YOU