CHEST XRAY IMAGE CLASSIFICATION

CLOUDXLAB CAPSTONE PROJECT

OBJECTIVE

The objective of this project is to develop an image classification application using Flask and TensorFlow Keras. The application should allow users to upload chest X-ray images, and the uploaded images should be classified into three categories: NORMAL, COVID19, and PNEUMONIA.

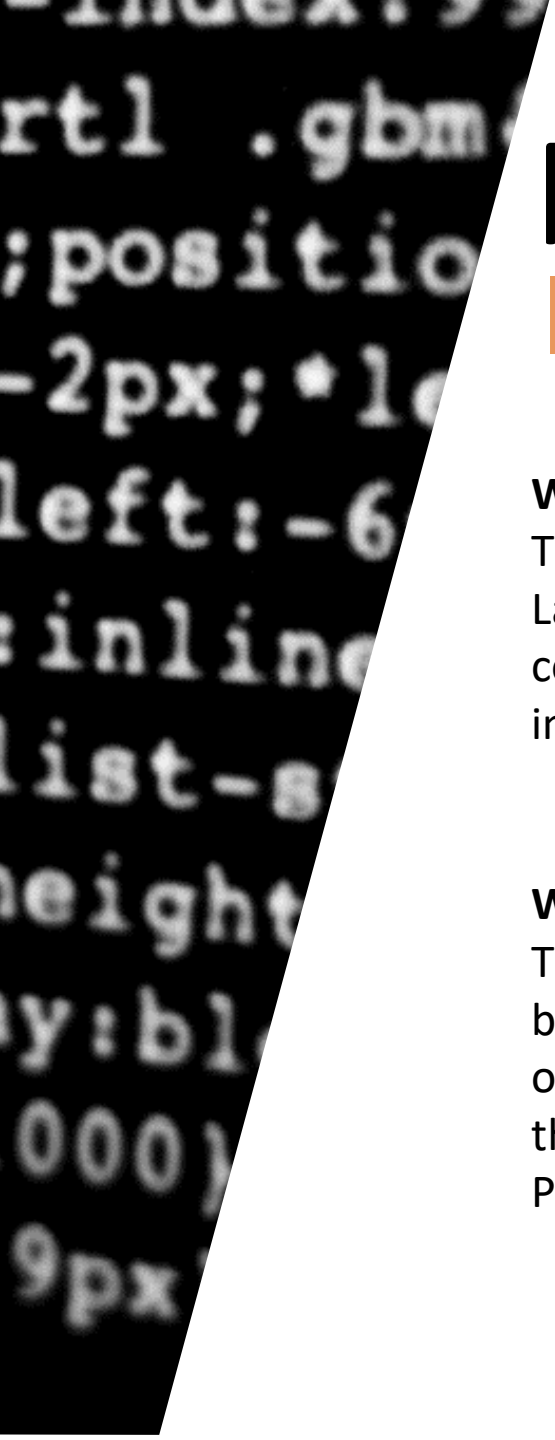
APPROACH TO SOLVING THE PROBLEM

Solution

1. **Data Collection:**
   - Chest X-ray images for training and testing were obtained Kaggle.
2. **Model Development:**
   - We used the pre-trained EfficientNetB0 model as the base model.
   - Custom classification layers were added on top of the base model.
   - The model was trained using the training data, and the training process included data augmentation.
3. **Flask Application Development:**
   - Flask was used to create a web application.
   - Routes were defined to handle image uploads and predictions.
   - HTML templates were created to design the user interface.
4. **Model Evaluation:**
   - The trained model was evaluated using the testing data.
   - Accuracy and other relevant metrics were calculated to assess the model's performance.

DATA VISUALIZATION

```
# Display images with labels
plt.figure(figsize=(10, 5))
for i, (image_path, label) in enumerate(zip(selected_paths, selected_labels)):
  plt.subplot(1, num_images, i + 1)
  image = Image.open(image_path)
  plt.imshow(image)
  plt.title(label)
  plt.axis("off")
plt.show()
```



MODEL SUMMARY:

LET'S DIVE IN

Without Pre-trained Keras Model

The model architecture consists Flatten Layer, four dense layers and Dropout Layer with ReLU activation and he_normal kernel_initializer. The output layer consists of three nodes with softmax activation for classifying the input images into three categories: NORMAL, COVID19, and PNEUMONIA.

With Pre-trained Keras Model

The model architecture consists of the EfficientNetB0 base model followed by global average pooling and two dense layers with ReLU activation. The output layer consists of three nodes with softmax activation for classifying the input images into three categories: NORMAL, COVID19, and PNEUMONIA.

Without Pre-trained Keras Model

```
model.summary()
```

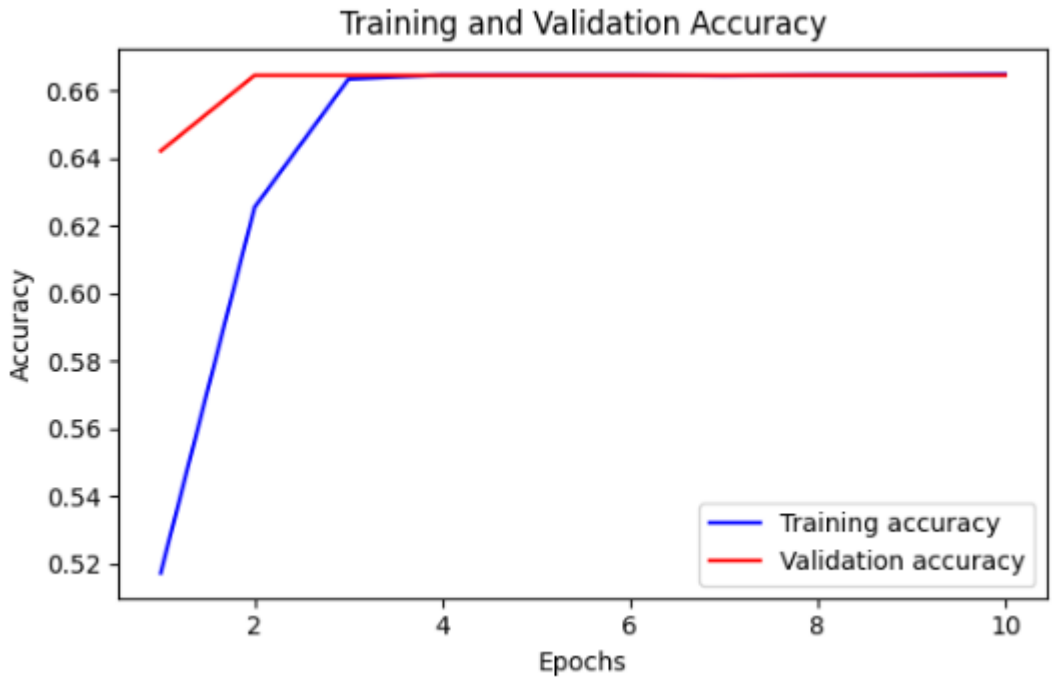
```
Model: "sequential_6"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
flatten_6 (Flatten)          (None, 157323)            0
_________________________________________________________________
dense_29 (Dense)             (None, 300)               47197200
_________________________________________________________________
dropout_23 (Dropout)         (None, 300)               0
_________________________________________________________________
dense_30 (Dense)             (None, 100)               30100
_________________________________________________________________
dropout_24 (Dropout)         (None, 100)               0
_________________________________________________________________
dense_31 (Dense)             (None, 500)               50500
_________________________________________________________________
dropout_25 (Dropout)         (None, 500)               0
_________________________________________________________________
dense_32 (Dense)             (None, 500)               250500
_________________________________________________________________
dropout_26 (Dropout)         (None, 500)               0
_________________________________________________________________
dense_33 (Dense)             (None, 3)                 1503
=================================================================
Total params: 47,529,803
Trainable params: 47,529,803
Non-trainable params: 0
_________________________________________________________________
```

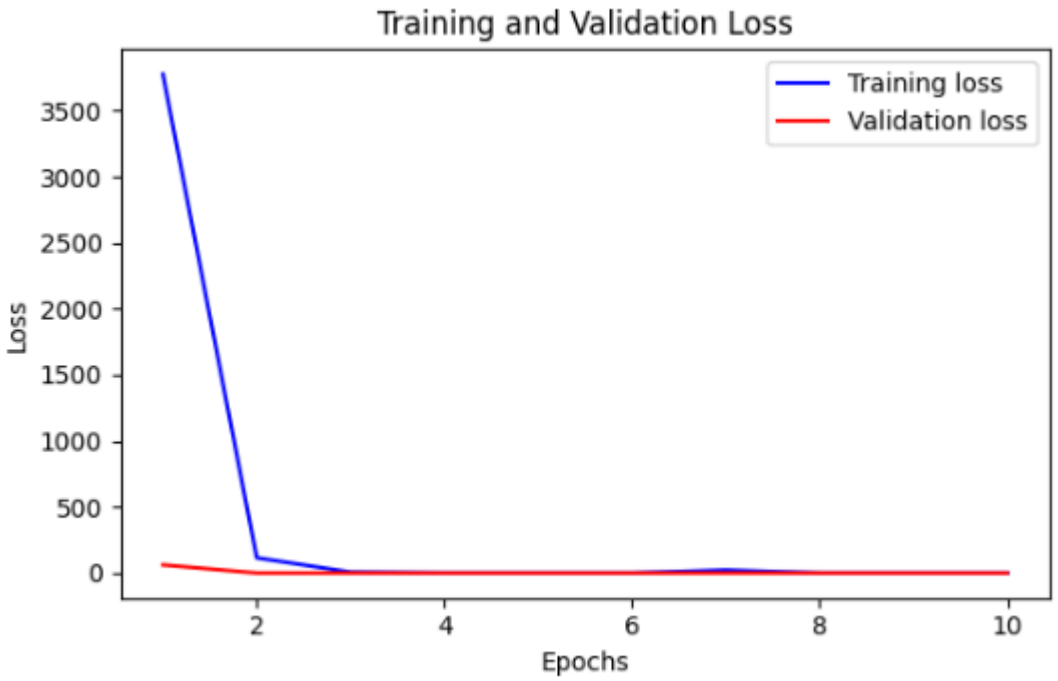
With Pre-trained Keras Model

```
model.summary()
```

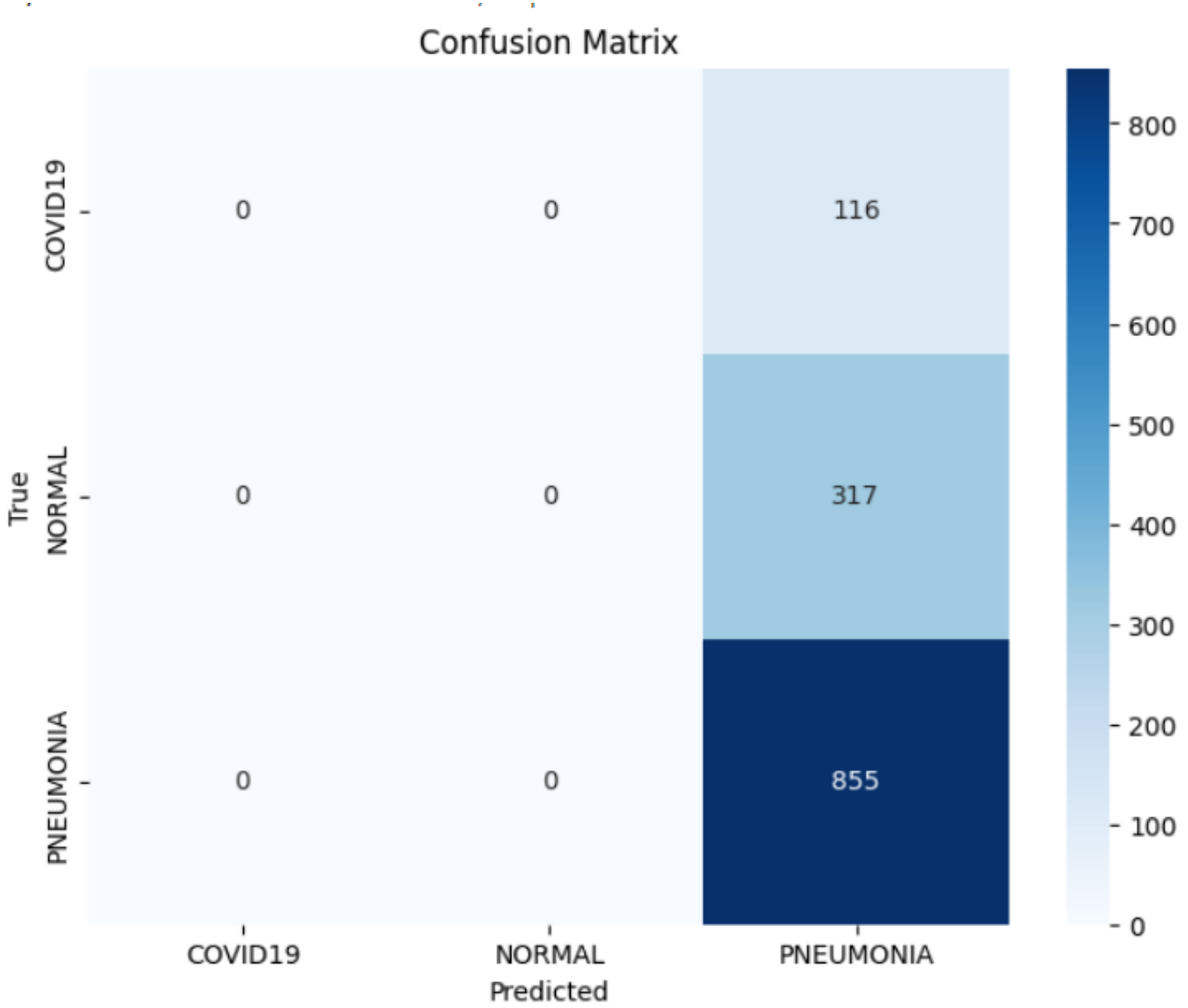
```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
efficientnetb0 (Functional)  (None, 8, 8, 1280)        4049571
_________________________________________________________________
global_average_pooling2d (Gl (None, 1280)              0
_________________________________________________________________
dense (Dense)                (None, 256)               327936
_________________________________________________________________
dropout (Dropout)            (None, 256)               0
_________________________________________________________________
dense_1 (Dense)              (None, 3)                 771
=================================================================
Total params: 4,378,278
Trainable params: 328,707
Non-trainable params: 4,049,571
_________________________________________________________________
```

ACCURACY AND LOSS WITHOUT PRETRAINED MODEL





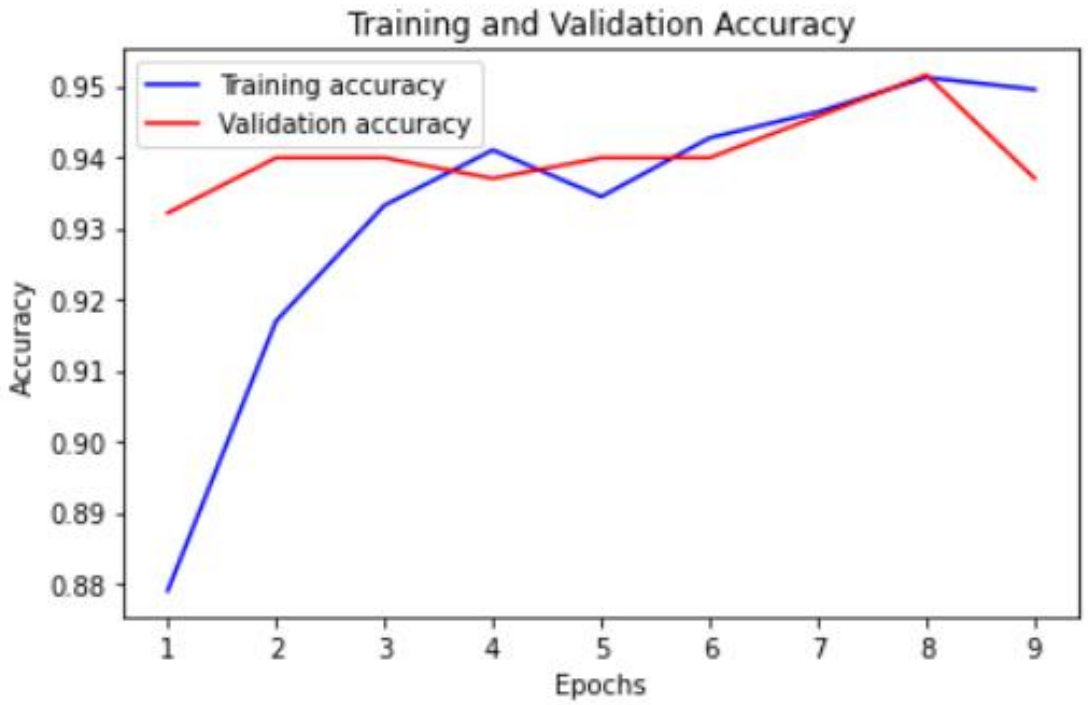
PERFORMANCE WITHOUT PRETRAINED MODEL

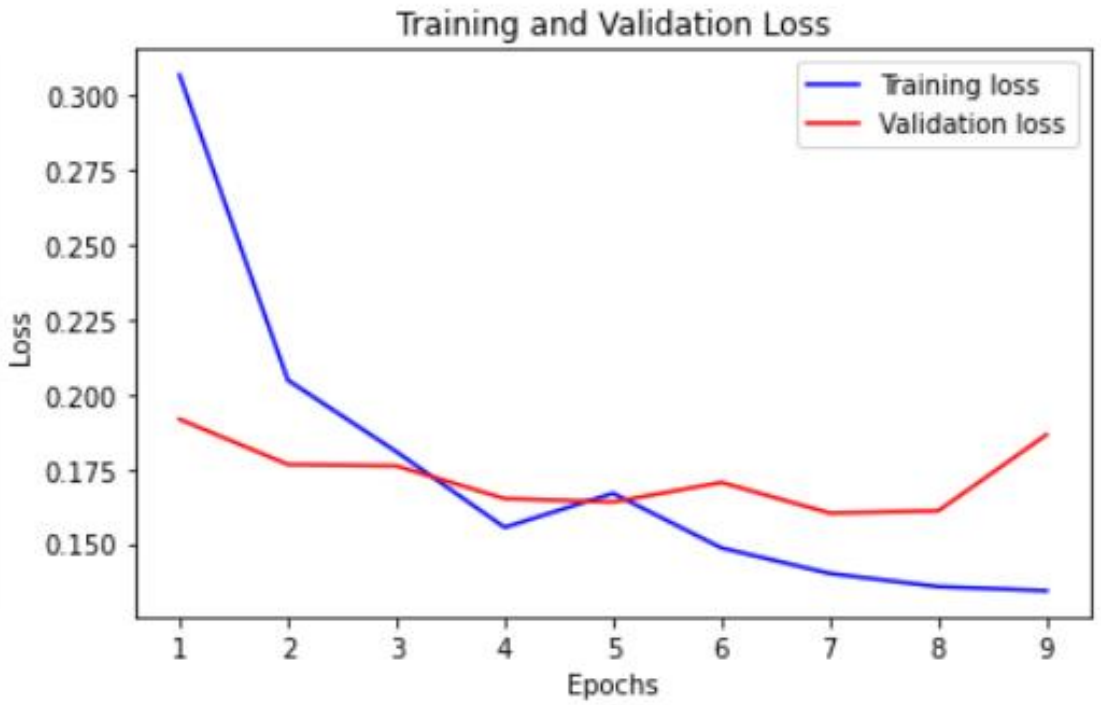


Classification Report:

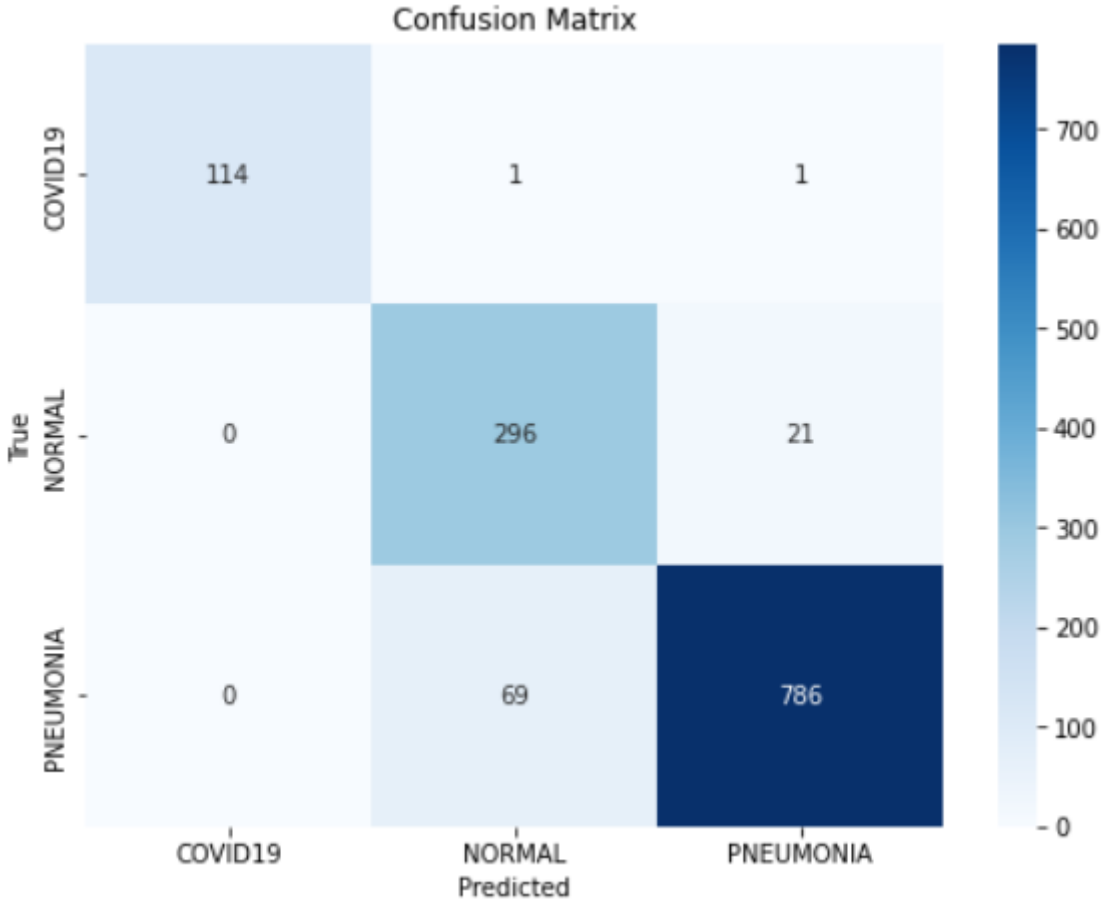
	precision	recall	f1-score	support
COVID19	0.00	0.00	0.00	116
NORMAL	0.00	0.00	0.00	317
PNEUMONIA	0.66	1.00	0.80	855
accuracy			0.66	1288
macro avg	0.22	0.33	0.27	1288
weighted avg	0.44	0.66	0.53	1288

ACCURACY AND LOSS WITH EFFICIENTNETB0 MODEL





PERFORMANCE WITH EFFICIENTNETB0 MODEL

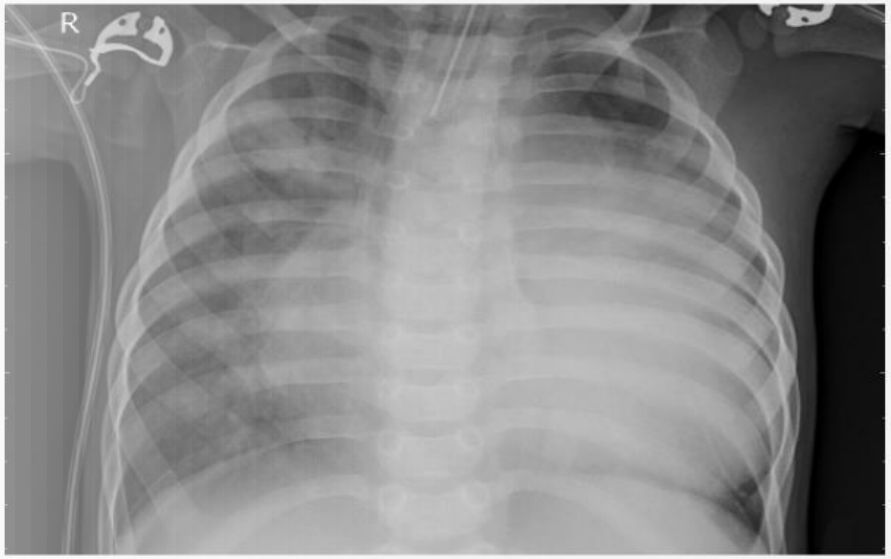


Classification Report:

	precision	recall	f1-score	support
COVID19	1.00	0.98	0.99	116
NORMAL	0.81	0.93	0.87	317
PNEUMONIA	0.97	0.92	0.95	855
accuracy			0.93	1288
macro avg	0.93	0.95	0.93	1288
weighted avg	0.93	0.93	0.93	1288

INFERENCE

- Users can upload images through the application's user interface, and the application provides real-time predictions.
- The developed application successfully classifies chest X-ray images into NORMAL, COVID19, and PNEUMONIA categories.

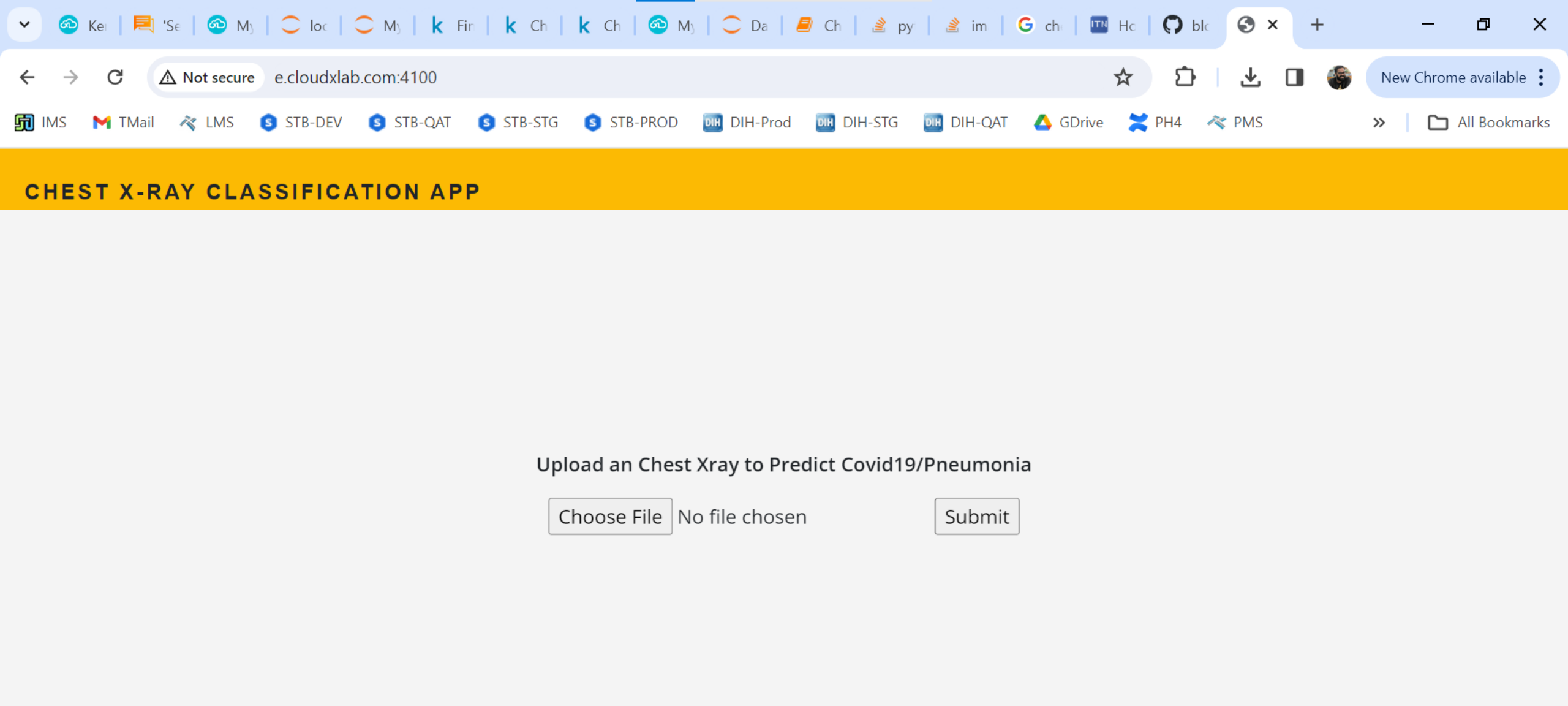


PNEUMONIA

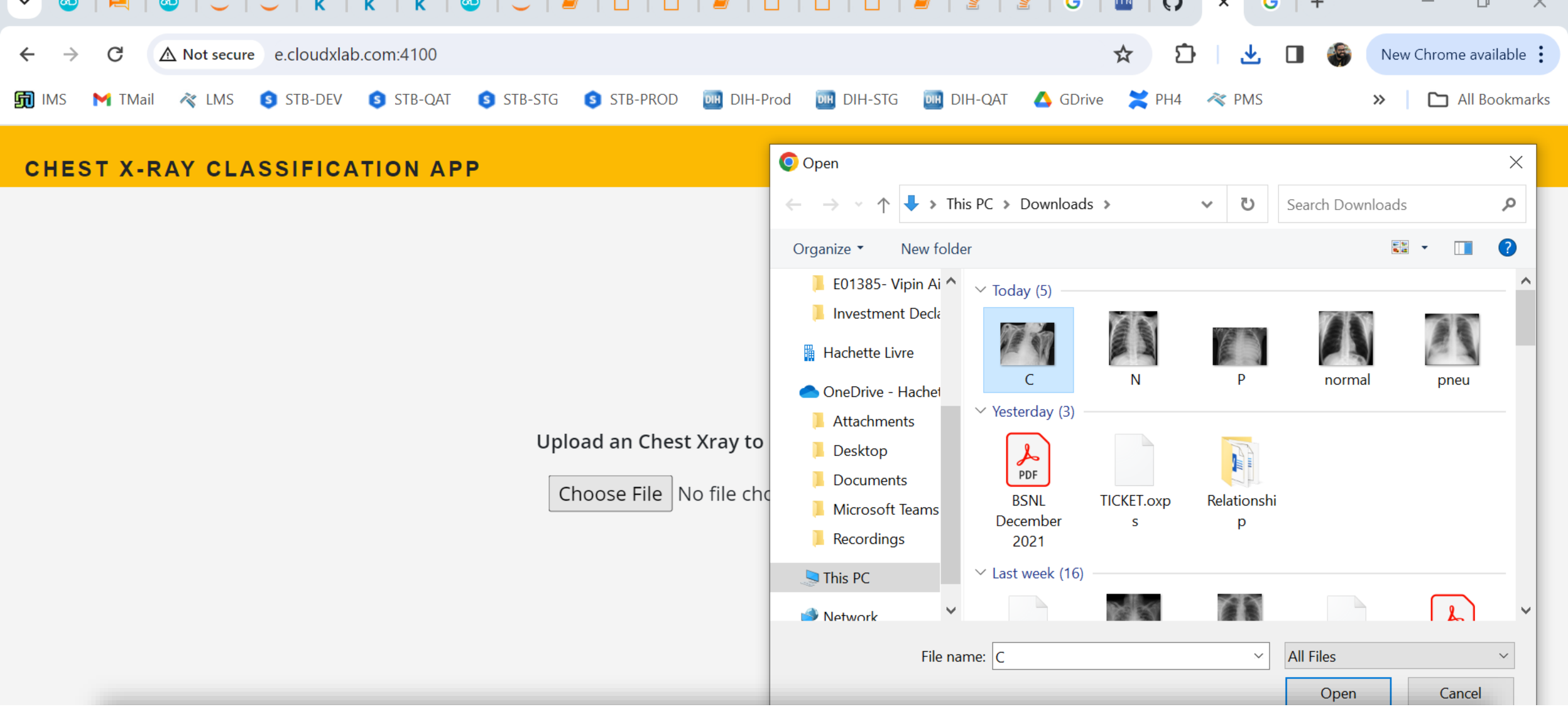
Upload another?

Choose File No file chosen

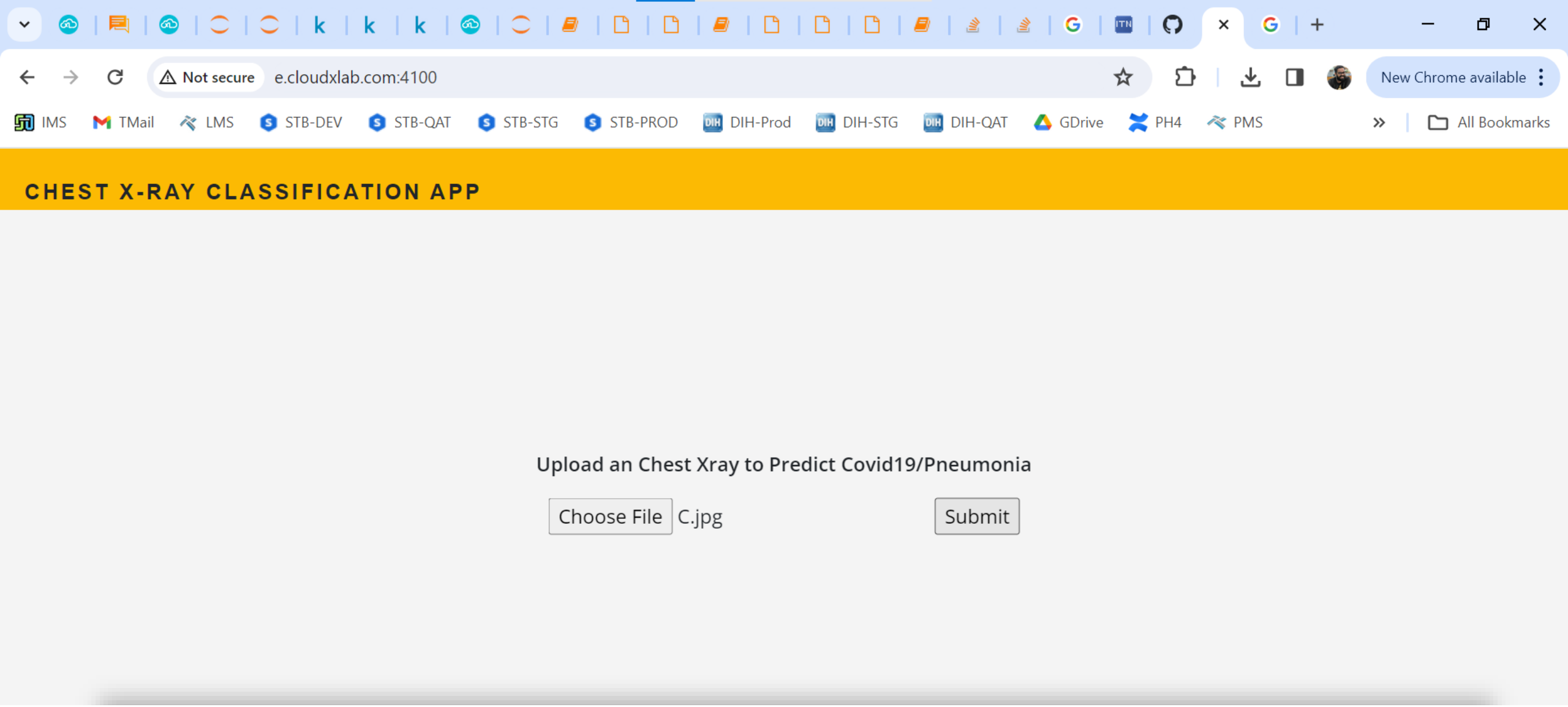
Submit



HOME PAGE FOR FLASK APP



CHOOSE AN IMAGE



SELECT AN IMAGE AND SUBMIT

Not secure e.cloudxlab.com:4100/upload

New Chrome available

IMS TMail LMS STB-DEV STB-QAT STB-STG STB-PROD DIH-Prod DIH-STG DIH-QAT GDrive PH4 PMS All Bookmarks

CHEST X-RAY CLASSIFICATION APP

COVID19

Upload another?

Choose File No file chosen

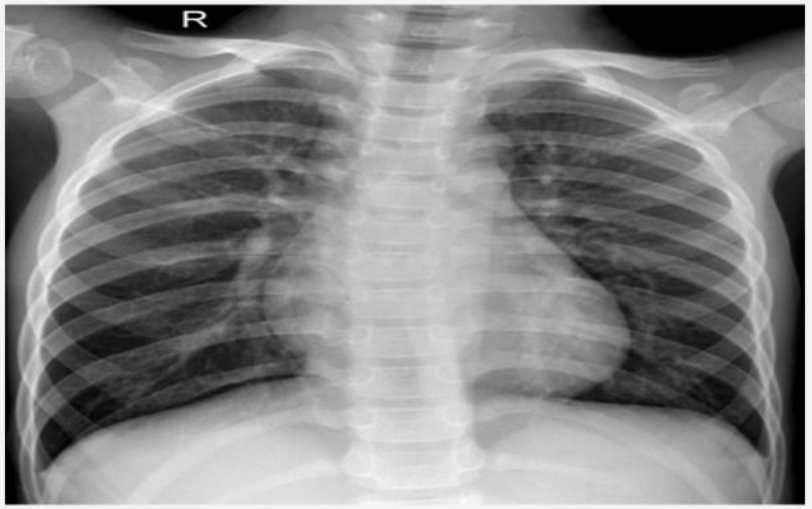
PREDICTION

Not secure e.cloudxlab.com:4100/upload

New Chrome available

IMS TMail LMS STB-DEV STB-QAT STB-STG STB-PROD DIH-Prod DIH-STG DIH-QAT GDrive PH4 PMS All Bookmarks

CHEST X-RAY CLASSIFICATION APP

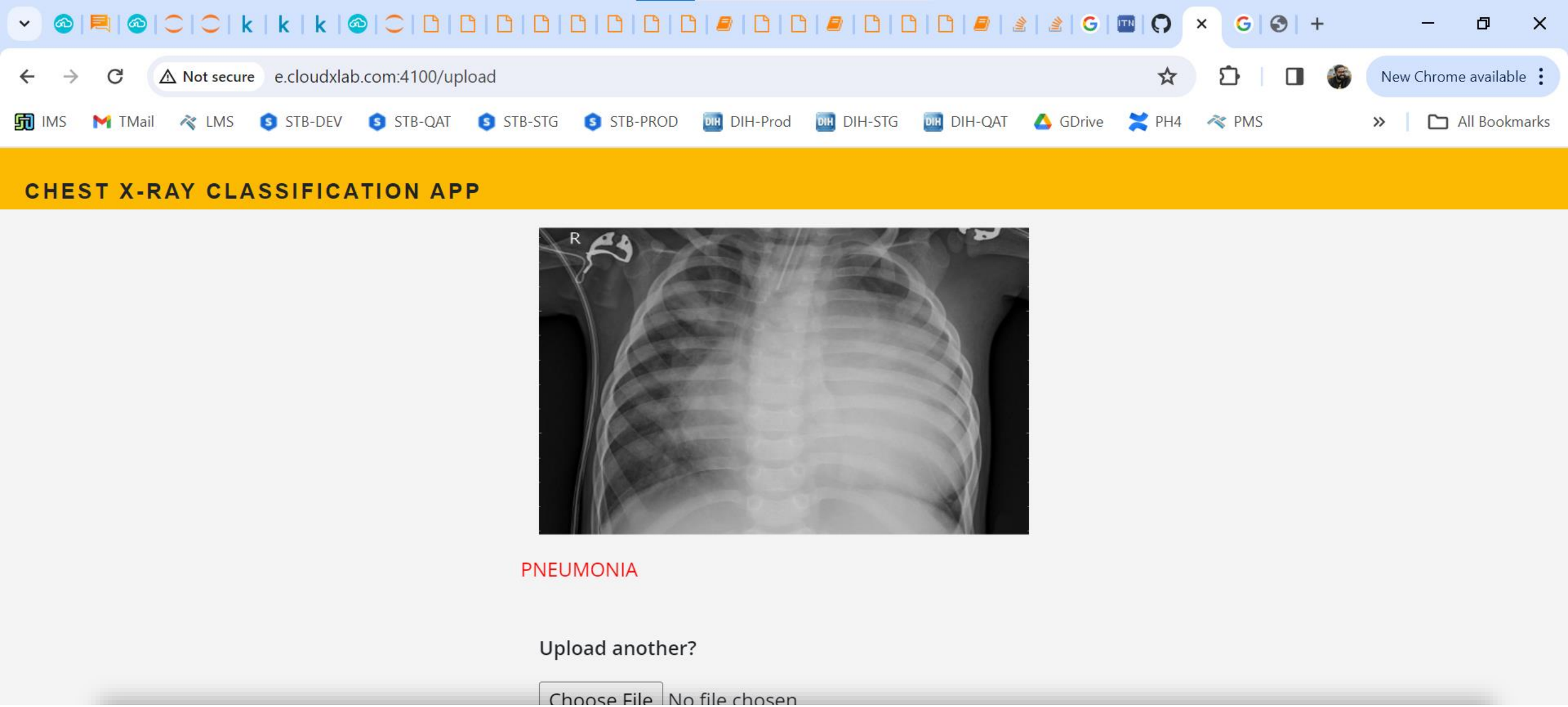


NORMAL

Upload another?

Choose File No file chosen

PREDICTION FOR NORMAL

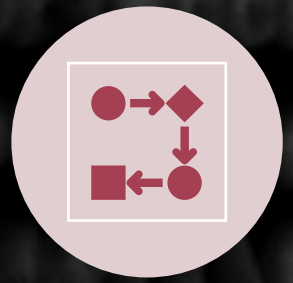


PREDICTION FOR PNEUMONIA

REFERENCES

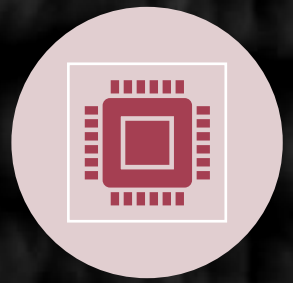
- EfficientNet: Rethinking Model Scaling for Convolutional Neural Networks (https://arxiv.org/abs/1905.11946)
- Flask documentation: https://flask.palletsprojects.com/en/2.0.x/
- TensorFlow documentation: https://www.tensorflow.org/
- Kaggle Dataset : https://www.kaggle.com/datasets/alsaniipe/chest-x-ray-image
- GitHub – https://github.com
- CloudxLab - https://cloudxlab.com/course/my#course-165

OTHER COMMENTS



Further fine-tuning of the model may improve its performance.

Experimenting with different pre-trained models or custom architectures could be explored to enhance classification accuracy.



Continuous monitoring and updating of the application based on user feedback and new developments in the field are recommended.

Additional features such as model retraining with new data, model versioning, and deployment to production environments can be considered for future enhancements.

https://github.com/vipinainvijayan/Chest-Xray-Image-Classification-App.git

Git Hub Link

THANK YOU

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