DEEP LEARNING FOR AUTOMATED MEDICAL IMAGE DIAGNOSIS

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Project Link: https://colab.research.google.com/drive/1IhEOcBLnyg9o3AQNyfKKq0fu5U4t9CUq?usp=sharing

```
# Mounting Google Drive
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
!pip install tensorflow matplotlib scikit-learn seaborn
```

```
Requirement already satisfied: tensorflow in /usr/local/lib/python3.11/dist-packages (2.18.0)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.11/dist-packages (3.10.0)
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.11/dist-packages (1.6.1)
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Requirement already satisfied: tensorboard<2.19,>=2.18 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (2.18.0)
Requirement already satisfied: keras>=3.5.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (3.8.0)
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Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /usr/local/lib/python3.11/dist-packages (from rich->keras>=3.5.0->tens
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-packages (from markdown-it-py>=2.2.0->rich->keras>=3
```

```
%cd /content/drive/MyDrive/Project_DeepLearning
```

```
/content/drive/MyDrive/Project_DeepLearning
```

```
!ls
```

```
Chest_Xray      data_loader.py  kaggle.json       predict.py   train.py
colab_setup.py  evaluate.py     model_builder.py  __pycache__
```

```
from data_loader import load_data
from model_builder import build_model
from train import train_model
from evaluate import plot_training_history, evaluate_model
from predict import predict_image
```

```
from google.colab import files
files.upload()
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving kaggle.json to kaggle (1).json
{'kaggle (1).json': b'{"username":"saisravanimadabhushi","key":"22b2a603ea6c106affd445b7e53470f1"}'}
```

```
# Make a directory
!mkdir -p ~/.kaggle

# Move kaggle.json to the directory
!cp kaggle.json ~/.kaggle/

# Set permissions

!chmod 600 ~/.kaggle/kaggle.json
```

```
# Now download dataset
!kaggle datasets download -d paultimothymooney/chest-xray-pneumonia -p /content/

# Unzip
!unzip /content/chest-xray-pneumonia.zip -d /content/NIH_Chest_Xray
```

```
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1223-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1224-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1225-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1226-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1227-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1228-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1231-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1232-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1234-0001.jpeg
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  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1237-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1240-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1241-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1242-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1243-0001.jpeg
  inflating: /content/NIH_Chest_Xray/chest_xray/train/NORMAL/NORMAL2-IM-1244-0001.jpeg
```

```
!cp -r /content/NIH_Chest_Xray/chest_xray/train/NORMAL /content/drive/MyDrive/Project_DeepLearning/Chest_Xray/train/
!cp -r /content/NIH_Chest_Xray/chest_xray/train/PNEUMONIA /content/drive/MyDrive/Project_DeepLearning/Chest_Xray/train/
```

```
^C
^C
```

```
train_dir = '/content/drive/MyDrive/Project_DeepLearning/Chest_Xray/train'
train_gen, val_gen = load_data(train_dir)
```

```
Found 4173 images belonging to 2 classes.
Found 1043 images belonging to 2 classes.
```

```
model = build_model()
model.summary()  # Optional: to see layer details
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernel
58889256/58889256 ━━━━━━━━━━━━━━━━━━━━ 0s 0us/step
Model: "sequential"
```

Layer (type)	Output Shape	Param #
vgg16 (Functional)	(None, 7, 7, 512)	14,714,688
flatten (Flatten)	(None, 25088)	0
dense (Dense)	(None, 128)	3,211,392
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 1)	129

```
Total params: 17,926,209 (68.38 MB)
Trainable params: 3,211,521 (12.25 MB)
```

```
from PIL import Image
import os

# Verify all images before training
def verify_images(directory):
    num_deleted = 0
    for subdir, _, files in os.walk(directory):
        for file in files:
            file_path = os.path.join(subdir, file)
            try:
                img = Image.open(file_path)
                img.verify()
            except (IOError, SyntaxError):
                print(f"Deleting corrupt image: {file_path}")
                os.remove(file_path)
                num_deleted += 1
    print(f"Deleted {num_deleted} corrupt images.")

verify_images('/content/drive/MyDrive/Project_DeepLearning/Chest_Xray/train')
```

```
Deleting corrupt image: /content/drive/MyDrive/Project_DeepLearning/Chest_Xray/train/PNEUMONIA/person1238_bacteria_3194.jpeg
Deleted 1 corrupt images.
```

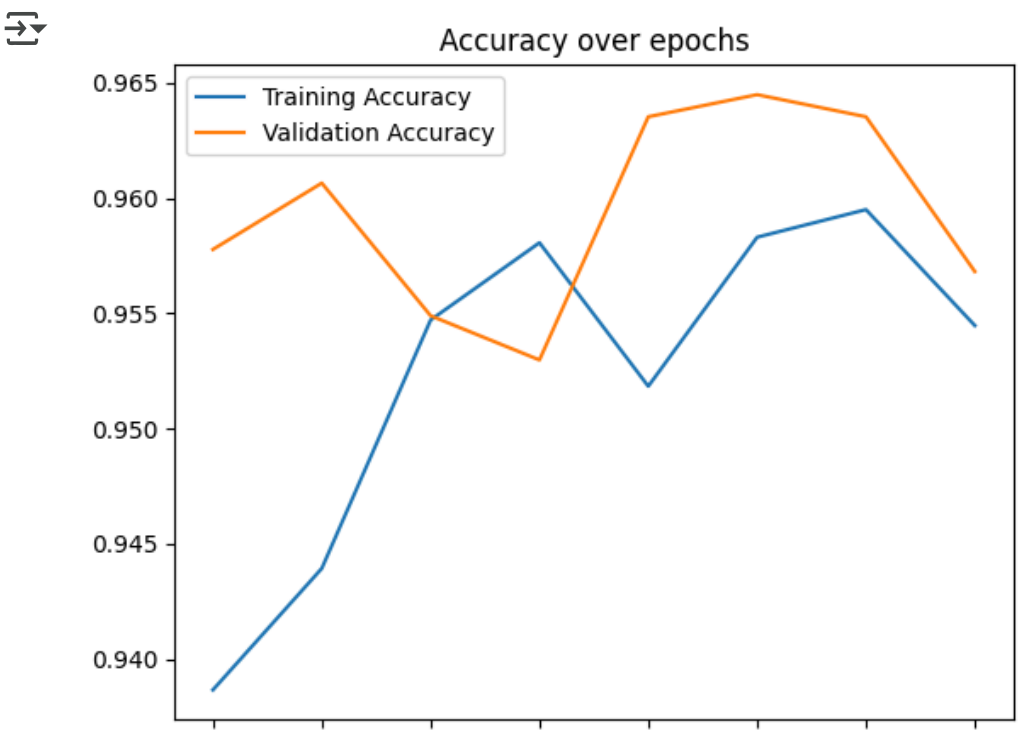
```
train_gen, val_gen = load_data(train_dir)
#reloading the data
```

```
Found 4173 images belonging to 2 classes.
Found 1042 images belonging to 2 classes.
```

```
history = train_model(model, train_gen, val_gen, epochs=10)
```

```
/usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:121: UserWarning: Your `PyDataset
  self._warn_if_super_not_called()
Epoch 1/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 0s 18s/step - accuracy: 0.9431 - loss: 0.1430 WARNING:absl:You are saving your model as an HDF5 fi
131/131 ━━━━━━━━━━━━━━━━━━━━ 2932s 22s/step - accuracy: 0.9431 - loss: 0.1430 - val_accuracy: 0.9578 - val_loss: 0.1156
Epoch 2/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 0s 18s/step - accuracy: 0.9377 - loss: 0.1557 WARNING:absl:You are saving your model as an HDF5 fi
131/131 ━━━━━━━━━━━━━━━━━━━━ 2963s 22s/step - accuracy: 0.9378 - loss: 0.1556 - val_accuracy: 0.9607 - val_loss: 0.0992
Epoch 3/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 2948s 22s/step - accuracy: 0.9585 - loss: 0.1224 - val_accuracy: 0.9549 - val_loss: 0.1060
Epoch 4/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 2925s 22s/step - accuracy: 0.9616 - loss: 0.1046 - val_accuracy: 0.9530 - val_loss: 0.1105
Epoch 5/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 0s 18s/step - accuracy: 0.9453 - loss: 0.1341 WARNING:absl:You are saving your model as an HDF5 fi
131/131 ━━━━━━━━━━━━━━━━━━━━ 2952s 22s/step - accuracy: 0.9454 - loss: 0.1340 - val_accuracy: 0.9635 - val_loss: 0.0879
Epoch 6/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 0s 18s/step - accuracy: 0.9555 - loss: 0.1207 WARNING:absl:You are saving your model as an HDF5 fi
131/131 ━━━━━━━━━━━━━━━━━━━━ 2962s 23s/step - accuracy: 0.9555 - loss: 0.1207 - val_accuracy: 0.9645 - val_loss: 0.0970
Epoch 7/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 3011s 23s/step - accuracy: 0.9600 - loss: 0.1127 - val_accuracy: 0.9635 - val_loss: 0.0914
Epoch 8/10
131/131 ━━━━━━━━━━━━━━━━━━━━ 2902s 22s/step - accuracy: 0.9517 - loss: 0.1252 - val_accuracy: 0.9568 - val_loss: 0.1081
```

```
plot_training_history(history)
```

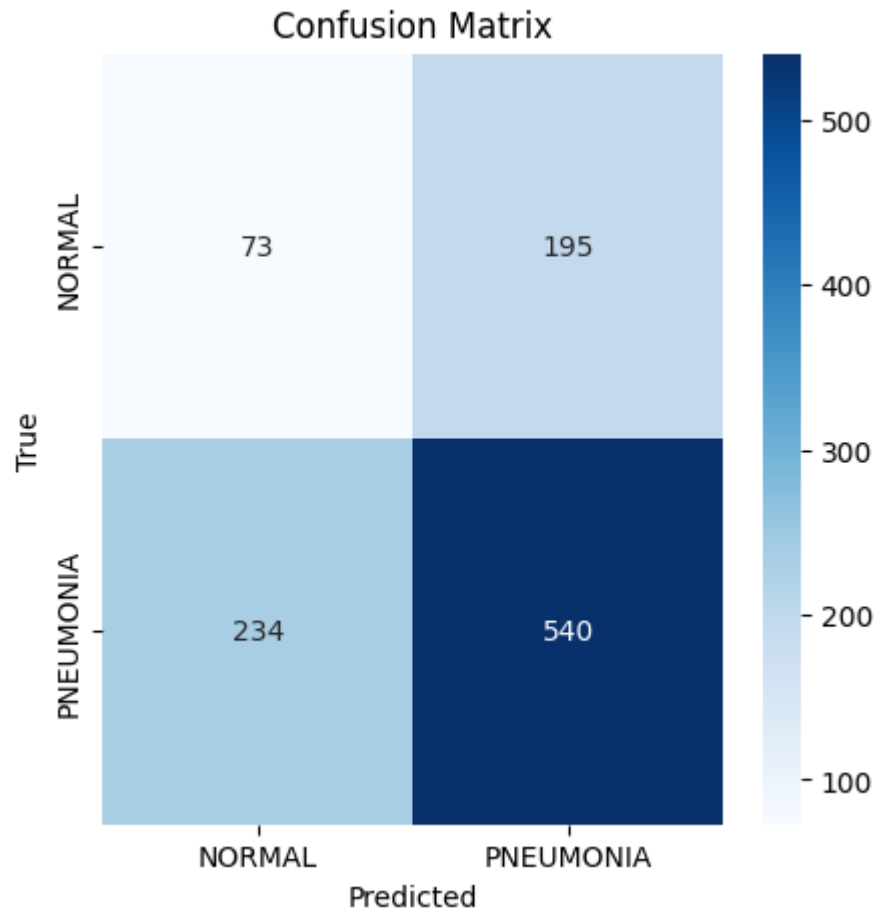



```
evaluate_model(model, val_gen)
```

```
33/33 ━━━━━━━━━━━━━━━━━━━━ 589s 18s/step
              precision    recall  f1-score   support

      NORMAL       0.24      0.27      0.25       268
   PNEUMONIA       0.73      0.70      0.72       774

    accuracy                           0.59      1042
   macro avg       0.49      0.49      0.48      1042
weighted avg       0.61      0.59      0.60      1042
```




```
model.save('/content/drive/MyDrive/Project_DeepLearning/Chest_Xray/final_model.h5')
```

```
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format
```

```
!ls /content/drive/MyDrive/Project_DeepLearning/Chest_Xray/test_image1.jpg
```

```
/content/drive/MyDrive/Project_DeepLearning/Chest_Xray/test_image1.jpg
```

```
img_path = '/content/drive/MyDrive/Project_DeepLearning/Chest_Xray/test_image1.jpg'
result = predict_image(model, img_path)

if result >= 0.5:
    print("Prediction: Pneumonia Detected 😷")
else:
    print("Prediction: Normal Chest X-ray 🫁")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 850ms/step
Prediction: Normal Chest X-ray 🫁
```

```
img_path = '/content/drive/MyDrive/Project_DeepLearning/Chest_Xray/test_image2.jpg'
result = predict_image(model, img_path)

if result >= 0.5:
    print("Prediction: Pneumonia Detected 😷")
else:
    print("Prediction: Normal Chest X-ray 🫁")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 479ms/step
Prediction: Pneumonia Detected 😷
```

```
img_path = '/content/drive/MyDrive/Project_DeepLearning/Chest_Xray/test_image3.jpg'
result = predict_image(model, img_path)

if result >= 0.5:
    print("Prediction: Pneumonia Detected 😷")
else:
```

```
    print("Prediction: Normal Chest X-ray 🫁")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 479ms/step
Prediction: Normal Chest X-ray 🫁
```

```
from google.colab import files
import cv2
import numpy as np
import matplotlib.pyplot as plt

# Function to upload, predict and print output
def upload_and_predict(model, img_size=(224,224)):
    uploaded = files.upload()

    for img_name in uploaded.keys():
        img = cv2.imread(img_name)
        img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        img_resized = cv2.resize(img, img_size)
        img_normalized = img_resized / 255.0
        img_expanded = np.expand_dims(img_normalized, axis=0)

        prediction = model.predict(img_expanded)[0][0]

        label = "Pneumonia Detected 😷" if prediction >= 0.5 else "Normal Chest X-ray 🫁"

        plt.imshow(img)
        plt.title(label)
        plt.axis('off')
        plt.show()

        print(f"Prediction for {img_name}: {label}")


upload_and_predict(model)
```

```
Choose Files No file chosen  Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.
Saving 00030724_000.png to 00030724_000.png
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 592ms/step
```


```
Prediction for 00030724_000.png: Pneumonia Detected 😷
```

```
!pip install streamlit
!pip install pyngrok
```

```
Requirement already satisfied: streamlit in /usr/local/lib/python3.11/dist-packages (1.44.1)
Requirement already satisfied: altair<6,>=4.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (5.5.0)
Requirement already satisfied: blinker<2,>=1.0.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (1.9.0)
Requirement already satisfied: cachetools<6,>=4.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (5.5.2)
Requirement already satisfied: click<9,>=7.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (8.1.8)
Requirement already satisfied: numpy<3,>=1.23 in /usr/local/lib/python3.11/dist-packages (from streamlit) (2.0.2)
Requirement already satisfied: packaging<25,>=20 in /usr/local/lib/python3.11/dist-packages (from streamlit) (24.2)
Requirement already satisfied: pandas<3,>=1.4.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (2.2.2)
Requirement already satisfied: pillow<12,>=7.1.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (11.1.0)
Requirement already satisfied: protobuf<6,>=3.20 in /usr/local/lib/python3.11/dist-packages (from streamlit) (5.29.4)
Requirement already satisfied: pyarrow>=7.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (18.1.0)
```

```
Requirement already satisfied: requests<3,>=2.27 in /usr/local/lib/python3.11/dist-packages (from streamlit) (2.32.3)
Requirement already satisfied: tenacity<10,>=8.1.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (9.1.2)
Requirement already satisfied: toml<2,>=0.10.1 in /usr/local/lib/python3.11/dist-packages (from streamlit) (0.10.2)
Requirement already satisfied: typing-extensions<5,>=4.4.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (4.13.2)
Requirement already satisfied: watchdog<7,>=2.1.5 in /usr/local/lib/python3.11/dist-packages (from streamlit) (6.0.0)
Requirement already satisfied: gitpython!=3.1.19,<4,>=3.0.7 in /usr/local/lib/python3.11/dist-packages (from streamlit) (3.1.44)
Requirement already satisfied: pydeck<1,>=0.8.0b4 in /usr/local/lib/python3.11/dist-packages (from streamlit) (0.9.1)
Requirement already satisfied: tornado<7,>=6.0.3 in /usr/local/lib/python3.11/dist-packages (from streamlit) (6.4.2)
Requirement already satisfied: jinja2 in /usr/local/lib/python3.11/dist-packages (from altair<6,>=4.0->streamlit) (3.1.6)
Requirement already satisfied: jsonschema>=3.0 in /usr/local/lib/python3.11/dist-packages (from altair<6,>=4.0->streamlit) (4.23
Requirement already satisfied: narwhals>=1.14.2 in /usr/local/lib/python3.11/dist-packages (from altair<6,>=4.0->streamlit) (1.3
Requirement already satisfied: gitdb<5,>=4.0.1 in /usr/local/lib/python3.11/dist-packages (from gitpython!=3.1.19,<4,>=3.0.7->st
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-packages (from pandas<3,>=1.4.0->streaml
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas<3,>=1.4.0->streamlit) (2025
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas<3,>=1.4.0->streamlit) (202
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.27->stre
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.27->streamlit) (3.10
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.27->streamlit)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.27->streamlit)
Requirement already satisfied: smmap<6,>=3.0.1 in /usr/local/lib/python3.11/dist-packages (from gitdb<5,>=4.0.1->gitpython!=3.1
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.11/dist-packages (from jinja2->altair<6,>=4.0->streamli
Requirement already satisfied: attrs>=22.2.0 in /usr/local/lib/python3.11/dist-packages (from jsonschema>=3.0->altair<6,>=4.0->s
Requirement already satisfied: jsonschema-specifications>=2023.03.6 in /usr/local/lib/python3.11/dist-packages (from jsonschema>
Requirement already satisfied: referencing>=0.28.4 in /usr/local/lib/python3.11/dist-packages (from jsonschema>=3.0->altair<6,>=
Requirement already satisfied: rpds-py>=0.7.1 in /usr/local/lib/python3.11/dist-packages (from jsonschema>=3.0->altair<6,>=4.0->
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.8.2->pandas<3,>=1.4
Requirement already satisfied: pyngrok in /usr/local/lib/python3.11/dist-packages (7.2.5)
Requirement already satisfied: PyYAML>=5.1 in /usr/local/lib/python3.11/dist-packages (from pyngrok) (6.0.2)
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True)
```

```
model.save('/content/drive/MyDrive/Project_DeepLearning/final_model.h5')
```

```
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format
```

```
model = tf.keras.models.load_model('/content/drive/MyDrive/Project_DeepLearning/final_model.h5')
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have yet to be built. `model.compile_metrics` will be empty unt
```

```
%%writefile app.py
import streamlit as st
import tensorflow as tf
import numpy as np
import cv2
from PIL import Image

# Load your trained model
model = tf.keras.models.load_model('/content/drive/MyDrive/Project_DeepLearning/final_model.h5')

uploaded_file = st.file_uploader("Choose an X-ray image...", type=["jpg", "jpeg", "png"])

if uploaded_file is not None:
    # Read and preprocess the uploaded image
    image = Image.open(uploaded_file)

    # Forcefully convert to RGB (IMPORTANT!!!)
    if image.mode != "RGB":
        image = image.convert("RGB")

    img_array = np.array(image)

    # Resize while preserving 3 channels (224, 224, 3)
    img_resized = cv2.resize(img_array, (224, 224))

    img_normalized = img_resized / 255.0  # Normalize pixel values
```

```
    img_expanded = np.expand_dims(img_normalized, axis=0)  # Add batch dimension (1, 224, 224, 3)

    # Predict
    prediction = model.predict(img_expanded)[0][0]

    label = "Pneumonia Detected 😷" if prediction >= 0.5 else "Normal Chest X-ray 🫁"

    # Display
    st.image(image, caption='Uploaded Chest X-ray.', use_column_width=True)
    st.subheader(f"Prediction: {label}")
```

```
Overwriting app.py
```

```
!pip install pyngrok
from pyngrok import ngrok

# Set your ngrok authtoken
!ngrok authtoken 2wHjI3l6Gog35pEErepv421Hu8p_42uzfMgZPdYaThXD1Kqx
```

```
Requirement already satisfied: pyngrok in /usr/local/lib/python3.11/dist-packages (7.2.5)
Requirement already satisfied: PyYAML>=5.1 in /usr/local/lib/python3.11/dist-packages (from pyngrok) (6.0.2)
Authtoken saved to configuration file: /root/.config/ngrok/ngrok.yml
```

```
!pkill streamlit
!pkill ngrok
```

```
!streamlit run app.py &
```

```
Collecting usage statistics. To deactivate, set browser.gatherUsageStats to false.


  You can now view your Streamlit app in your browser.

  Local URL: http://localhost:8501
  Network URL: http://172.28.0.12:8501
  External URL: http://34.145.177.151:8501

  Stopping...
```

```
from pyngrok import ngrok

# Kill previous tunnels (important)
ngrok.kill()

# Now open a clean, new tunnel
public_url = ngrok.connect(addr="8501", bind_tls=True)
print(f"Streamlit App Link 👉 {public_url}")
```

```
Streamlit App Link 👉 NgrokTunnel: "https://61d6-34-145-177-151.ngrok-free.app" -> "http://localhost:8501"
```