

Chest X-ray Analysis with RAG in Google Colab

This guide explains how to run the Chest X-ray Analysis with RAG implementation in Google Colab using a T4 GPU.

Setup Instructions

1. Prepare the Notebook

- Upload the `Xray_analysis.ipynb` file to Google Drive
- Right-click the file and select "Open with" > "Google Colaboratory"
- Alternatively, create a new Colab notebook and copy-paste the code

2. Enable T4 GPU

- Click on "Runtime" in the menu
- Select "Change runtime type"
- Set Hardware accelerator to "GPU"
- Ensure "GPU type" is set to "T4" (this is typically the default)
- Click "Save"

3. Kaggle API Setup

The notebook requires downloading the chest X-ray dataset from Kaggle. Set up your Kaggle credentials:

```
# Run this in a new cell at the beginning of the notebook
from google.colab import files
uploaded = files.upload() # Upload your kaggle.json file
```

```
!mkdir -p ~/.kaggle
!cp kaggle.json ~/.kaggle/
!chmod 600 ~/.kaggle/kaggle.json
```

To get your kaggle.json:

1. Go to kaggle.com and sign in
2. Go to Account > API > Create New API Token

3. Upload the downloaded file when prompted

Running the Notebook

Important: Run Cells One by One

For optimal execution and to avoid memory issues, run the notebook cells sequentially instead of all at once:

1. Start with Section 1: Environment Setup
 - This installs required libraries and creates project directories
 - Wait for all installations to complete before proceeding
2. Run Section 2: Download Data from Kaggle
 - This downloads the chest X-ray dataset
 - Ensure the download completes before continuing
3. Run Section 3: Enhanced Data Exploration and Analysis
 - This creates visualizations of the dataset
 - These visualizations help understand the data distribution
4. Run Section 4: Enhanced Multi-Condition Model Building and Training
 - This trains the deep learning model
 - Note: This section takes ~20-30 minutes on a T4 GPU
 - Watch for potential memory issues; reduce batch size if needed
5. Run Section 5: Enhanced Model Evaluation with Detailed Metrics
 - This evaluates the model performance
 - Review the metrics to understand model accuracy
6. Run Section 6: Enhanced Model Testing with Detailed Lung Analysis
 - This tests the model on sample images
 - You can upload your own X-ray images for testing
7. Run Section 7: Enhanced RAG with LangChain and Advanced Medical Knowledge
 - This builds the retrieval system for medical knowledge
 - Note: This section takes ~10-15 minutes to run
8. Run Section 8: X-ray Analysis Integrated with Advanced RAG-Based Diagnostic Assistant
 - This integrates the model with the RAG system
 - Creates a unified diagnostic pipeline
9. Run Section 9: Enhanced Web Interface with Chatbot-Style Q&A
 - This creates the Gradio interface
 - **IMPORTANT:** At the end of this section, you will receive a public URL link
 - The link will be displayed as: **Running on public URL:**
<https://xxx.gradio.app>
 - Use this link to access the web interface

Accessing the Gradio Interface

After running the final section, you will see a message similar to:

Running on local URL: <http://127.0.0.1:7860>

Running on public URL: <https://xxxx-xxxx-xxxx.gradio.app>

1. Click on the public URL link to open the web interface
2. The interface has three tabs:
 - **Detailed Analysis:** Upload an X-ray and get a comprehensive report
 - **ChatBot Q&A:** Talk with the AI about the X-ray findings
 - **About:** Information about the system
3. The link will remain active for about 72 hours or until your Colab session ends

Memory Management Tips

The T4 GPU has 16GB of memory. If you encounter memory issues:

- Run cells one by one as suggested
- Reduce batch size in Section 4 (`batch_size = 16` instead of `32`)
- Use a smaller language model in Section 7
- Restart the runtime if you get CUDA out of memory errors
- Save intermediate results to Google Drive

Saving Your Results

To save models and results to Google Drive:

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

```
# Save model to Drive
```

```
!mkdir -p /content/drive/MyDrive/chest_xray_project
```

```
!cp -r ./chest_xray_project/models /content/drive/MyDrive/chest_xray_project/
```

Troubleshooting

- **CUDA out of memory:** Restart runtime and reduce batch sizes
- **Kaggle dataset download fails:** Check your API token and internet connection
- **Gradio link not appearing:** Make sure to include `share=True` in the Gradio launch command
- **Language model loading fails:** Try a smaller model like Flan-T5-small

Remember that your Colab session will eventually time out. If this happens, you'll need to re-run the notebook.