

# Tuberculosis Detector Documentation

## Group 5

18<sup>th</sup> December 2023

### 1. Major task

This software developed an algorithm for Biomedical Image Analysis 4 (BIA4) ICA1 Group 5 to segment and then classify chest X-ray images into healthy and with tuberculosis.

### 2. Input and Output

Input: A chest x-ray image in **.png, .jpg, .jpeg** format from your local directory.

Output: A segmented chest x-ray image and the classification result.

### 3. Key algorithms

- 1) **Segmentation:** U-Net is a compact convolutional neural network optimized for biomedical image segmentation. It adopts a U-shaped framework, with downsampling for contextual feature extraction and subsequent upsampling for accurate spatial localization. Its efficiency with limited datasets and robust feature concatenation capabilities makes it highly effective for detailed medical imagery analysis.
- 2) **Classification:** DenseNet is a type of highly compressed convolutional neural networks (CNNs). By stacking one layer to the next layer, the model cannot easily forget the information in previous models. Therefore, this model is insensitive to vanishing gradient and has a relatively high performance over other CNNs. This model is widely used in image analysis and audio tasks.

### 4. Setting up running environment

This program requires python 3.7 or above. Please first ensure the python environment of the device.

#### Packages

PyQt5 == 5.15.10

Tensorflow == 2.15.0

opencv-python == 4.8.1.78

numpy == 1.26.2

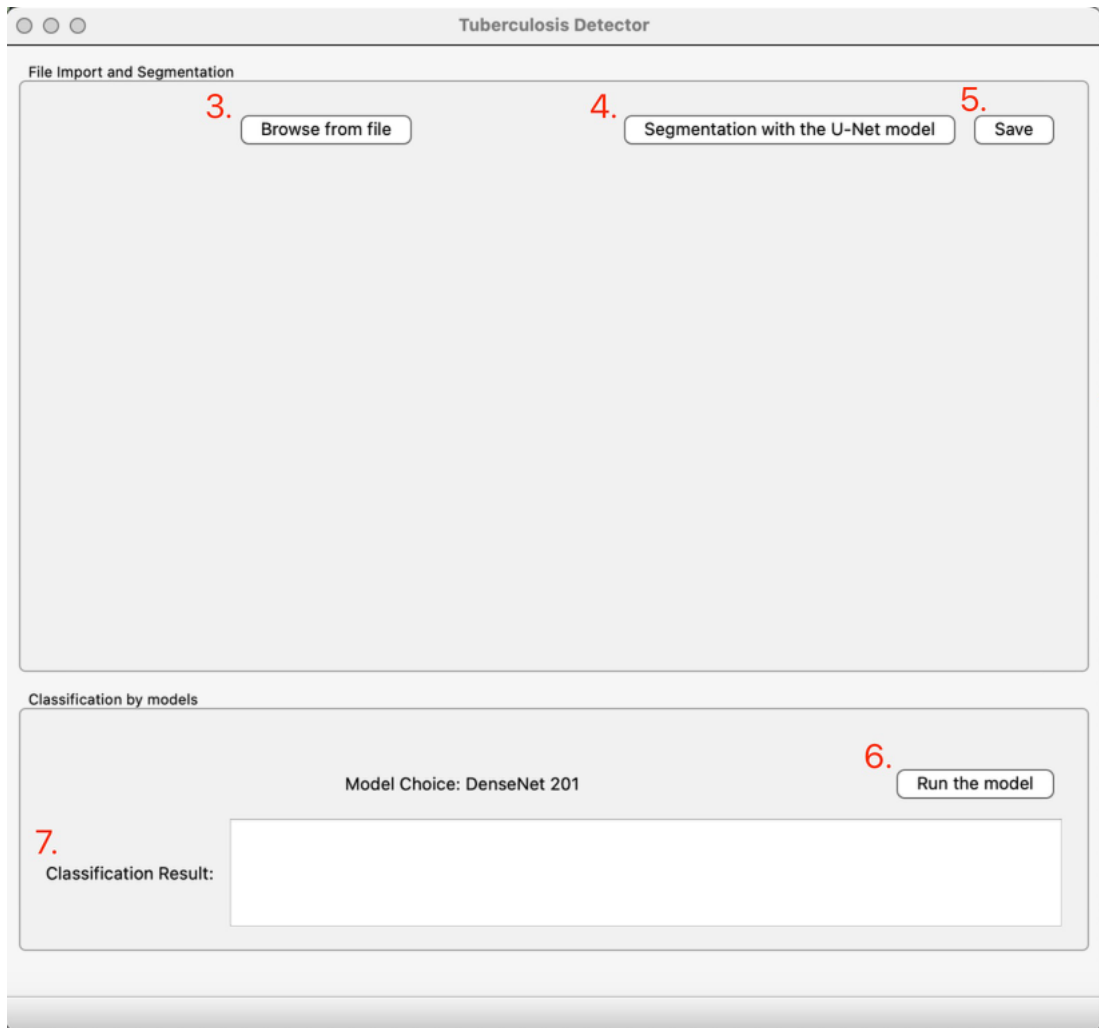
#### Installation

If you do not have the above packages, you can install by typing “pip install (package name)” or “pip3 install (package name)” in your terminal.

For example, “pip install numpy”.

### 5. Test running instruction of Tuberculosis Detector

```
Tuberculosis_Detector — Python GUImain_final.py — 80x24
Last login: Mon Dec 18 00:39:19 on ttys000
/Users/user/.zshrc:1: module_init: function definition file not found
[user@MacBook-Air-2 ~ % cd /Users/user/Desktop/Tuberculosis_Detector] 1.
[user@MacBook-Air-2 Tuberculosis_Detector % python3 GUImain_final.py] 2.
█
```



- 1) Open your terminal and enter the *Tuberculosis Detector* directory in your computer by typing “cd (pathname)” in the terminal. For example, if your *Tuberculosis Detector* directory is “/Users/user/Desktop/Tuberculosis\_Detector”,

type “cd /Users/user/Desktop/Tuberculosis\_Detector” in your terminal.

- 2) Type “python GUImain\_final.py” or “python3 GUImain\_final.py” (depending on your python version) in the terminal to run the *Tuberculosis Detector*.
- 3) Under “File import and Segmentation”, upload chest X-ray image by clicking “Browse from file”. The uploaded chest X-ray image will appear on the left side of the screen upon success.
- 4) Click “Segmentation by the U-net model” to run the chest X-ray image through segmentation. The segmented chest X-ray image will appear on the right side of the screen upon success.
- 5) Click “Save” to save the segmented chest X-ray image.
- 6) Click “Run the model” to run the “DenseNet 201” model to classify if chest X-ray image is tuberculosis positive or not.
- 7) The classification result will be shown in the box labelled “Classification Result”.

# Preprocess (optional): If you think your image is low-quality, before running the *Tuberculosis Detector* you can do the preprocess instructed in the <https://github.com/chowjx/BIA4-ICA1/tree/main/Pre-Processing> . Notice: If the image quality is relatively high, preprocessing may affect the classification result as preprocessing uses Gaussian Blur that may lead to loss of some important details.

## 6. Readme file

This software is based on **python3.7** or later, aiming to help clinical researchers to accurately segment the thoracic region and classify tuberculosis from patients’ chest x-ray images. For image processing, these algorithms will occupy a large memory. Therefore, please use it properly based on your operating device.

Before using this software, ensure that you have installed python packages **PyQt5 5.15.10**, **Tensorflow 2.15.0**, **opencv-python 4.8.1.78**, **numpy 1.26.2** in your python environment. This software zip file contains three python script files, three .h5 model files, as well as three test cases.

The input image should be a chest x-ray image in **.png, .jpg, .jpeg** format. We support the image segmentation and classification of a single x-ray image.

What you could run is the file, **GUImain\_final.py**.

**GUImain.py** will produce the graphical user interface of the software *Tuberculosis Detector*. You can follow the instructions in the “**5. Test running instruction of Tuberculosis Detector**” part above or watch the video ***Tuberculosis\_Detector\_user\_guide.mp4*** ([https://github.com/chowjx/BIA4-ICA1/blob/main/Tuberculosis\\_Detector\\_user\\_guide.mp4](https://github.com/chowjx/BIA4-ICA1/blob/main/Tuberculosis_Detector_user_guide.mp4)) to run the software on your server.

## 7. Developers

Biomedical Image Analysis 4 (BIA4) ICA1 Group 5

