Challenge II
Nodule detection

110-1 DLCV Final Project
B08901058 陳宏恩 B08902047 汪昊新 B08901073 王維芯

Introduction

The goal of this challenge is to identify the location of pulmonary nodules from volumetric CT images. We are given a 3-dimensional voxel dataset along with an annotation file labeled by experienced radiologists. We employ preprocessing steps on our dataset and perform nodule detection refering to the *DeepLung* study by Wentao Zhu et al. (2018)[1].

Dataset-Preprocessing

Segmentation - baseline

The CT images consist of slices on the vertical axis. We extract only the useful segments for training.
There are seven steps in the baseline segmentation:

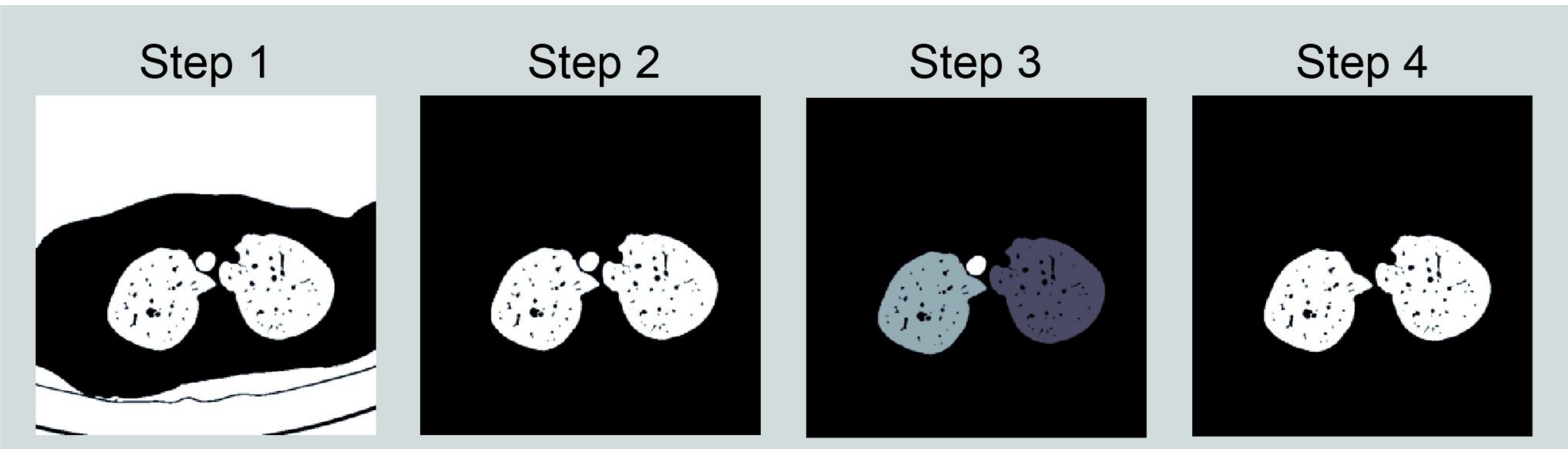

Figure 1

Step1~4 clear the background and keep the two lungs.

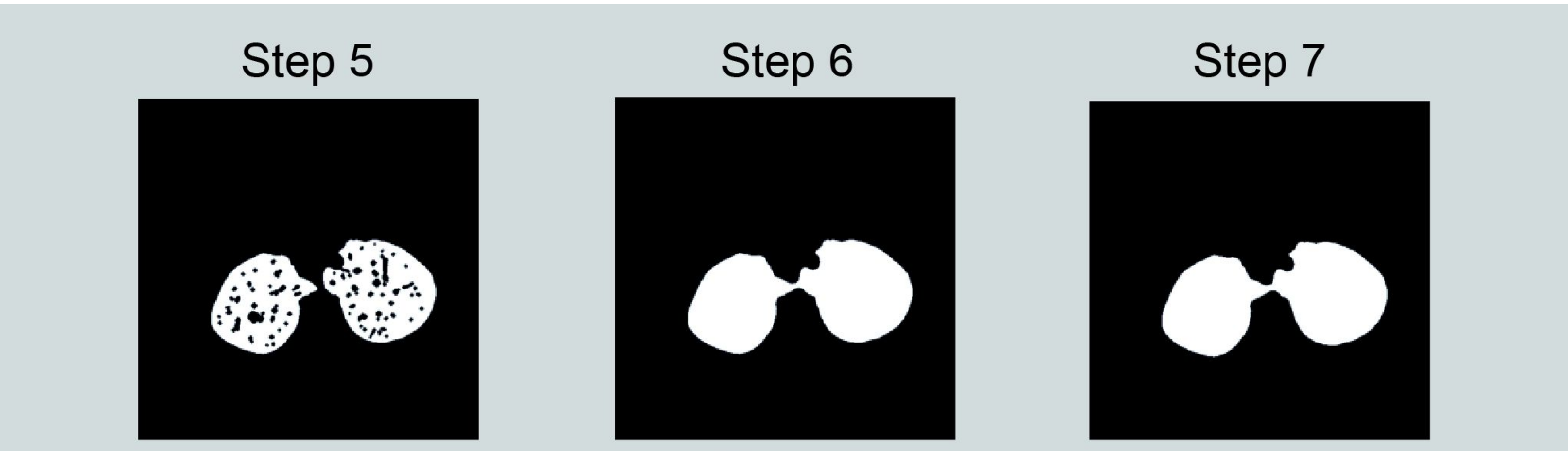

Figure 2

Step5~7 separate the lung nodules attached to the blood vessels and remove the bronchi and alveoli. In short, segmentation gives us a clear mask of the lungs.

Segmentation - improved

Figure 3

We implement an alternative method named Tianchi that can better preserve the lung regions and additionally apply the last two CV operations to fill out the cavities. Results are proven to grant higher FROC score by 0.03.

Method-Model

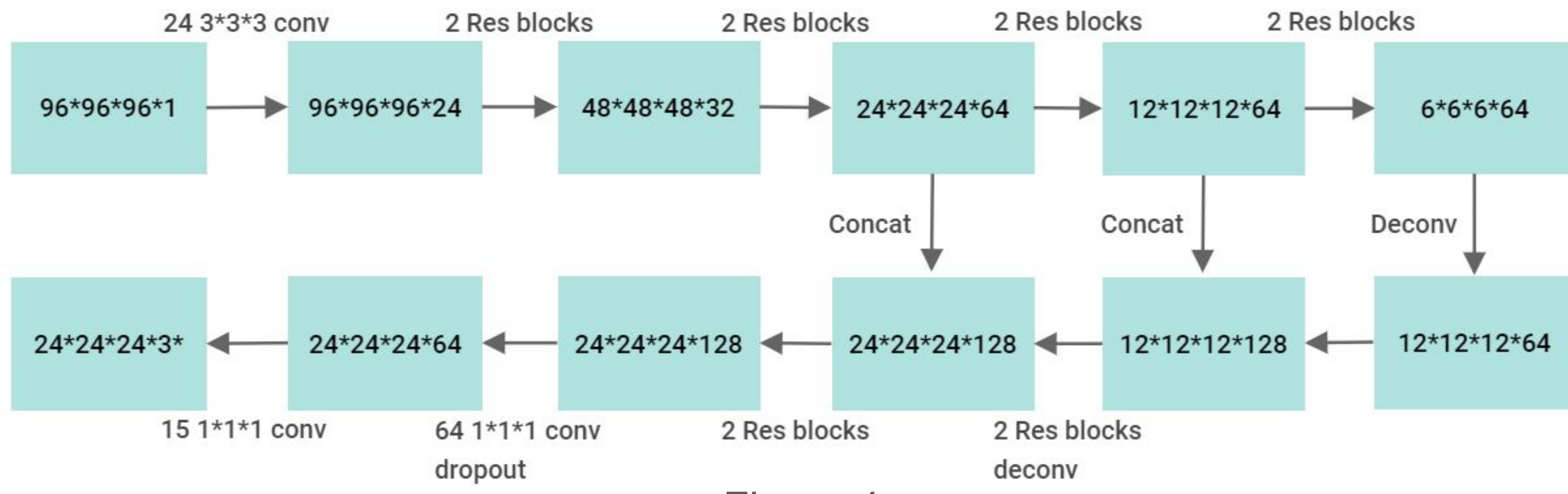

Figure 4

Model features:

- U-net-like encoder-decoder framework allows the deep nets to learn efficiently.
- Apply 3D Faster R-CNN for region proposal by conducting pixel-wise multi-scale learning.
- Pixel-wise labeling with Unet enables candidate nodule generation to be more effective.
- Design 3 anchors(5, 10, 20) for scale references based on the distribution of nodule sizes.

Loss function:

$$L(p_i, \mathbf{t_i}) = \lambda L_{cls}(p_i, p_i^\star) + p_i^\star L_{reg}(\mathbf{t_i}, \mathbf{t_i}^\star)$$

Results

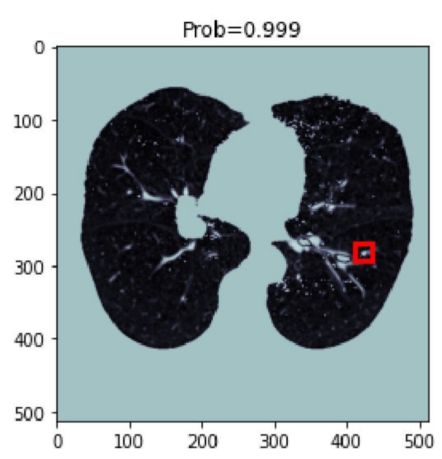

Figure 5

We successfully locate the nodules in the masked CT scan with the coordinate of predicted candidate nodules. We compare model using different patch sizes.

However, memory grows rapidly as patches size increases.

Froc\model	Res18 128x128	Res18 96x96	DPN3D26 96x96
Public	0.72	0.74	0.55
Private	0.69	0.72	0.53

Figure 6

Discussion

- The model converges after arround 90 epochs, and both TP and TN rate reaches arround 0.98.
- By examining the preprocessed images, we found out that some CT scan are still corrupted.
- The number of negative samples outweights positive samples are unbalanced.

References

[1] Zhu, Wentao, Chaochun Liu, Wei Fan, and Xiaohui Xie. "DeepLung: Deep 3D Dual Path Nets for Automated Pulmonary Nodule Detection and Classification." IEEE WACV, 2018.