PSNA Pneumonia Detection Challenge

Teng-Te Yu, Zheng-Yan Chen, Yi-Hsin Chen

Team 19

Outline

- Introduction

- Related Work

- Methodology

- Experiments

- Conclusion

- Future Work

Outline

- Introduction

- Related Work

- Methodology

- Experiments

- Conclusion
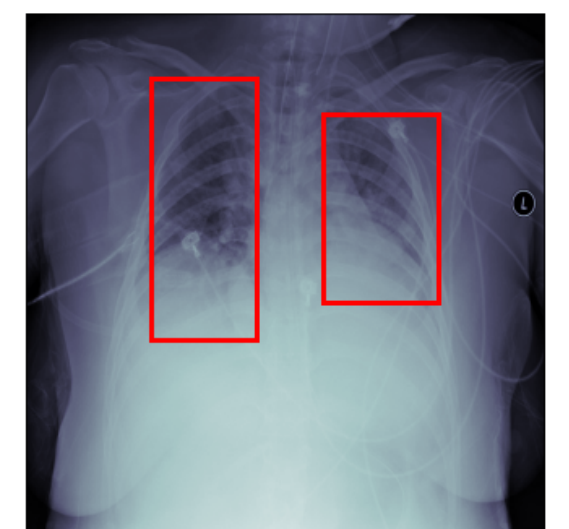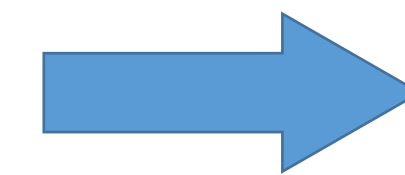
- Future Work

Introduction

Background

- Pneumonia is top 10 causes of death in both United States and Taiwan

- Analysis patient's chest radiographs (CXRs) is time consuming

Task

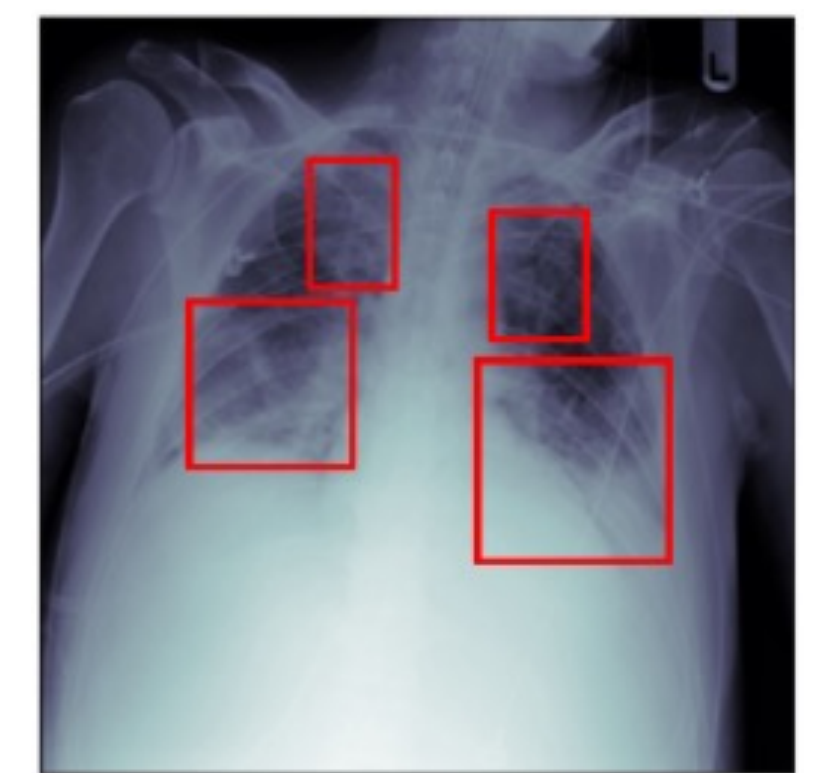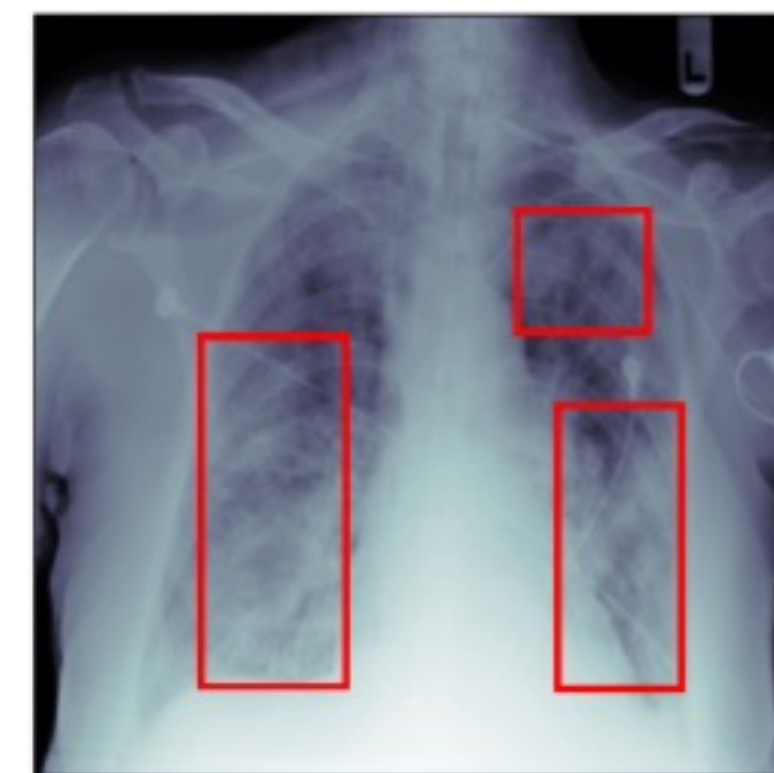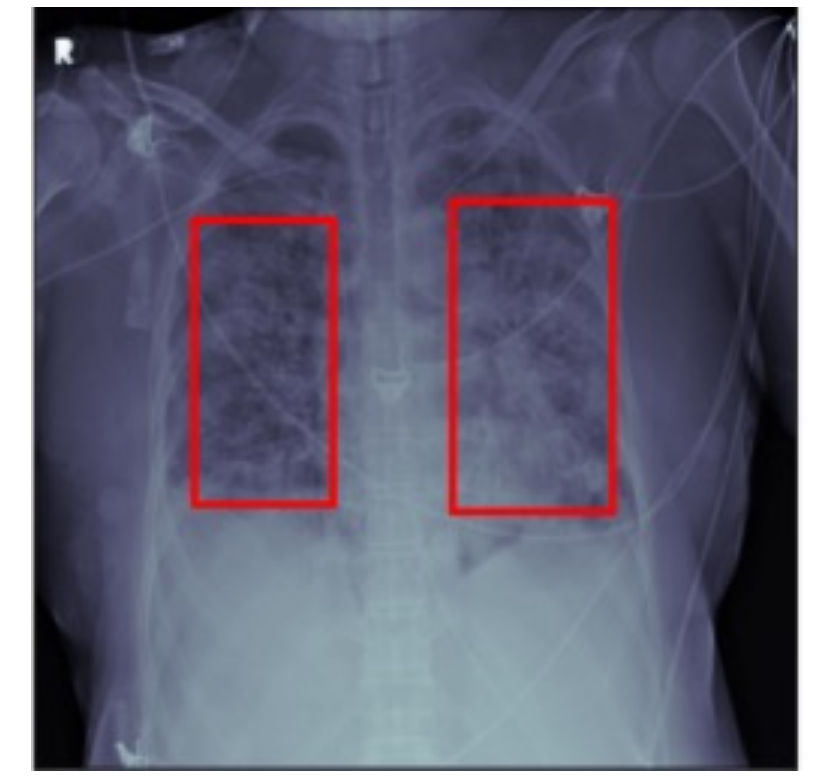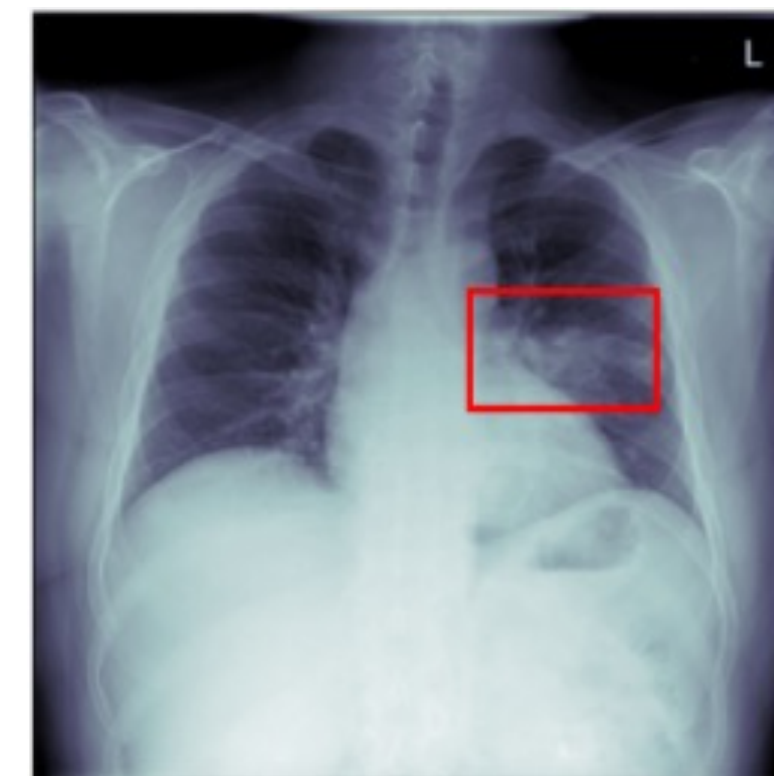Build a model to detect lung opacities on CSRs

Detection

Challenge

- Not all of the input images contain lung opacities

- We can not predict 100% like ground truth

  - Not sure is there exists noise data

  - Hard to debug from the detection results

Outline

- Introduction

- Related Work

- Methodology

- Experiments

- Conclusion

- Future Work

Related Work

	YOLOv5	Faster R-CNN
stage	One-stage	Two-stage
Speed	Faster	Slower
Accuracy	?	?

Outline

- Introduction

- Related Work

- Methodology
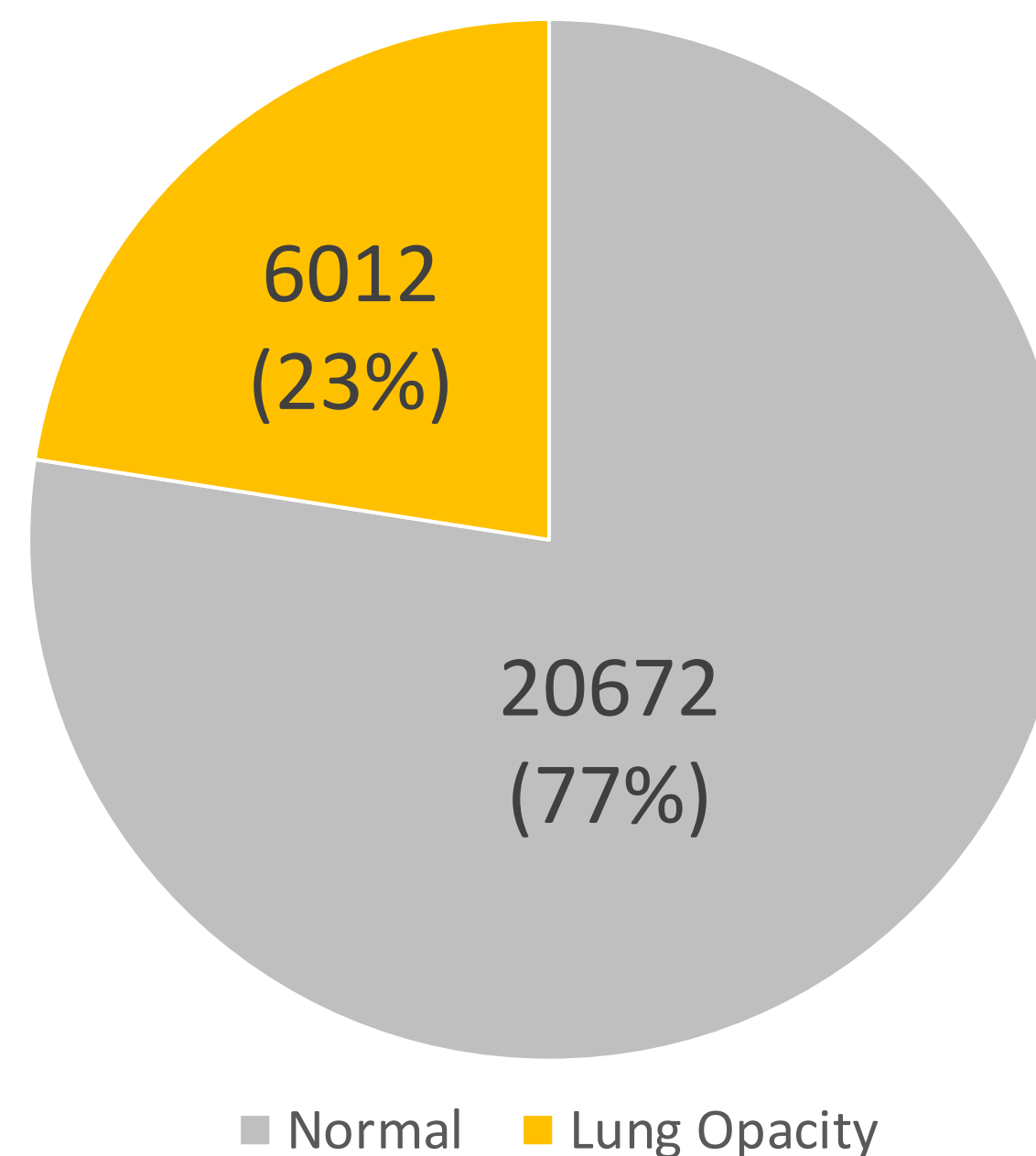
- Experiments

- Conclusion

- Future Work

Overview
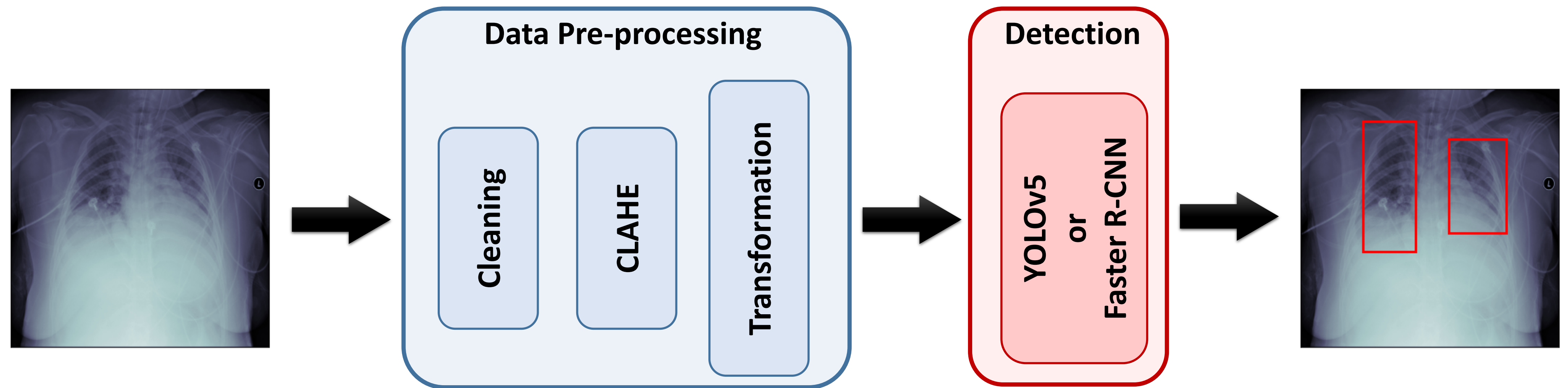
- In this project, we focus on data processing

Data Pre-processing – Cleaning

- Contain 26,684 image training dataset

- Use those images with lung opacity only

6012 (23%)

20672 (77%)

■ Normal   ■ Lung Opacity

Data Pre-processing – CLAHE

Contrast Limited Adaptive Histogram Equalization (CLAHE)

- Improve contrast in images

- Widely used in medical images

Data Pre-processing – Transformation

- Resize: $1024 \times 1024 \rightarrow 500 \times 500$ for saving computational resources

- Flip: randomly flipping for data augmentation

- Rotate: randomly rotate 90 degree for data augmentation

Mosaic in YOLOv5

- Mixing 4 training images into one

- Increase the variety of background

  → Identify the targets from a local view of an image

- BN from 4 different images on each layer

  → Reduce the need for GPU

Issue of Using Mosaic in Pneumonia dataset

- Mosaic is not suitable for Pneumonia dataset

- Pneumonia detection need to consider whole image

  - Find the location of lungs → Detect the opacities
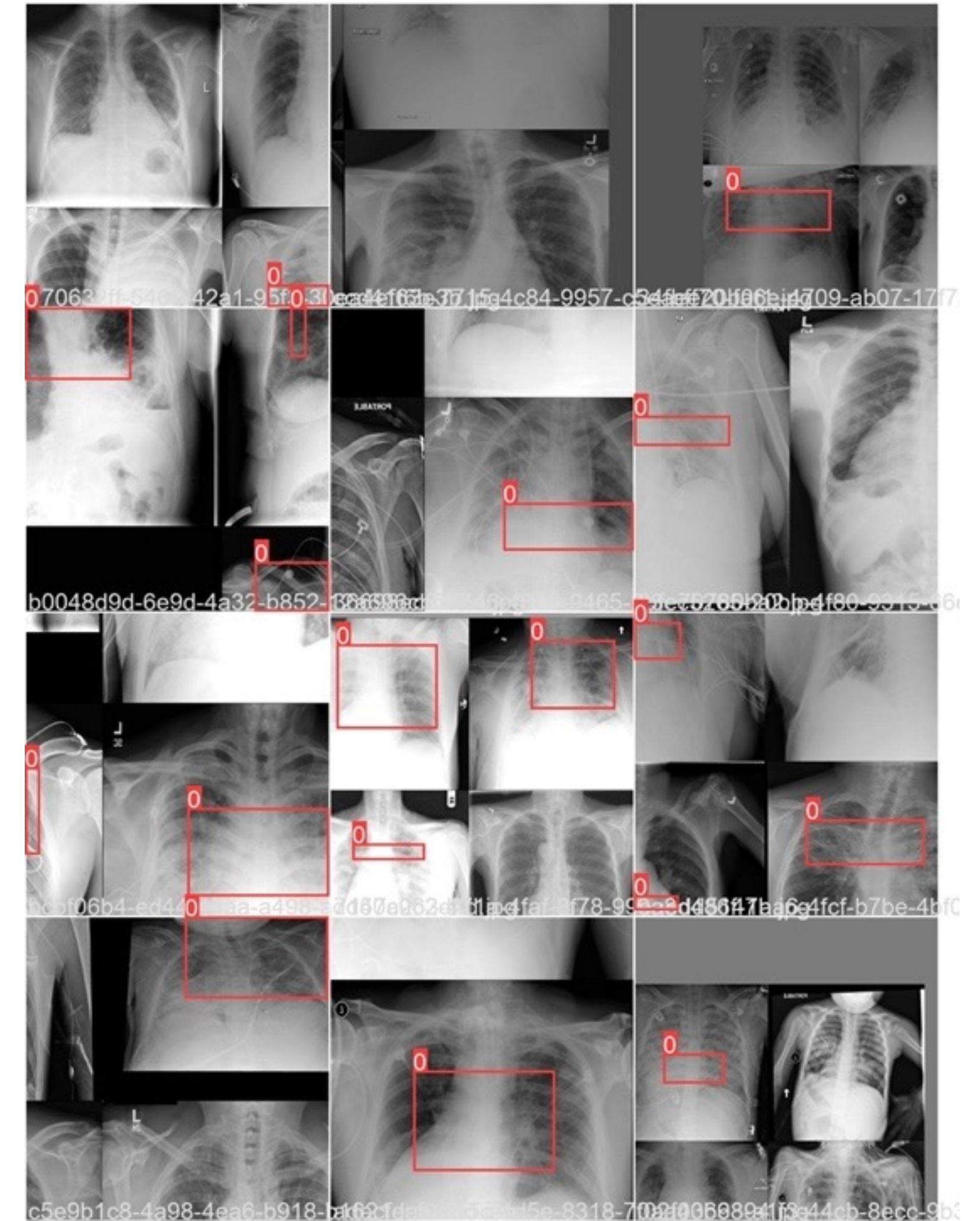
Outline

- Introduction

- Related Work

- Methodology

- Experiments

  - Setup

  - Experimental Results

  - Ablation Studies

  - Discussion

- Conclusion

- Future Work

Setup

Dataset

- Training: 26,684 images (only 6,012 images are used for training after data cleaning)

- Testing: 3,000 images

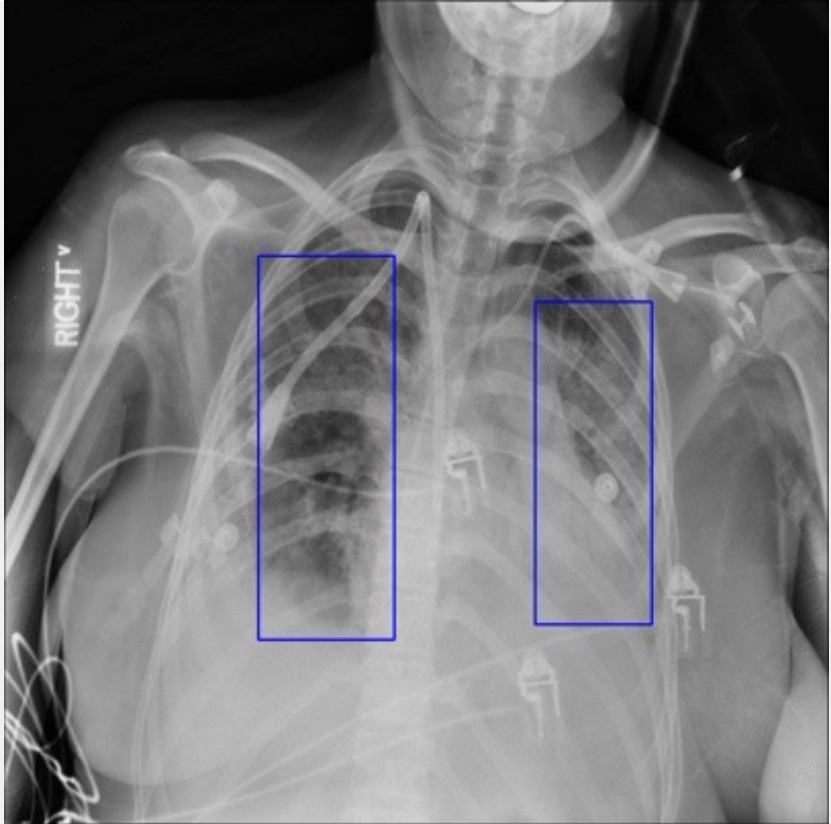**Evaluation Metric**
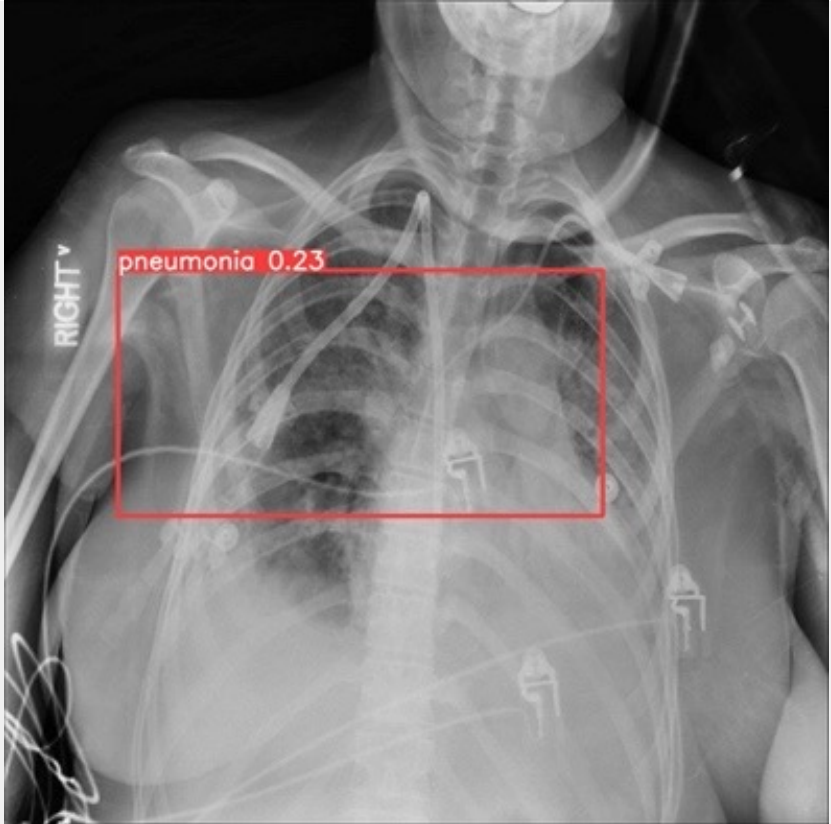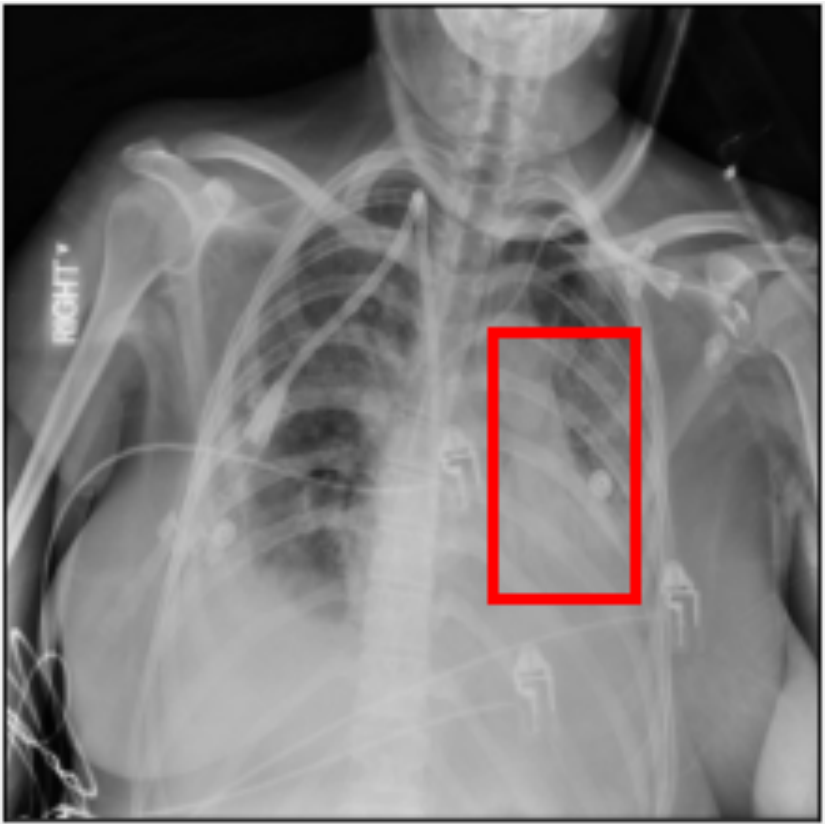
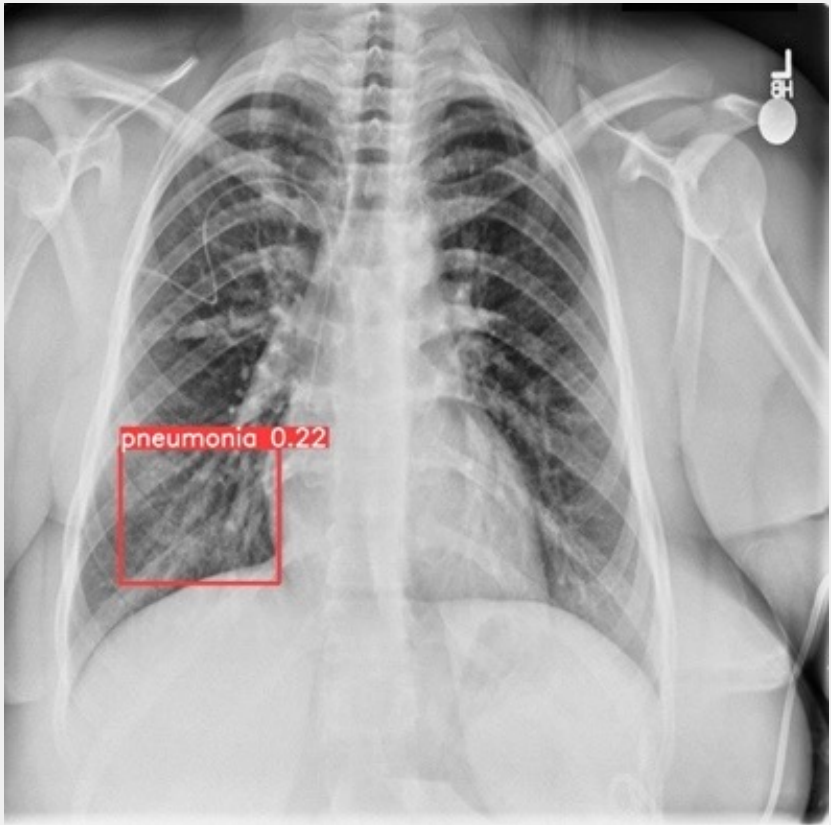Mean Average Precision (mAP)

Model
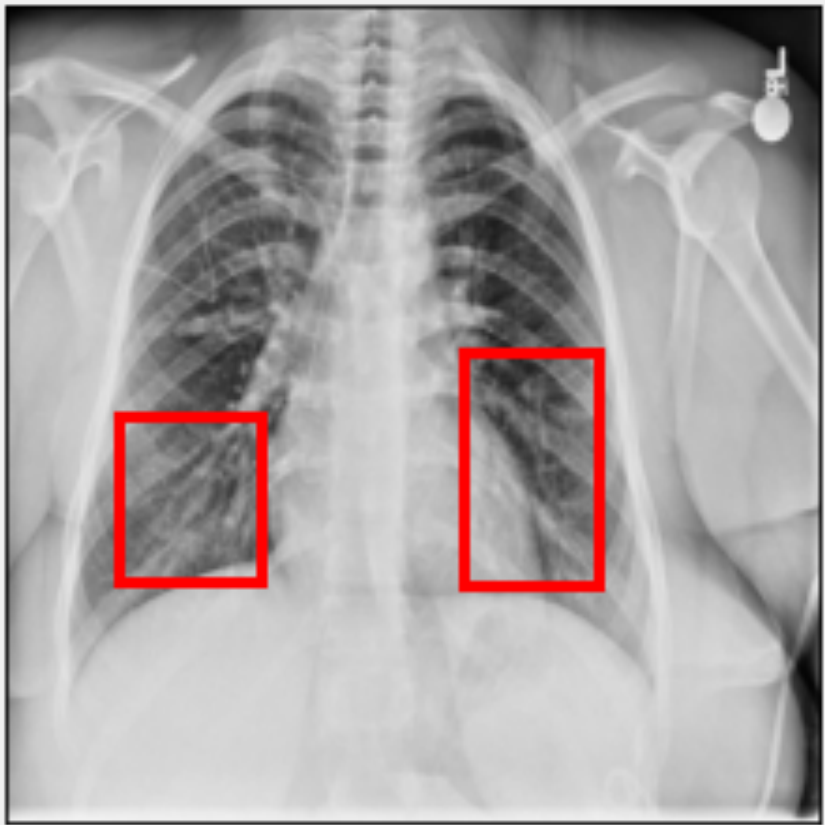
- YOLOv5: Pre-trained YOLOv5X with CSPDarknet53 as the backbone

- Faster R-CNN: Pre-trained Faster R-CNN with ResNet50 as the backbone

Experimental Results

Model	mAP
Baseline	**0.20125**
YOLOv5	0.05240
Faster R-CNN	0.14062

- Baseline > Faster R-CNN > YOLOv5

Qualitative Detection Results

Type	Ground Truth	YOLOv5	Faster R-CNN
Training			
Test			

Ablation Studies

1. w/o Mosaic v.s. w/ Mosaic (YOLOv5)

2. w/o Data cleaning v.s. w/ Data Cleaning (Faster R-CNN)

3. w/o CLAHE v.s. w/ CLAHE (Faster R-CNN)

4. w/o Resizing v.s. w/ Resizing (Faster R-CNN)

5. w/o Rotation v.s. w/ Rotation (Faster R-CNN)

w/o Mosaic v.s. w/ Mosaic

Setting	mAP
w/o Mosaic	**0.05240**
w/ Mosaic	0.01470

- **+ 0.0354** mAP without using Mosaic

- Mosaic is not suitable for this dataset

w/o Data cleaning v.s. w/ Data Cleaning

Setting	mAP
CLAHE + rotate90 + resize	0.12755
CLAHE + cleaning + rotate90 + resize	**0.14062**

- **+ 0.01305** mAP with data cleaning

w/o CLAHE v.s. w/ CLAHE

Setting	mAP
cleaning + rotate90 + resize	0.13948
CLAHE + cleaning + rotate90 + resize	**0.14062**

- **+ 0.00114** mAP with CLAHE

- The gain of CLAHE is quite limited

w/o Resizing v.s. w/ Resizing

Setting	mAP
CLAHE + rotate90	0.12240
CLAHE + rotate90 + resize	**0.12755**

- **+ 0.00515** mAP with resize input 1024×1024 to 500×500

- Resize the inputs to smaller size do not hurt the performance

w/o Rotation v.s. w/ Rotation

| Setting	mAP
cleaning + resize	0.09697
cleaning + rotate90 + resize	**0.13948**

- **+ 0.04251** mAP with randomly rotate input 90 degree as data augmentation

Small Conclusion for Ablation Studies

1. **w/o Mosaic** v.s. w/ Mosaic (YOLOv5) $\rightarrow$ + 0.03540

2. w/o Data cleaning v.s. **w/ Data Cleaning** (Faster R-CNN) $\rightarrow$ + 0.01305

3. w/o CLAHE v.s. **w/ CLAHE** (Faster R-CNN) $\rightarrow$ + 0.00114

4. w/o Resizing v.s. **w/ Resizing** (Faster R-CNN) $\rightarrow$ + 0.00515

5. w/o Rotation v.s. **w/ Rotation** (Faster R-CNN) $\rightarrow$ + 0.04251

Discussion
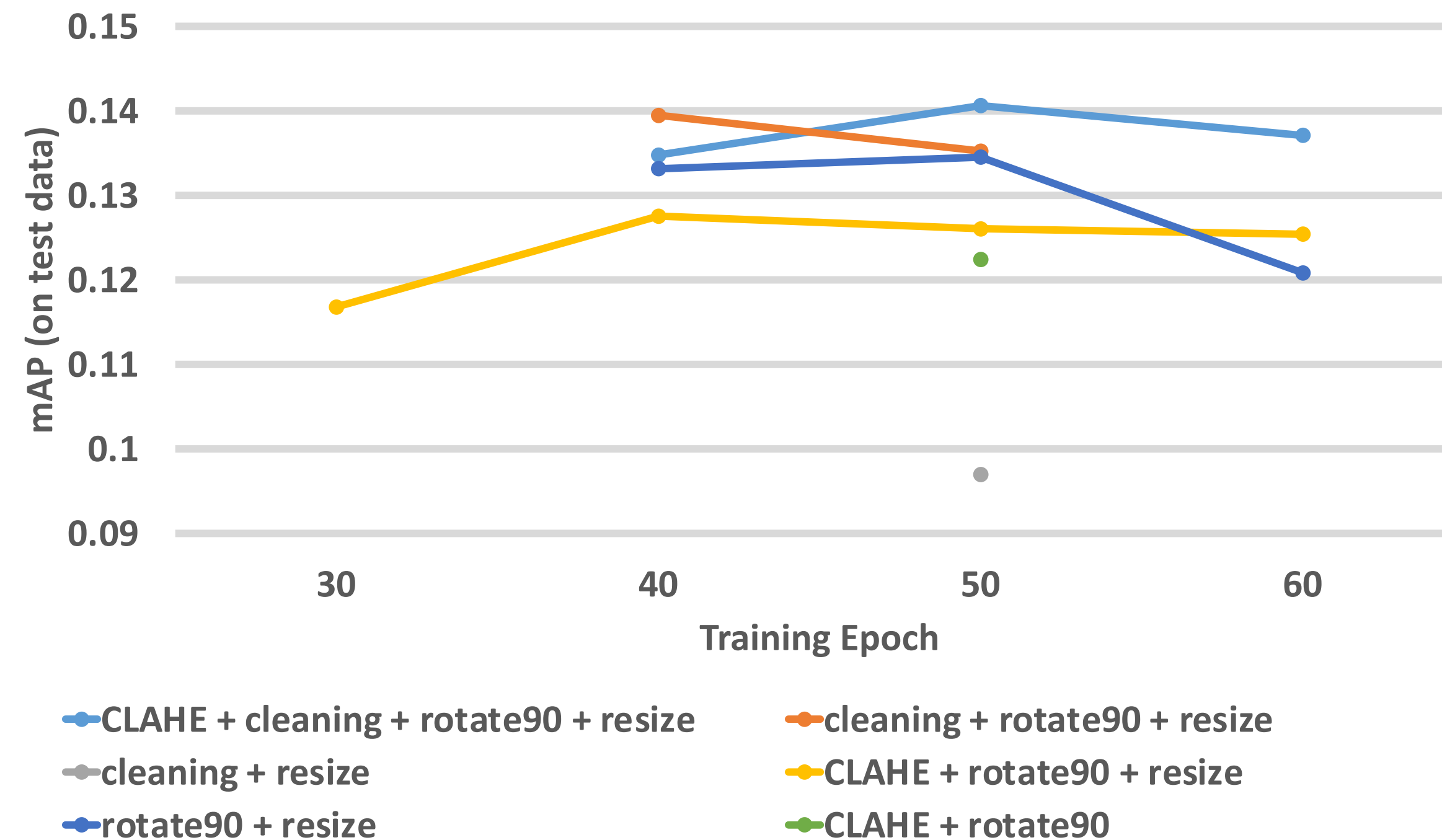
- Test performance stays flat or even drops as training epoch increase

- Overfitting to training data or inappropriate hyper-parameter (e.g. schedule of LR)

Outline

- Introduction

- Related Work

- Methodology

- Experiments

- Conclusion

- Future Work

Conclusion

- Faster R-CNN performs better than YOLOv5 in our experiment

- Proper data processing does help improve the performance

- Mosaic in YOLOv5 is not suitable for this dataset

Outline

- Introduction

- Related Work

- Methodology

- Experiments

- Conclusion

- Future Work

Future Work

Modification on Faster R-CNN

- Apply K-Means++ to obtain the initial anchor box size

- Use multi-scale features to generate region of interests (original Faster R-CNN only use one scale feature)