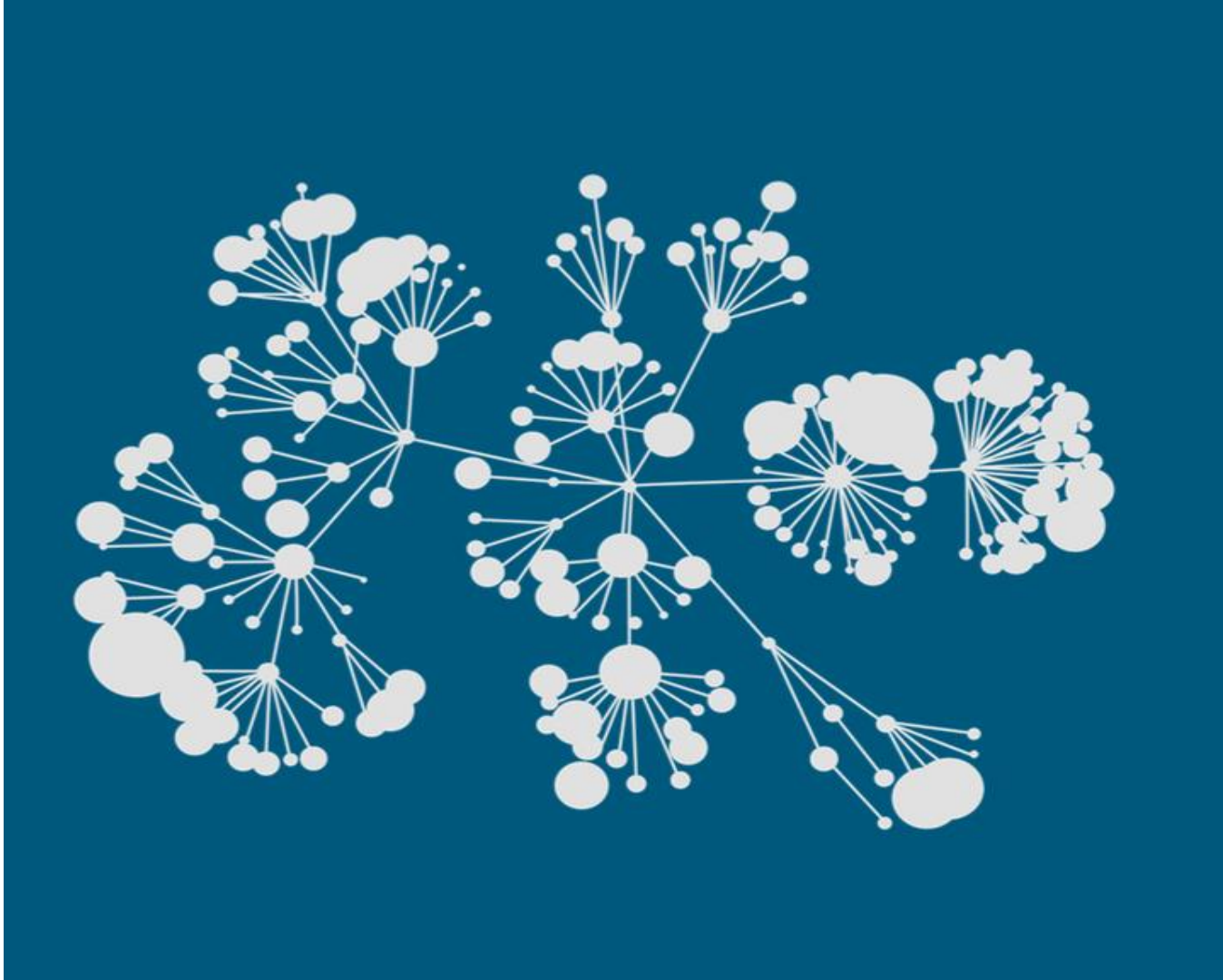
SIIM-ACR Pneumothorax Segmentation

Anuar Aimoldin

kaggle



Agenda

1. Background
2. Overview
3. Input Data
4. Model
5. Post Processing
6. Final Prediction
7. References

1. Background

linkedin.com/anuar-aimoldin

GitHub
github.com/sneddy/

kaggle
kaggle.com/sneddy

Anuar Aimoldin

- Master of Science at Moscow State University
- AI Department Team Lead at BTSDigital
- Creator of community Data Science Kazakhstan
- No prior knowledge of medicine

#	△pub	Team Name	Notebook	Team Members	Score	Entries	Last
1	▲208	[dsmlkz] sneddy			0.8679	15	13h
2	▲114	X5			0.8665	3	6d
3	▲16	bestfitting			0.8651	7	10h
4	▲237	[ods.ai] amirassov			0.8644	2	2d
5	▲127	earhian			0.8643	5	7h
6	▲154	[vuno.ai] 4 Goose island			0.8636	5	2h
7	▲38	xknife			0.8635	6	3h
8	▲236	APPA			0.8629	6	3h
9	▲87	Ian & Felipe			0.8627	2	6d
10	▲2	[ods.ai] Scizzzo			0.8625	11	2h
11	▲87	[ods.ai] Yury & Konstantin			0.8615	2	15h

Yandex School of Data Analysis

Competitions Summary

Competitions Master

Rank
14
of 116,463

3 | 5 | 0

2. Overview

Input data

- Aggressive augmentation
- Sliding Sample Rate

Model

Neural Nets Ensemble

- Wide model zoo
- Combo Loss
- Reduce learning and sample rate over time
- Uptrain from lower resolution dataset

Post processing

0.8	0.2	0.7
0.1	0.1	0.9
0.1	0.2	0.1

→

1	0	1
0	0	1
0	0	0

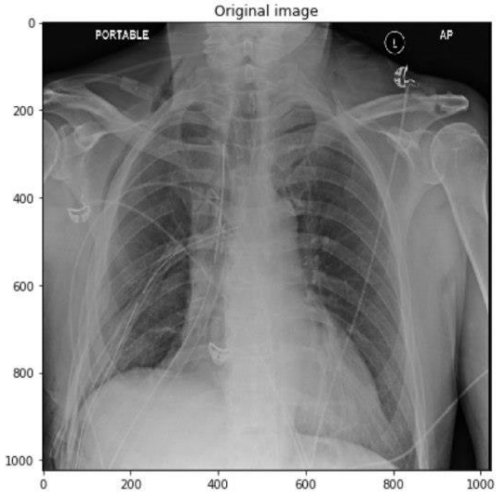
«Triplet» rule

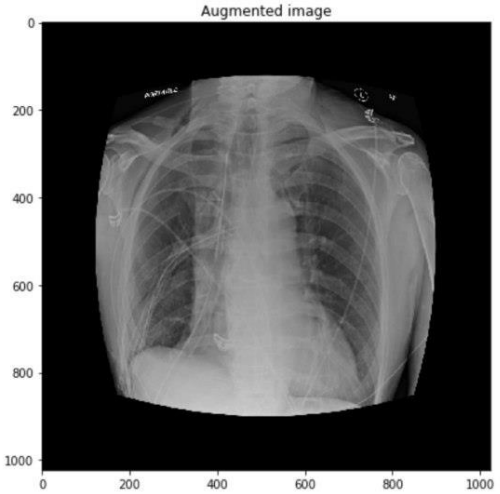
Final Prediction

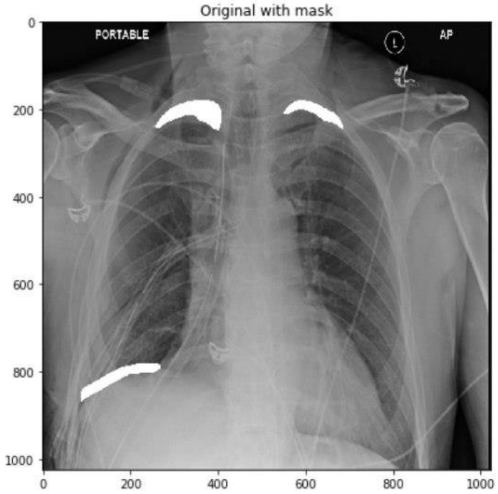
- Top-3 checkpoints averaging from each fold
- Horizonal flip TTA

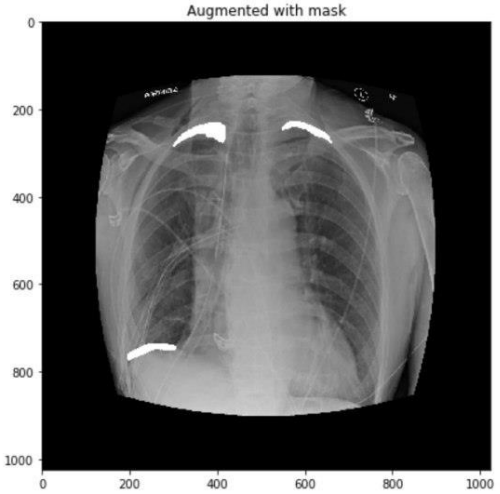
3. Input Data:

- Aggressive Augmentation
  - HorizontalFlip
  - RandomContrast
  - RandomGamma
  - RandomBrightness
  - ElasticTransform
  - GridDistortion
  - OpticalDistortion
  - ShiftScaleRotate
  - Resize



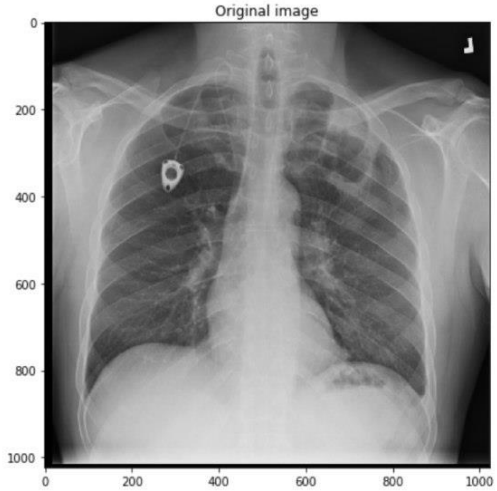


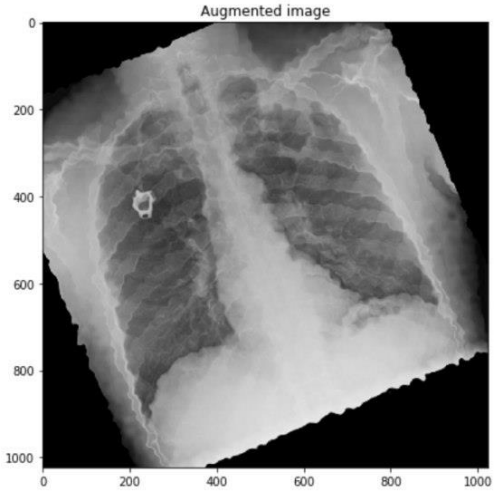


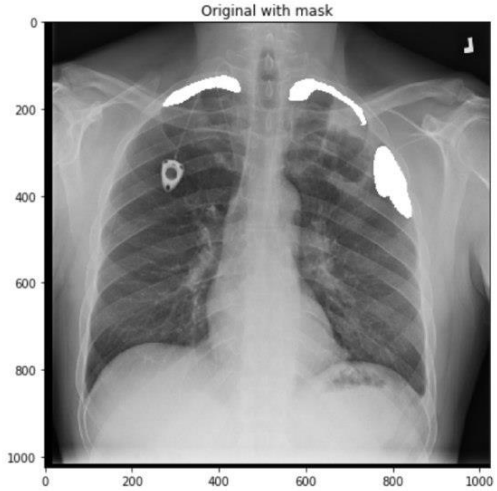


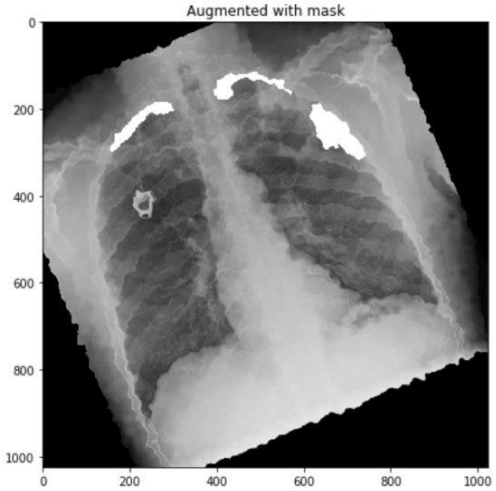
3. Input Data:

- **Aggressive Augmentation**
  - HorizontalFlip
  - RandomContrast
  - RandomGamma
  - RandomBrightness
  - ElasticTransform
  - GridDistortion
  - OpticalDistortion
  - ShiftScaleRotate
  - Resize



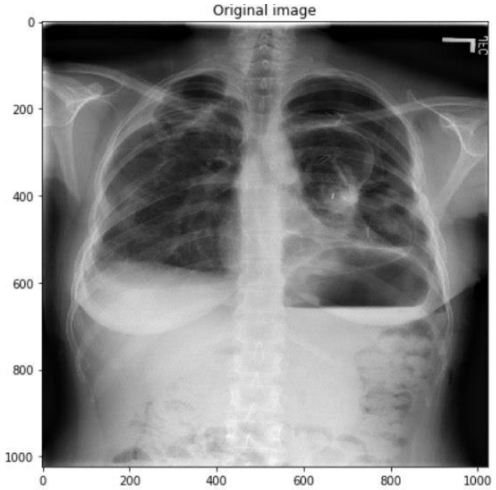


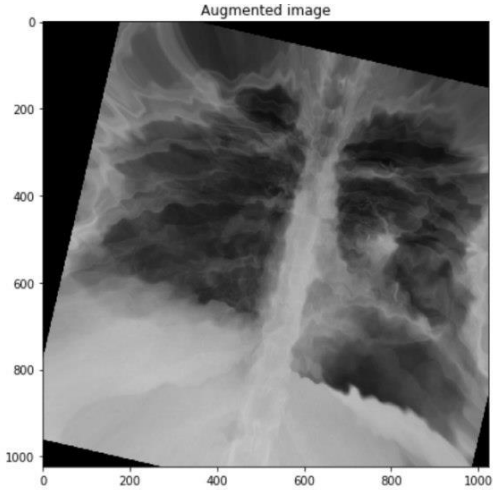


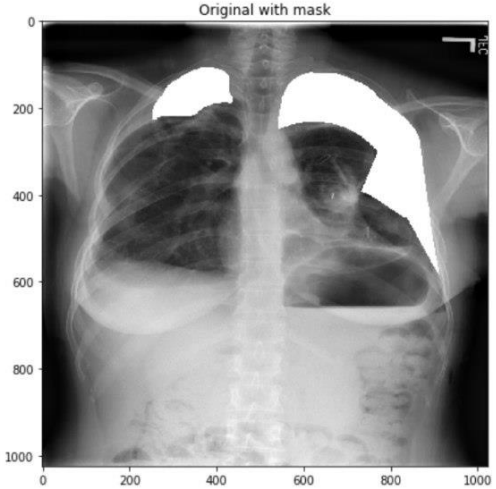


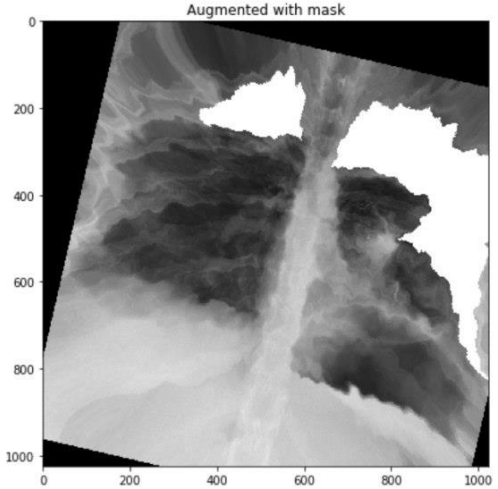
3. Input Data:

- Aggressive Augmentation
  - HorizontalFlip
  - RandomContrast
  - RandomGamma
  - RandomBrightness
  - ElasticTransform
  - GridDistortion
  - OpticalDistortion
  - ShiftScaleRotate
  - Resize



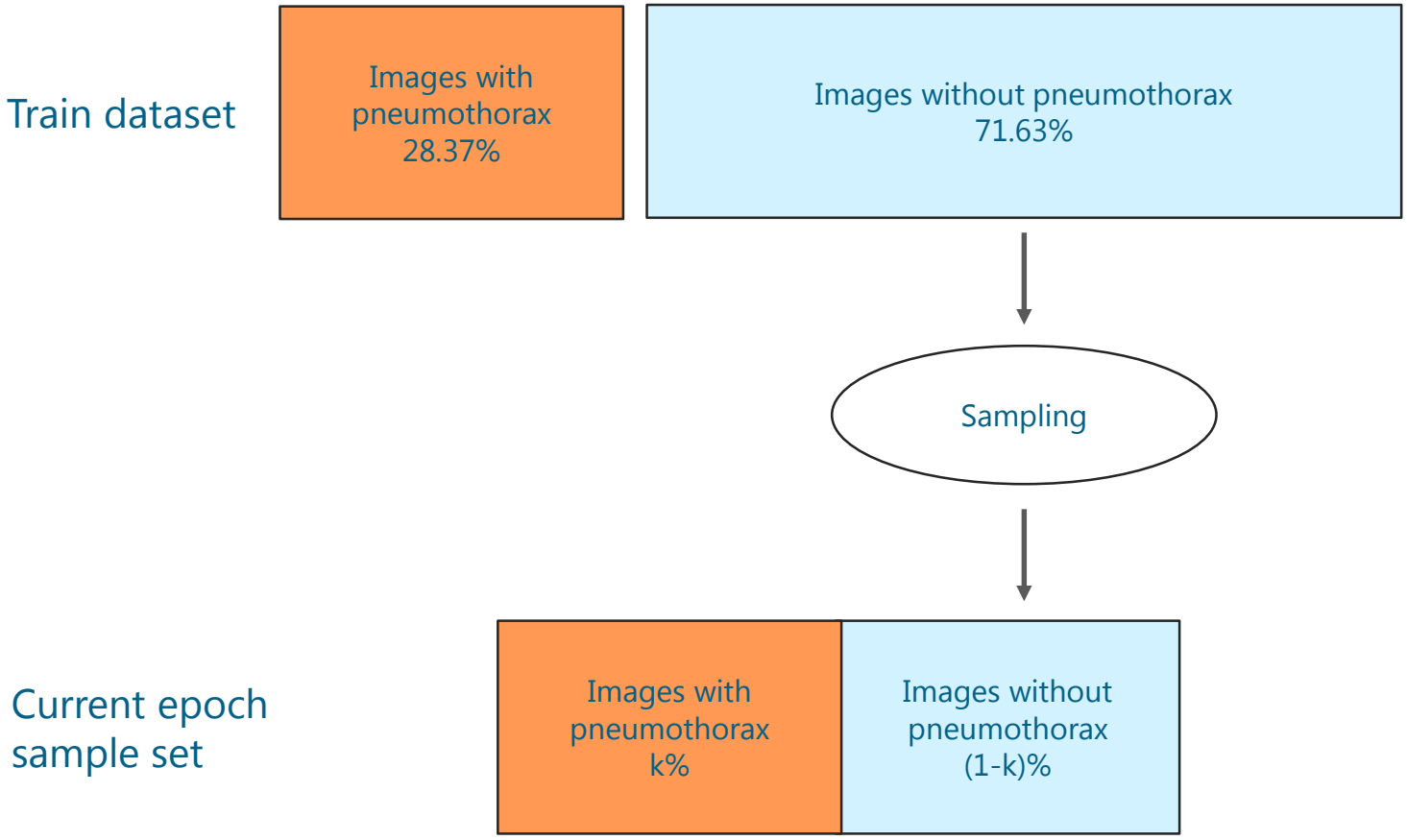






3. Input Data:

- Sliding Sample Rate



4. Model

- Model zoo
- Combo loss

Model Zoo:

- resnet34 (albunet)
- resnet50
- seresnext50 (seunet)

Combo loss:

I use combinations of BCE, dice and focal loss.
In the best experiments the weights of
(BCE, dice, focal), that I use are:

- (3,1,4) for albunet_valid and seunet
- (1,1,1) for albunet_public
- (2,1,2) for resnet50

Experiment name	Train info	Fold 0	Fold 1	Fold 2	Fold 3	Fold 4	Mean by folds	Submit Info	Public LB	Exist Pneumothorax
AlbunetPublic-512	TRAIN_TRANSFORMS: transforms/train_transforms_complex_512_old.json VALID_TRANSFORMS: transforms/valid_transforms_512_old.json	0.8528	0.8503	0.8499	0.8533	0.8493	**0.85112**	best 'AREA_THRESHOLD': 1000, 'SCORE_THRESHOLD': 0.3,	0.8753	221
								top3 'AREA_THRESHOLD': 1000, 'SCORE_THRESHOLD': 0.3,	0.8757	231
AlbunetPublic	TRAIN_TRANSFORMS: transforms/train_transforms_complex_1024_old.json VALID_TRANSFORMS: transforms/valid_transforms_1024_old.json	0.857	0.856	0.857	0.8539	0.85551	**0.8558**	AREA_THRESHOLD': 2250, 'SCORE_THRESHOLD': 0.45,	0.8827	257
								AREA_THRESHOLD: 600 TOP_SCORE_THRESHOLD: 0.75 BOTTOM_SCORE_THRESHOLD: 0.4	0.8871	251
SeUnet-512	TRAIN_TRANSFORMS': 'transforms/train_transforms_complex_512_old.json', 'VALID_TRANSFORMS': 'transforms/valid_transforms_512_old.json'	0.85391	0.8525	0.8521	0.85648	0.8511	**0.853218**	AREA_THRESHOLD: 600 TOP_SCORE_THRESHOLD: 0.75 BOTTOM_SCORE_THRESHOLD: 0.4	0.8777	252
SeUnet-1024	TRAIN_TRANSFORMS: transforms/train_transforms_complex_1024_old.json VALID_TRANSFORMS: transforms/valid_transforms_1024_old.json	0.8634	0.8584	0.8601	0.859	0.8611	**0.8604**	AREA_THRESHOLD: 600 TOP_SCORE_THRESHOLD: 0.75 BOTTOM_SCORE_THRESHOLD: 0.4	0.88	261
AlbunetValid-512	transforms/train_transforms_complex_512_old.json'	0.8554	0.85334	0.852	0.85431	0.8507	**0.85315**			
AlbunetValid	transforms/train_transforms_complex_1024_old.json'	0.85771	0.8535	0.8591	0.86154	0.85718	**0.857806**	AREA_THRESHOLD: 600 TOP_SCORE_THRESHOLD: 0.75 BOTTOM_SCORE_THRESHOLD: 0.4	0.8842	254
Resnet50	train_transforms_complex_1024.json	0.85951	0.85674	0.85614	0.8583	0.86039	**0.858216**	AREA_THRESHOLD: 600 TOP_SCORE_THRESHOLD: 0.75 BOTTOM_SCORE_THRESHOLD: 0.4	0.8831	228

4. Model

- Reduce learning rate over time
- Reduce sample rate over time
- Uptrain from lower resolution dataset

Part 0

Train for 10-12 epoches from pretrained model **with large learning rate (~1e-4), large sample rate (0.8)** and ReduceLROnPlateau scheduler. The model can be pretrained on imagenet or on our dataset with **lower resolution (512x512)**. The goal of this part: quickly get a good enough model with validation score about 0.835

Part 1

Uptrain the best model from the previous step with **normal learning rate (~1e-5), large sample rate (0.6)** and CosineAnnealingLR or CosineAnnealingWarmRestarts scheduler. Repeat until best convergence

Part 2

Uptrain the best model from the previous step with **normal learning rate (~1e-5), small sample rate (0.4)** and CosineAnnealingLR or CosineAnnealingWarmRestarts scheduler. Repeat until best convergence

Second stage

Simple uptrain with relatively **small learning rate(1e-5 or 1e-6), small sample rate (0.5)** and CosineAnnealingLR or CosineAnnealingWarmRestarts scheduler.

5. Post processing:
- «Triplet» rule

Doublet
top_score_threshold, min_pneumo_area (0.5, 3)

0.8	0.5	0.6
0.1	0.1	0.9
0.1	0.2	0.1

→

1	1	1
0	0	1
0	0	0

We apply top_score_threshold. Sum is more than min_pneumo_area, therefore We keep it!

Second example:

0.4	0.4	0.8
0.1	0.1	0.9
0.1	0.2	0.1

→

0	0	0
0	0	0
0	0	0

Triplet
top_score_threshold, min_pneumo_area, bottom_score_threshold (0.7, 2, 0.3)

0.4	0.4	0.8
0.1	0.1	0.9
0.1	0.2	0.1

→

0	0	1
0	0	1
0	0	0

We apply top_score_threshold. Sum is more than min_pneumo_area, therefore We keep it!

After that we apply bottom_score_threshold to the source image

0.4	0.4	0.8
0.1	0.1	0.9
0.1	0.2	0.1

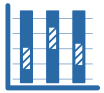
→

1	1	1
0	0	1
0	0	0

6. Final Prediction

Best experiments:

- albunet_public - best model for Public Leaderboard
- albunet_valid - best resnet34 model on validation
- seunet - best seresnext50 model on validation
- resnet50 - best resnet50 model on validation



Best triplet thresholds:

- on validation: (0.75, 2000, 0.4)
- on public leaderboard: (0.7, 600, 0.3)

For my final submissions I chose something in between these triplets

For the **final prediction**
I use Top-3 best checkpoints from each fold from each experiment

7. References

Augmentations from albumentations [1]

Albunet from ternausnet [2]

ComboLoss from selim_sef SpaceNet 4 [3]

kaggle™