# LUNG SEGMENTATION

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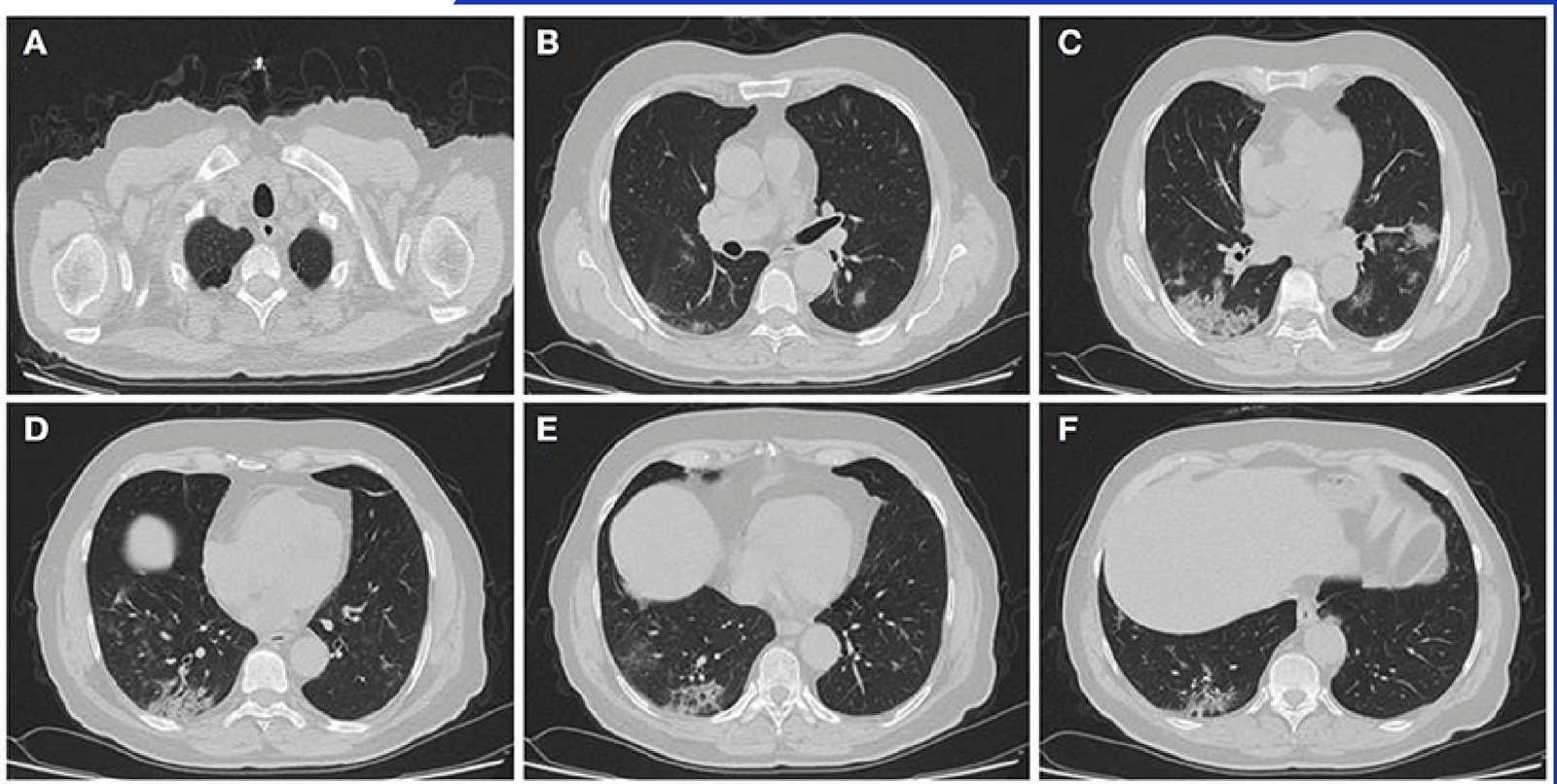
# summary

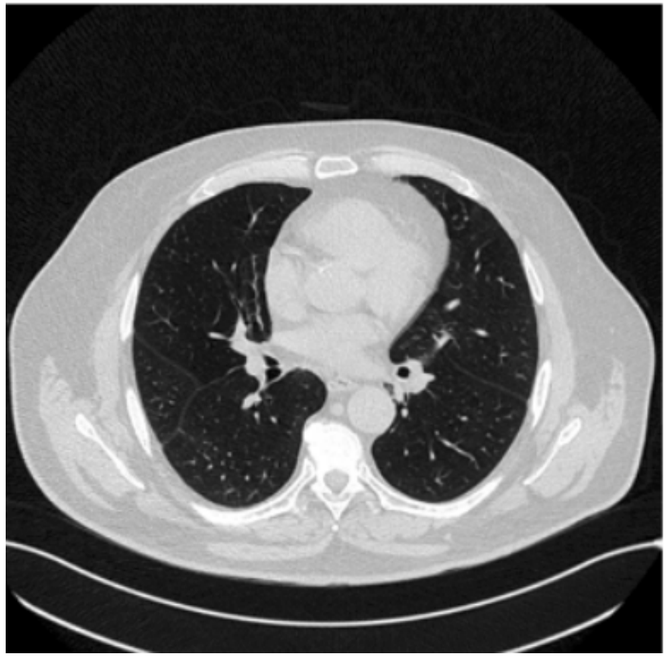
- the project
- our methodology
- analysis of performance
- limitations & future improvements

# The project




3D lung morphology obtainable with computed tomography scan

native CT-scan slice



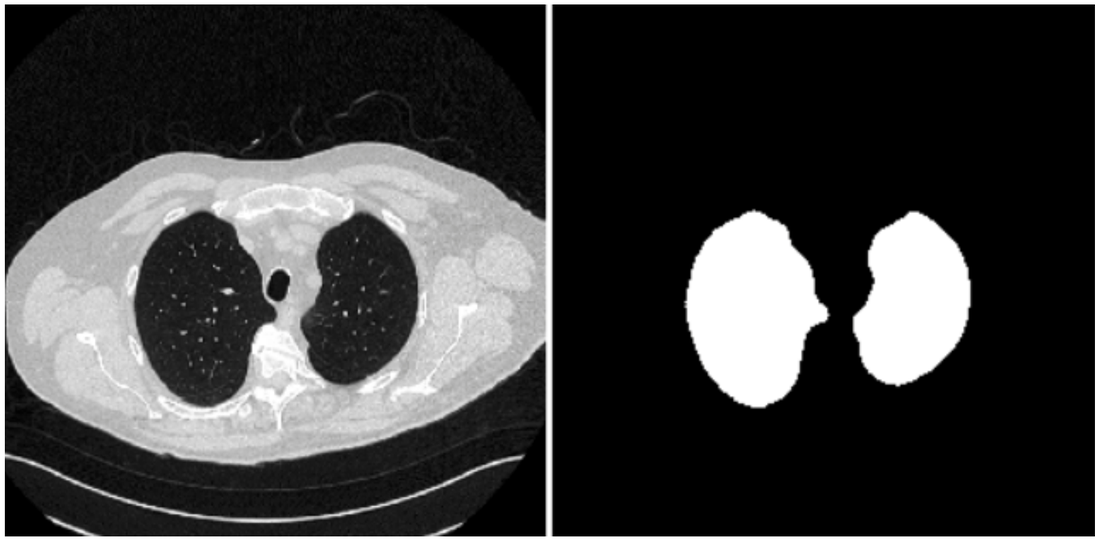
mask for the native scan

256x256 pixels

database: 57 patients with an average of 400 native slices / patient

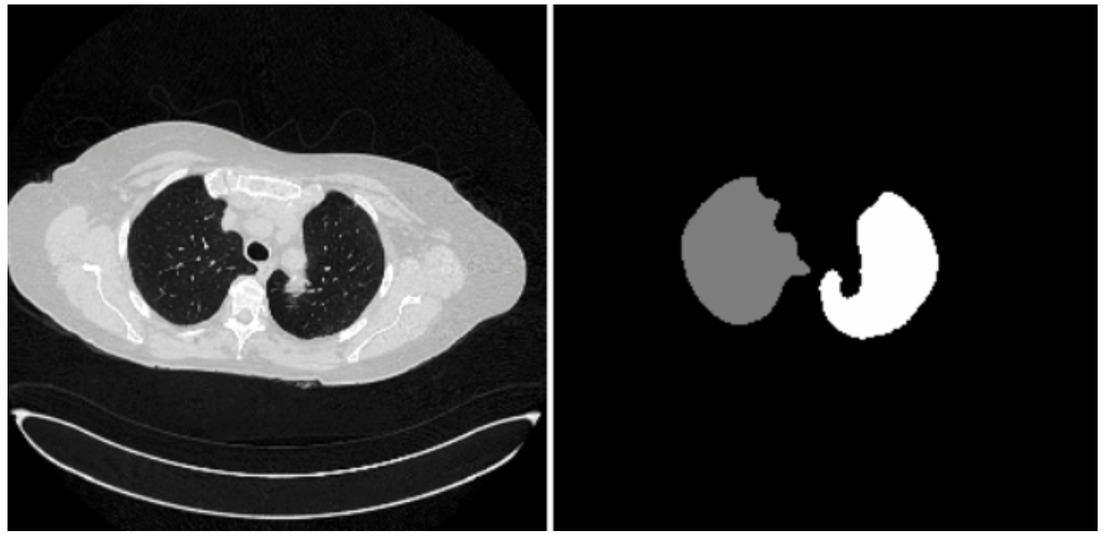
3 labels for the masks: background, left lung, right lung

## binary classification model



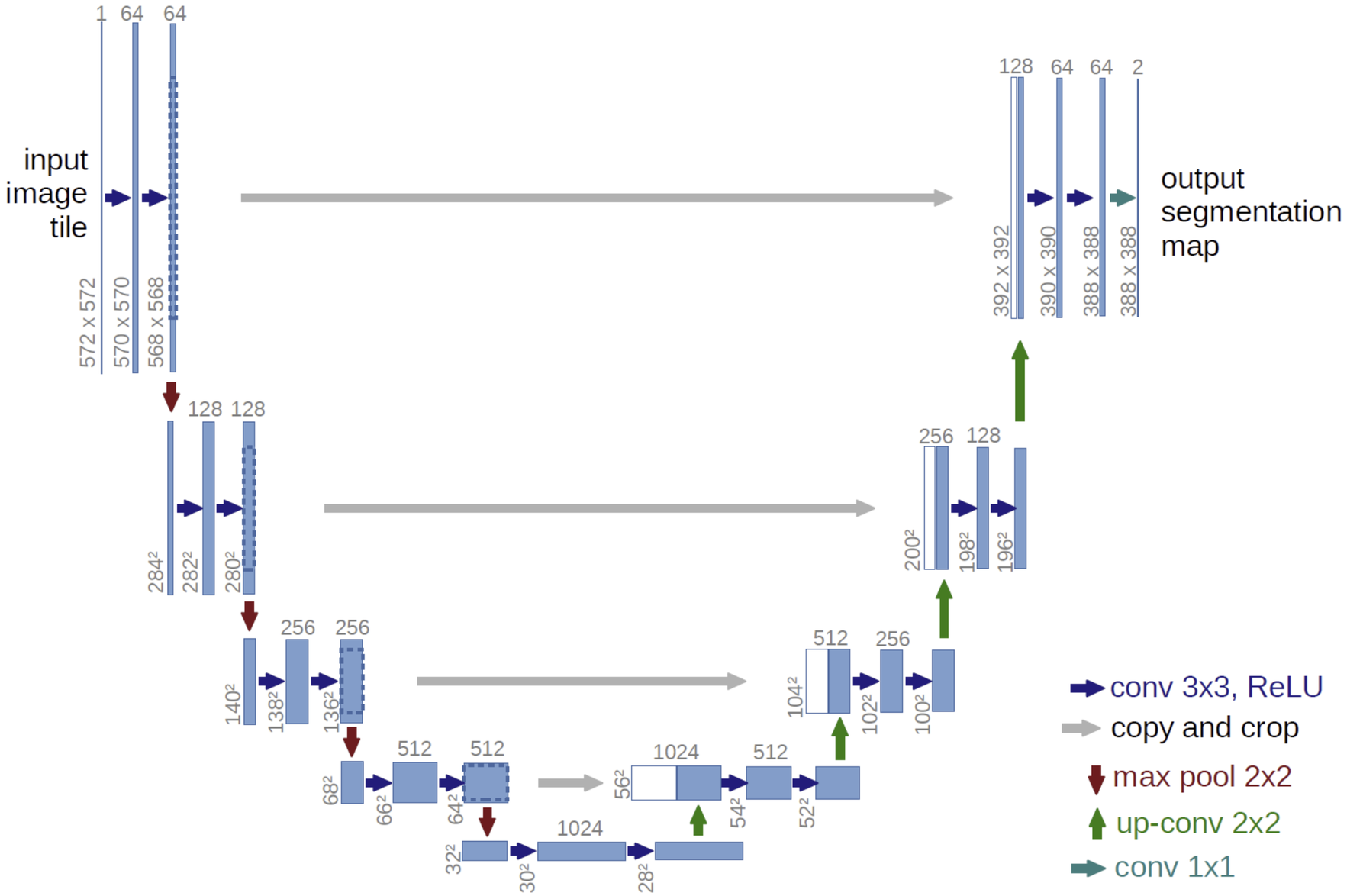
input image output mask

## 3 classes model



input image output mask

# U-NET architecture



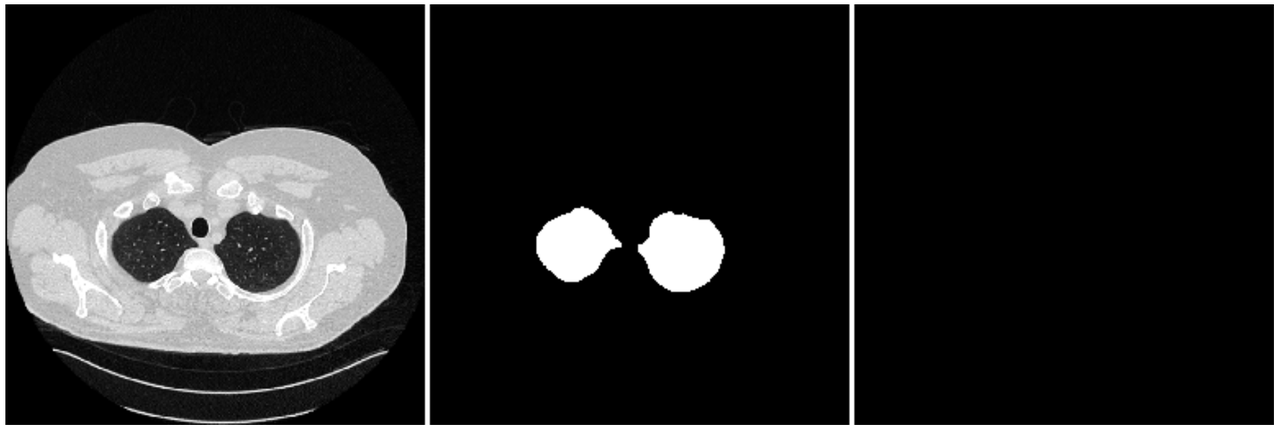
# "Out of allocated memory..."

- Reducing training dataset's size
- Introducing ModelCheckpoint and EarlyStopping

```
filepath="Model_weights_best.hdf5"
checkpoint = tf.keras.callbacks.ModelCheckpoint(filepath, monitor='loss', verbose=1, save_best_only=True)
es = tf.keras.callbacks.EarlyStopping(monitor='loss', patience=5)
callbacks_list = [checkpoint, es]
```

# Empty mask

Lung Scan | Ground truth mask | Predicted mask



- Lungs are only 10% of the scan
- Batch Normalization
- Accuracy is not a reliable metric here

$$\text{Accuracy} = \frac{(TP + TN)}{(TP + FP + TN + FN)}$$

# Comparison between 2 models

*optimizer='adam', batch_size=16, epochs = 10*

- **Binary crossentropy**

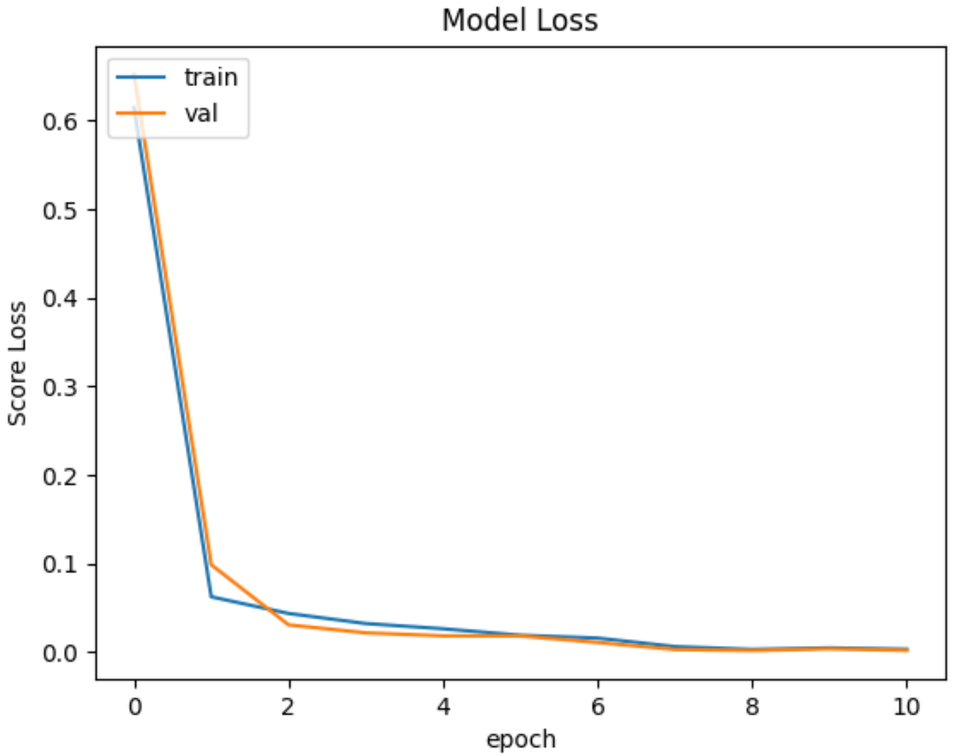
$$\mathrm{BCE}(\hat{p}, p) = -\left(p \cdot \log(p) + (1 - \hat{p}) \cdot \log(1 - p)\right)$$

- **Dice Loss**

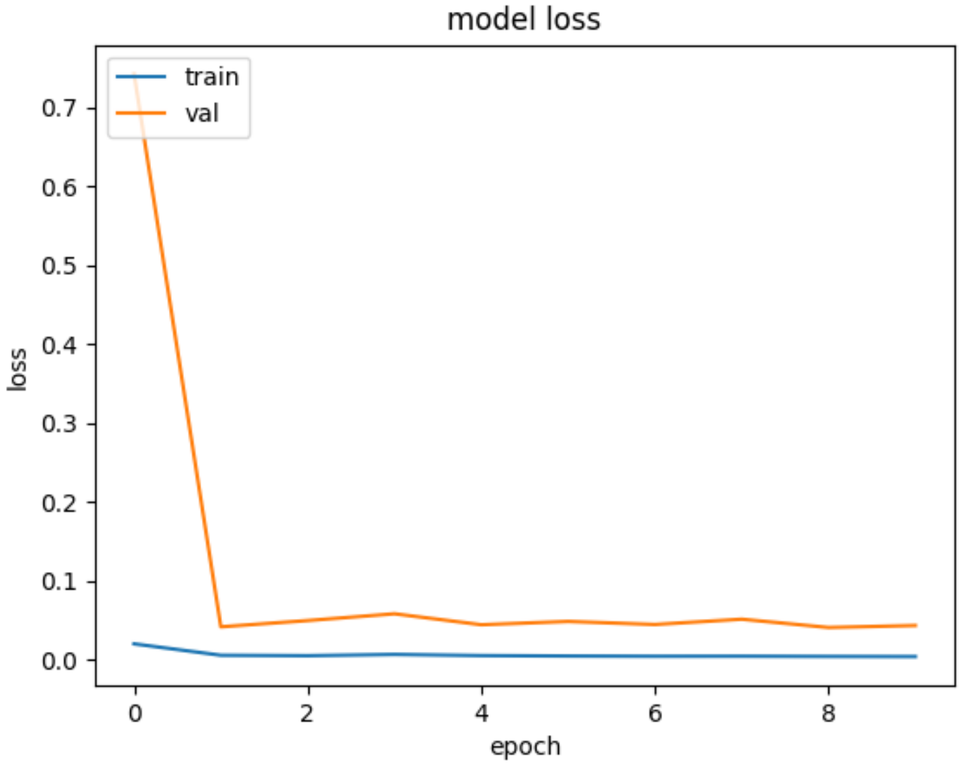
$$Dice = \frac{2\,|A \cap B|}{|A| + |B|}$$

# Comparison between 2 models

- **Binary crossentropy**



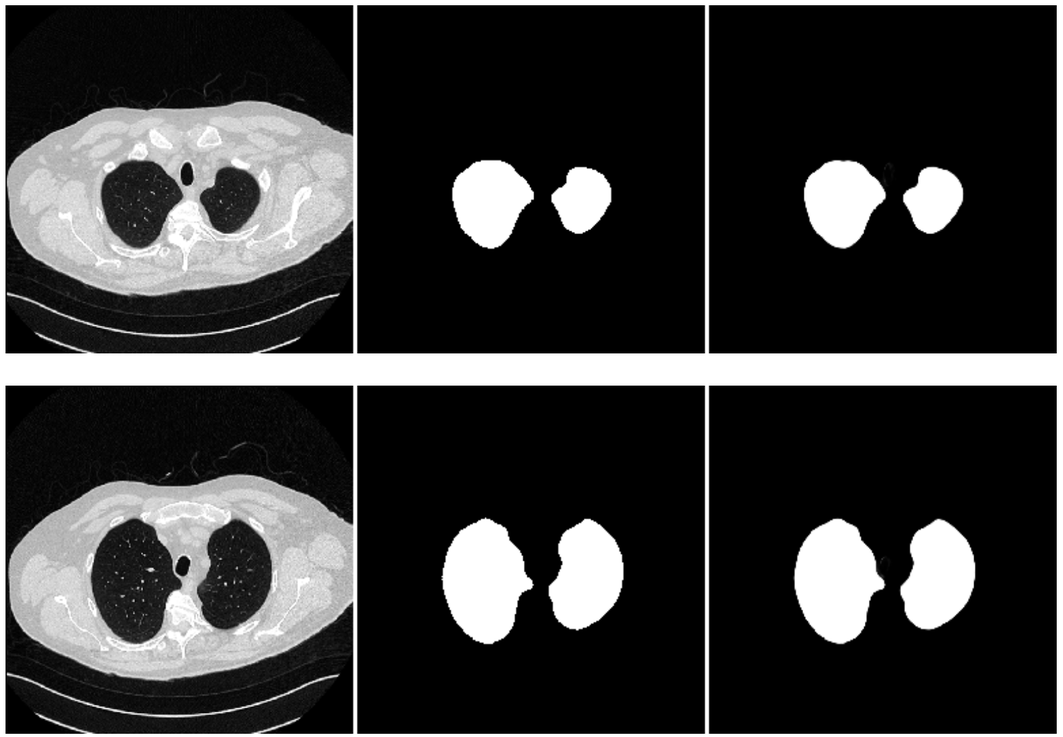

- **Dice Loss**



# Comparison between 2 models

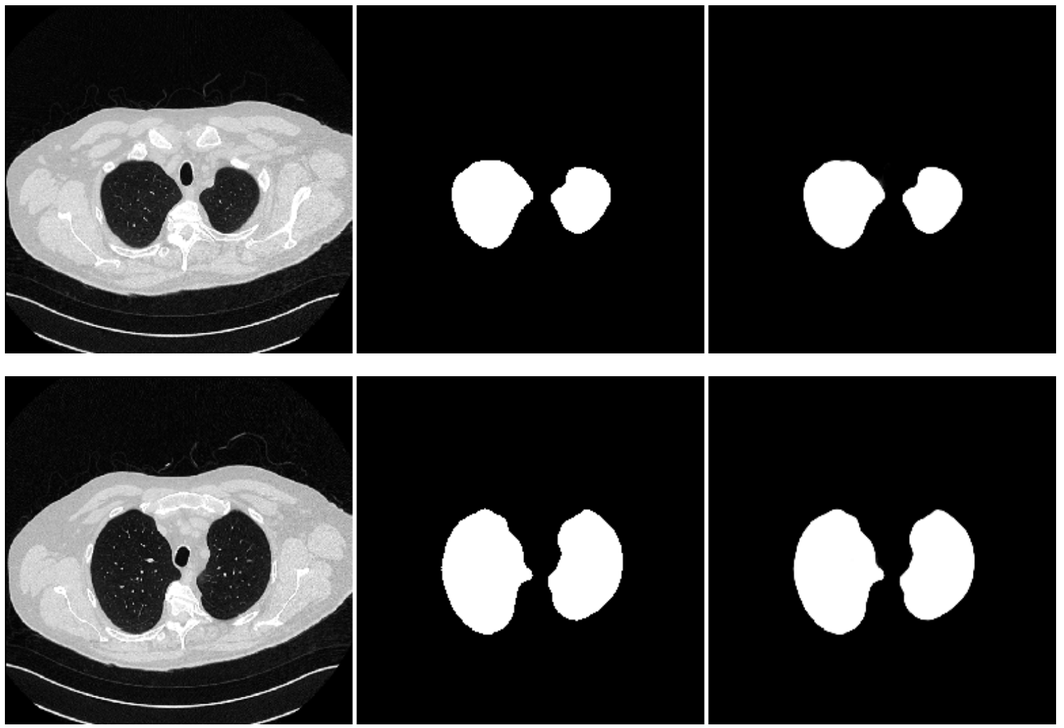
- Binary crossentropy

Lung Scan | Ground truth mask | Predicted mask



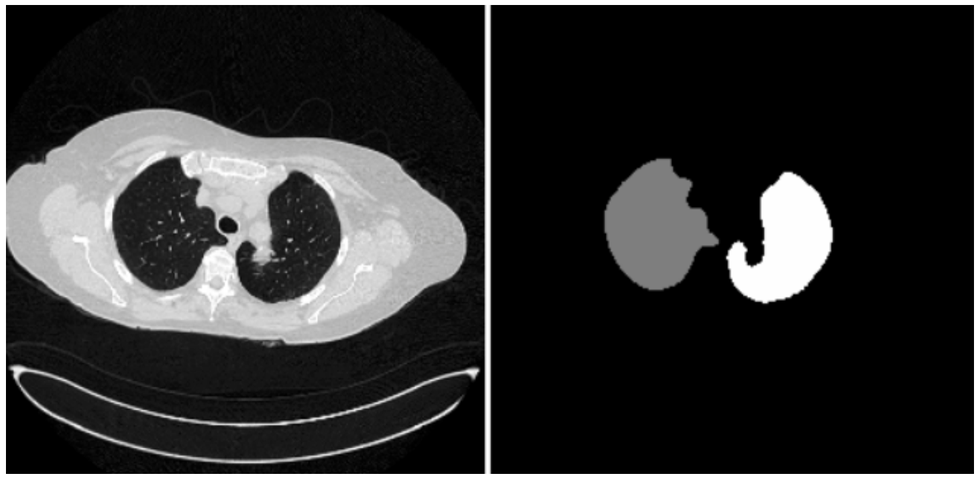
- Dice Loss

Lung Scan | Ground truth mask | Predicted mask



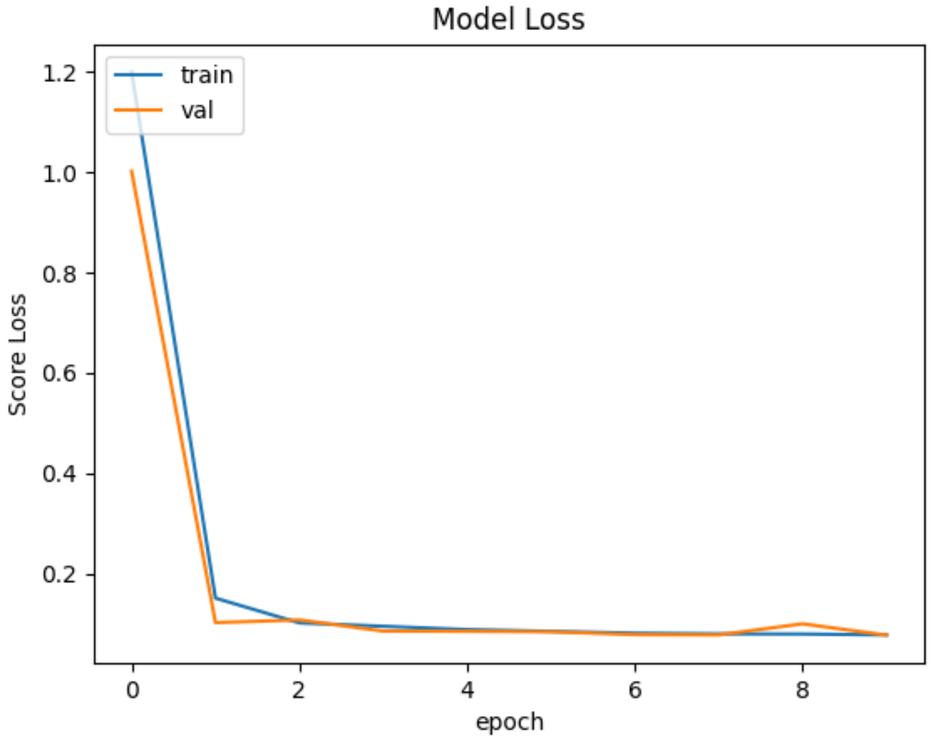
# 3-class categorical segmentation

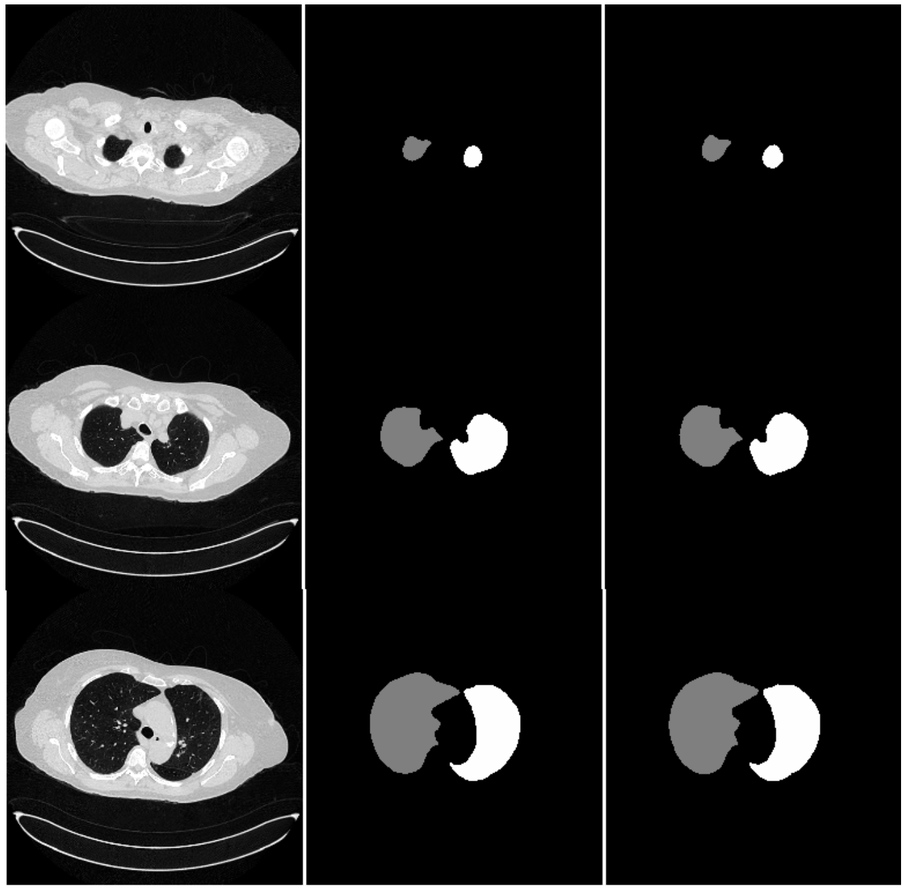
**From 1 binary map (lung/no lung) to 3 maps**



**using a fixed random seed**

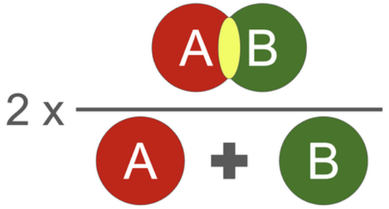
# With categorical crossentopy loss

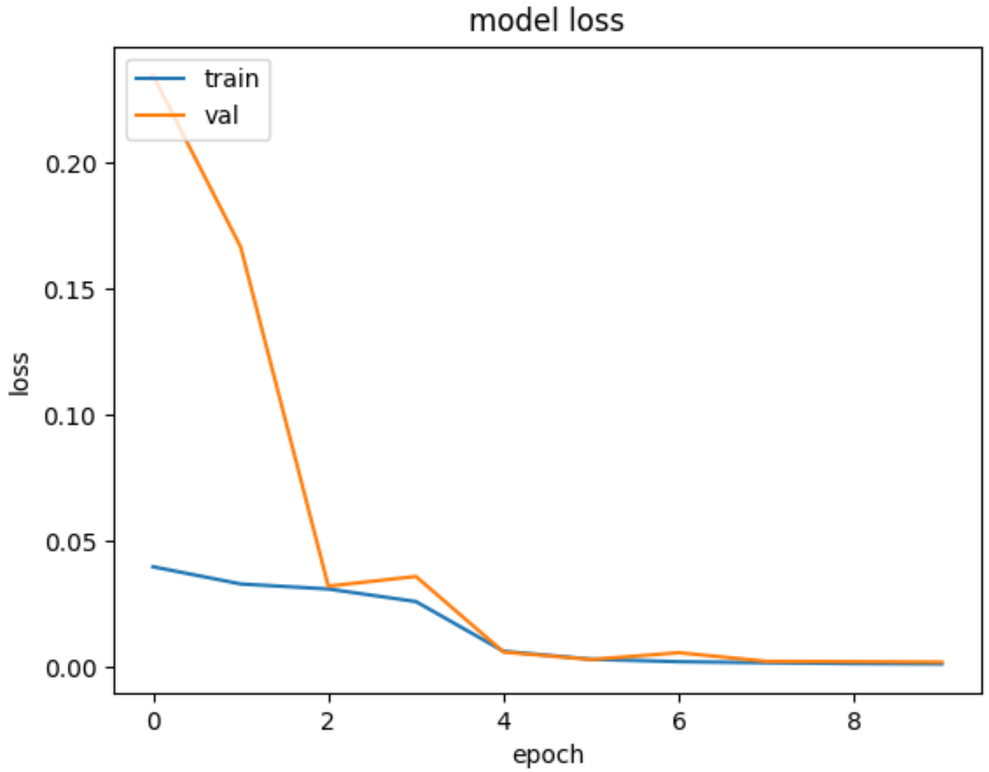


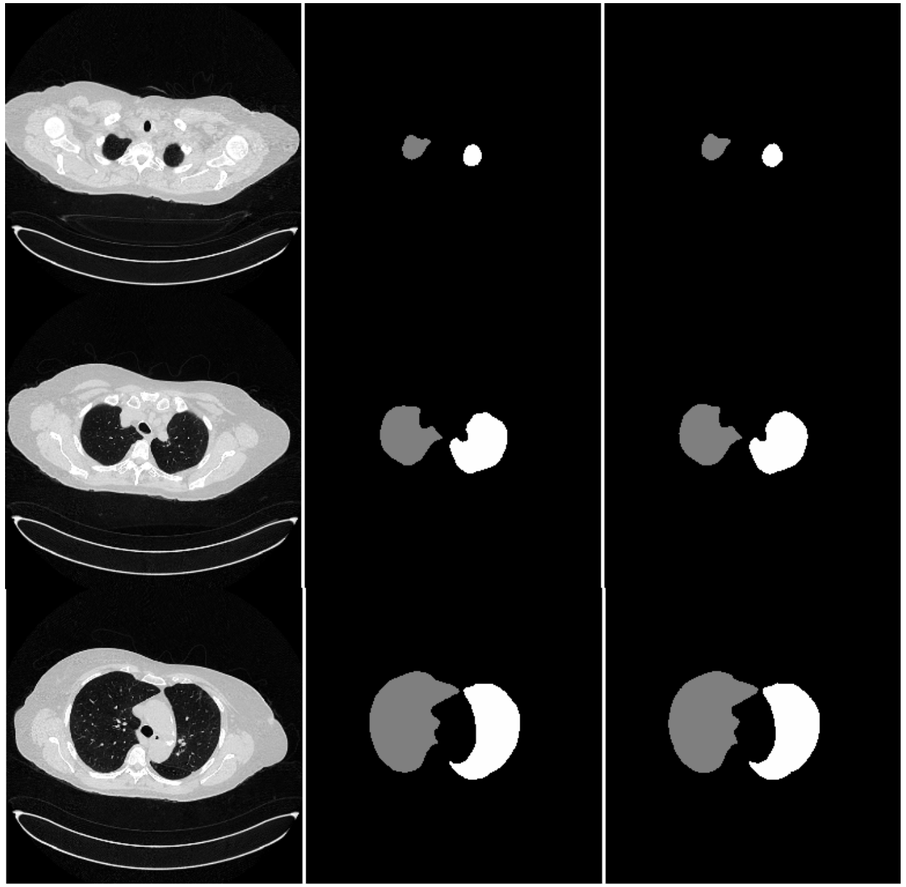



accuracy per class : 0.9991, 0.9920, 0.9922

# With dice loss

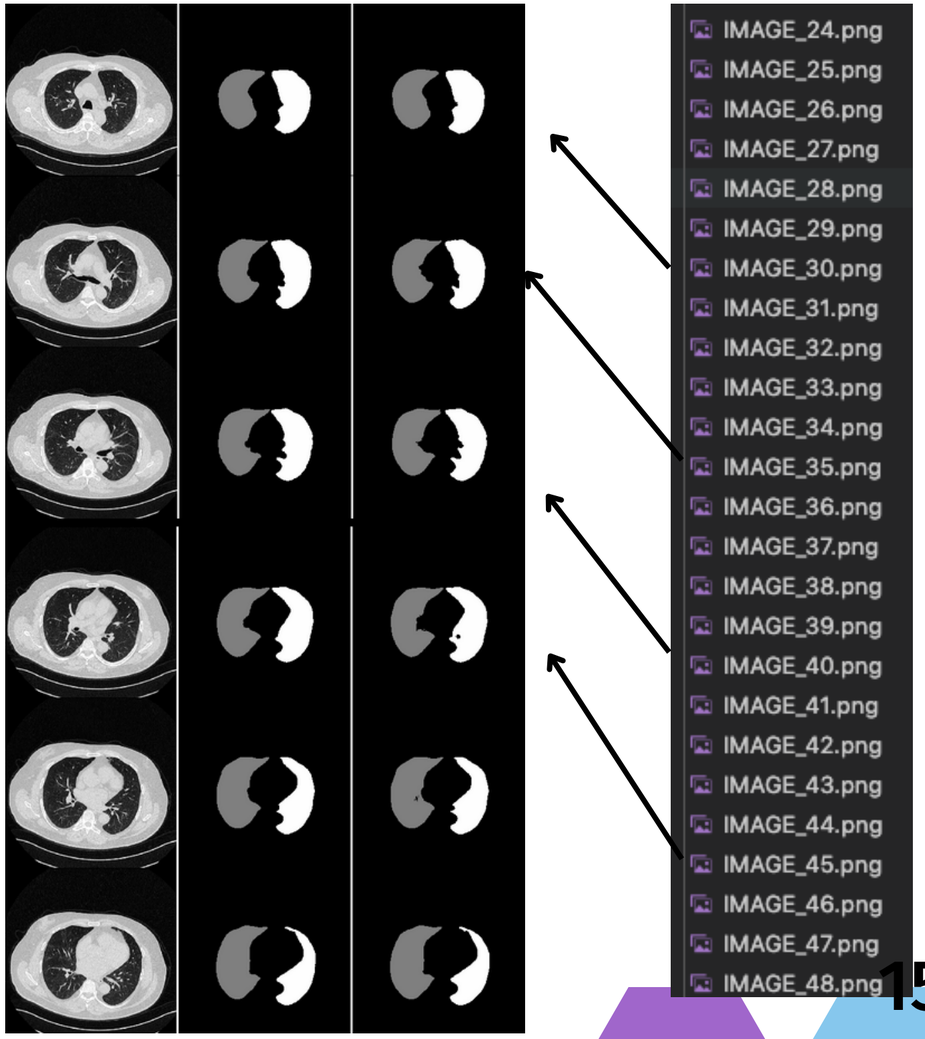


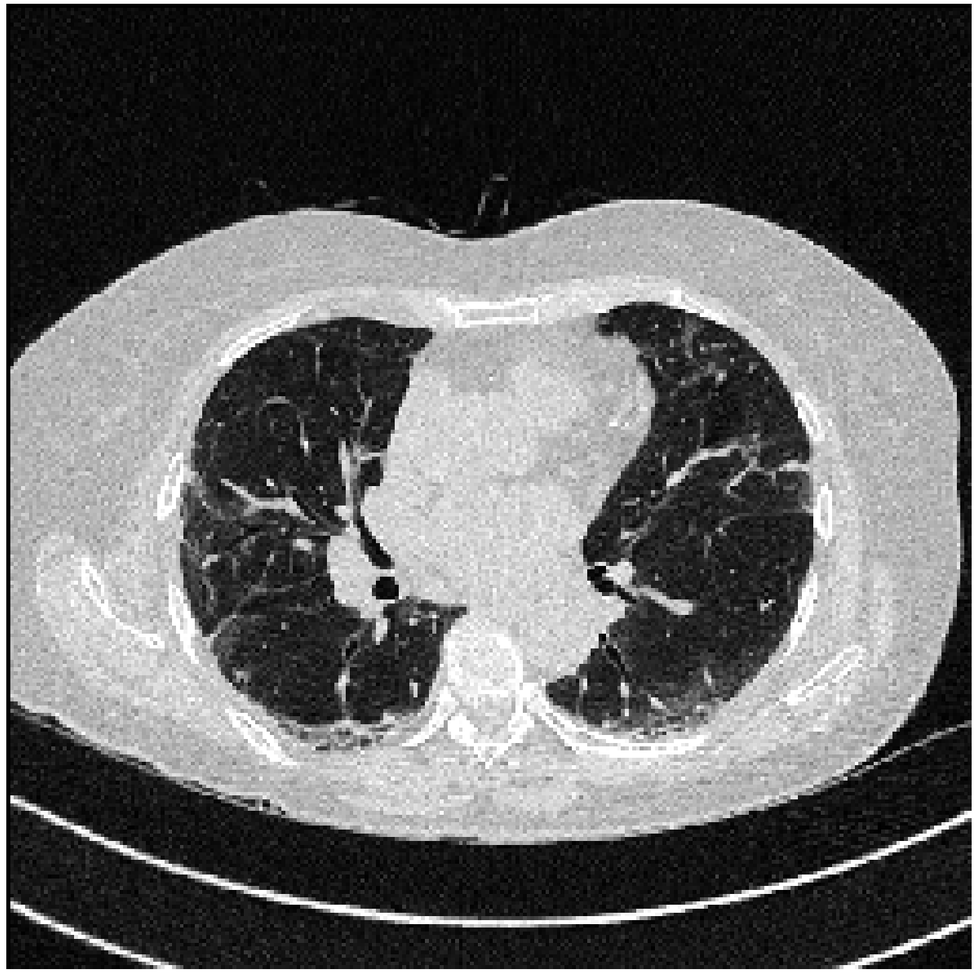



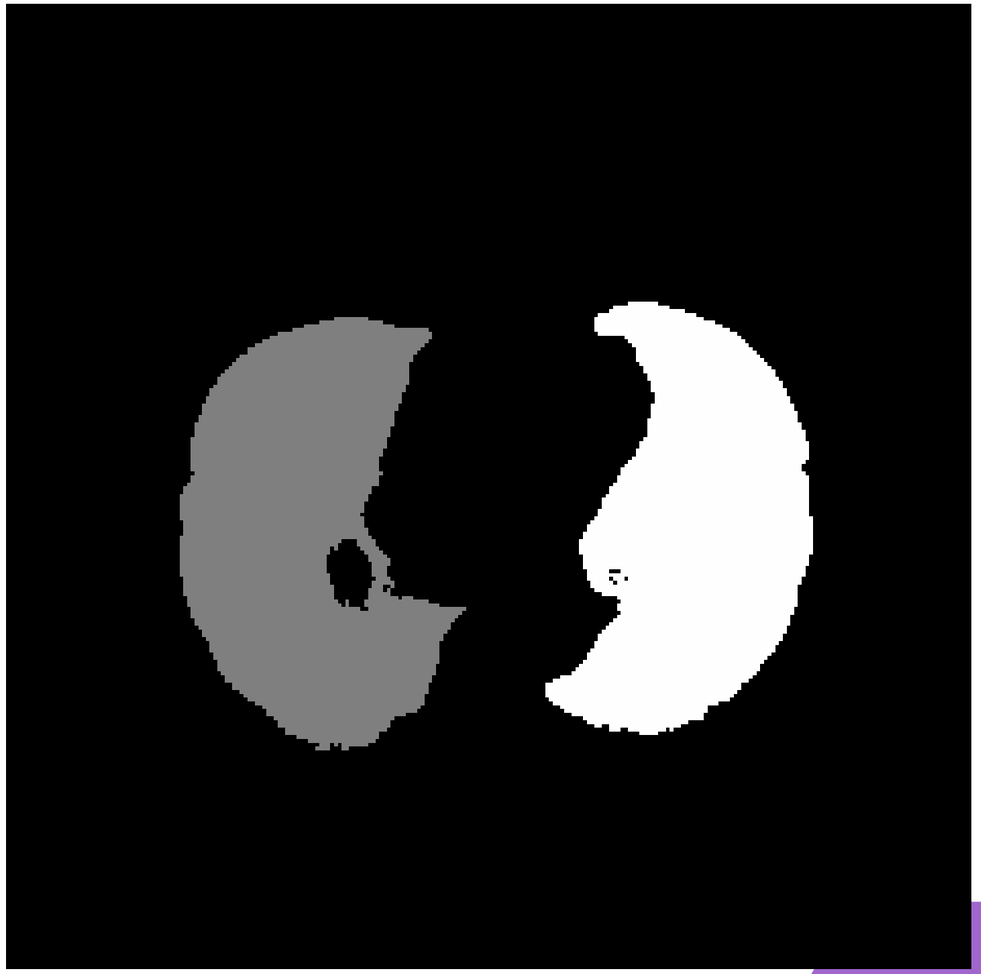
accuracy per class : 0.9992, 0.9923, 0.9929

# Additional metrics and verification

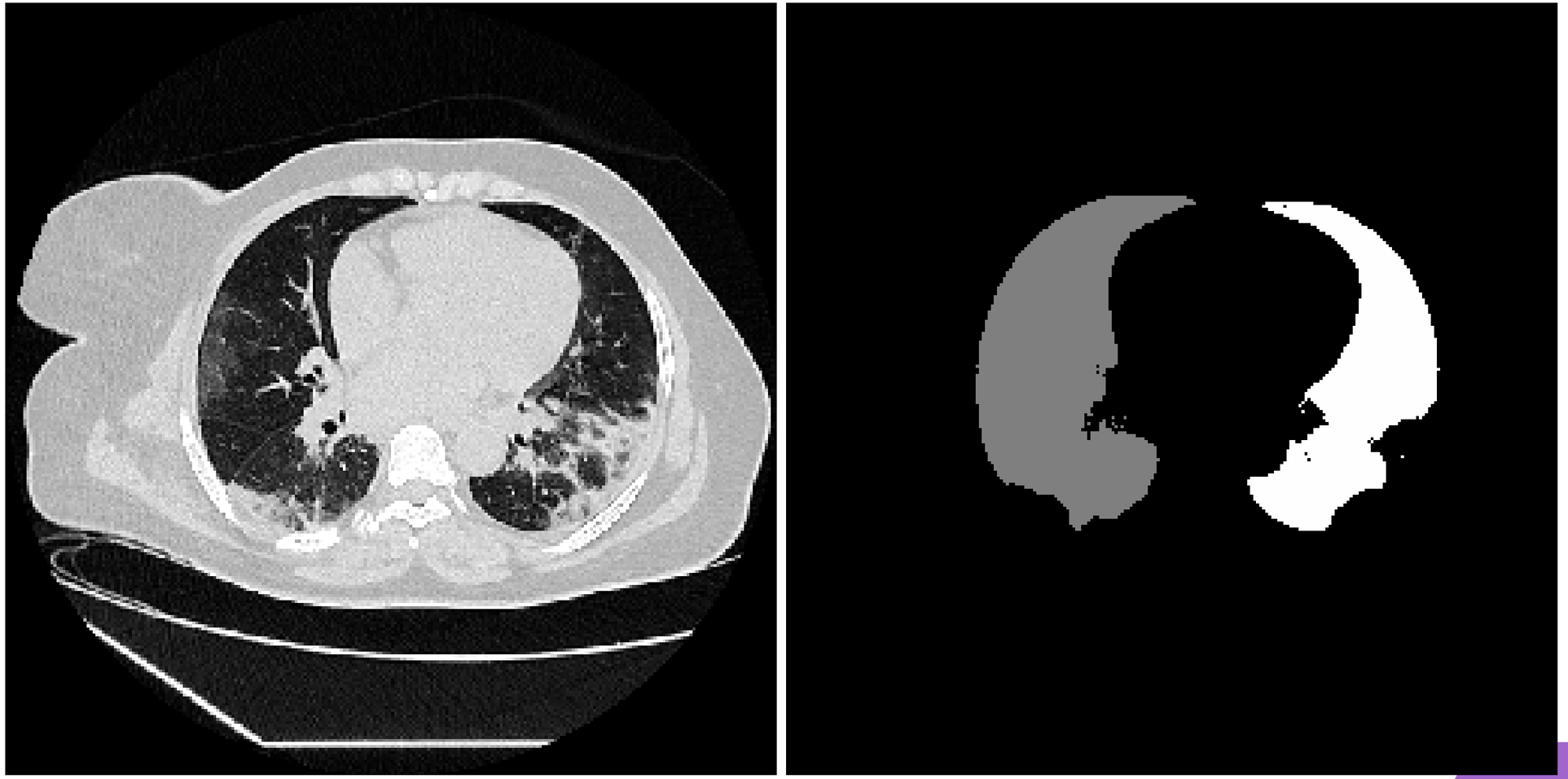



# Performance on diseased lungs





# Performance on diseased lungs



# Future improvements

Data augmentation

Metrics

Other architectures