Classification of COVID-19 in Computed Tomography using Deep Neural Networks

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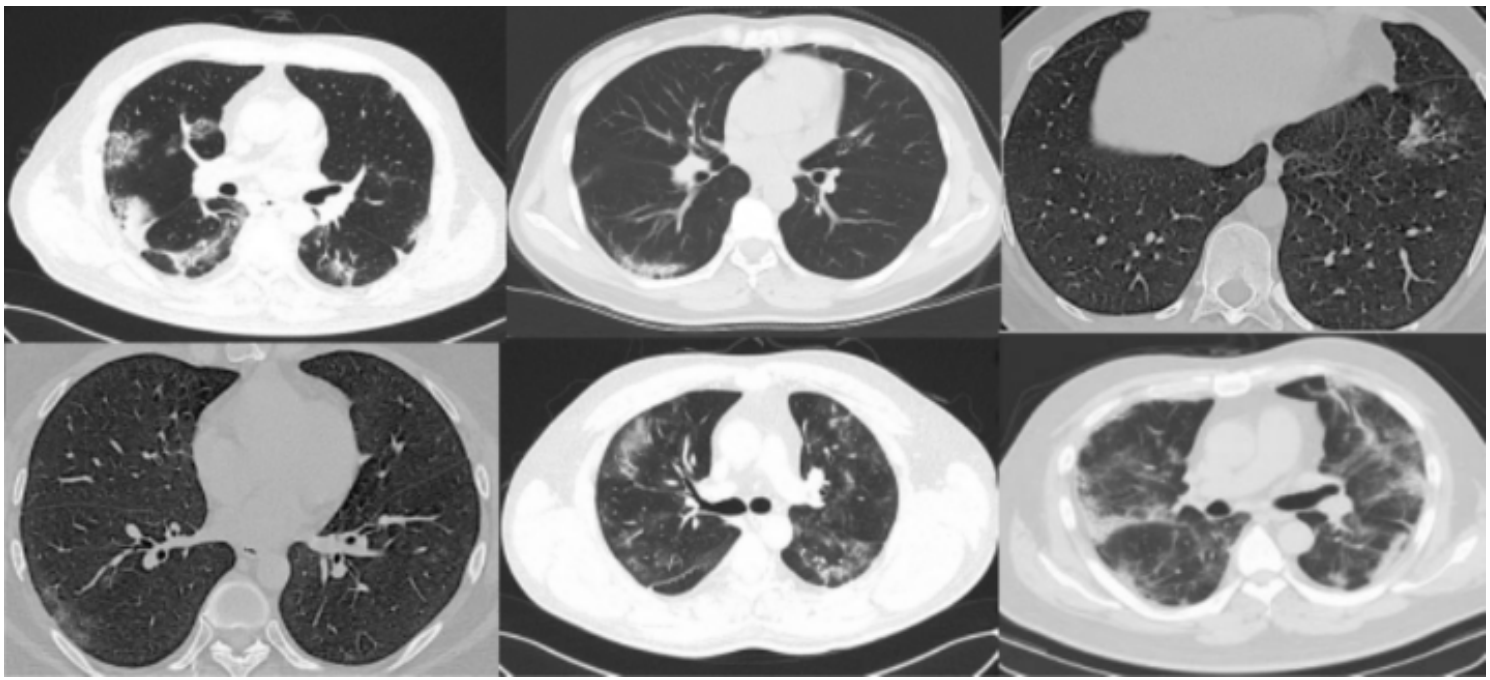
Introduction

- Deep learning in medicine is actively developing due to the large number of annotated images, increased computing power and development of new algorithms.
- The main methods for detecting the presence of the COVID-19 virus are PCR and CT of chest scans. The advantage of CT diagnostics is the speed of diagnosis and higher sensitivity compared to the reality of PCR diagnostics.
- In [1] "COVID-CT-Dataset: a CT scan dataset about COVID-19" (https://arxiv.org/pdf/2003.13865.pdf) Yang, He, et al. built an open-sourced dataset COVID-CT.
- In [2] "Sample-Efficient Deep Learning for COVID-19 Diagnosis Based on CT Scans" He, Yang, Zhang, et al. proposed an approach, which integrates contrastive self-supervised learning with transfer learning to learn powerful and unbiased feature representations.

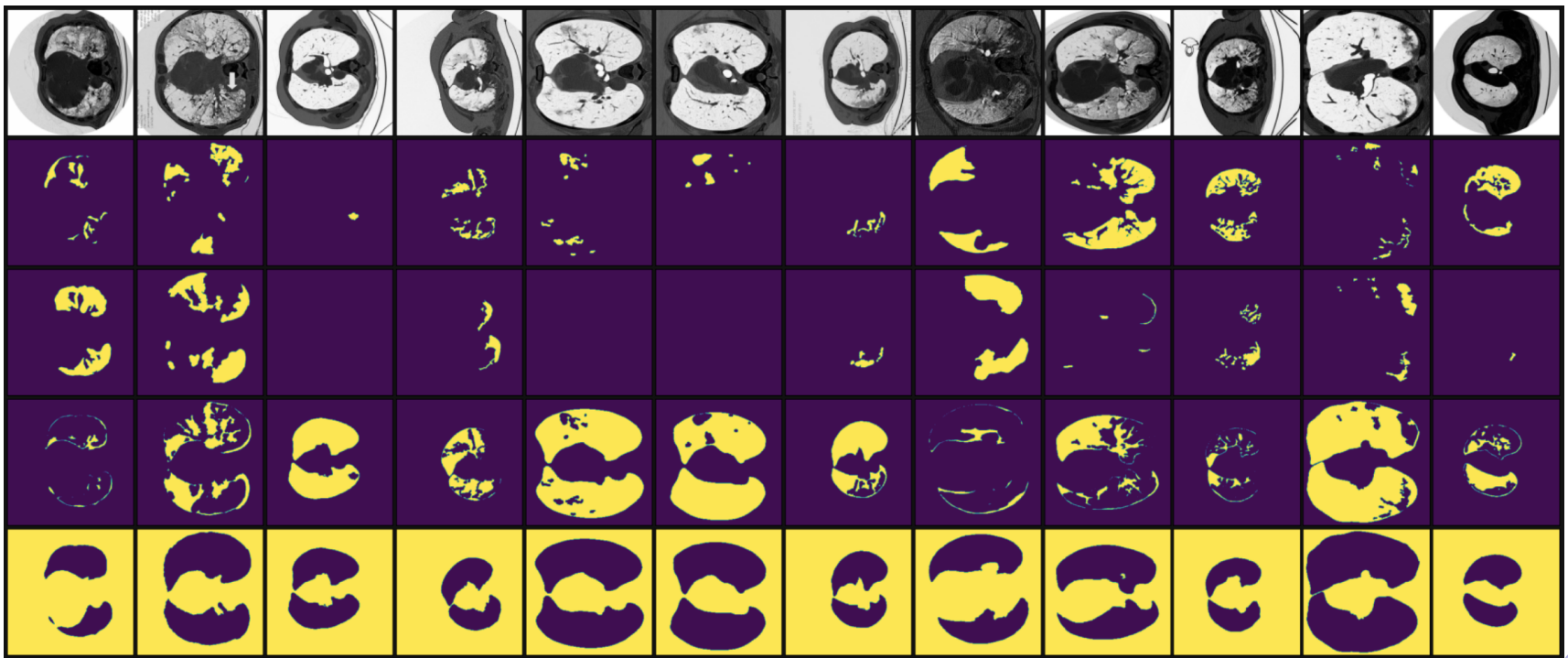
Classification Dataset

- COVID-CT (https://github.com/UCSD-AI4H/COVID-CT): 349 COVID and 397 Non-COVID CT images from 216 patients.
  Training set: 191/234 images
  Validation set: 60/58 images
  Test set: 98/105 images

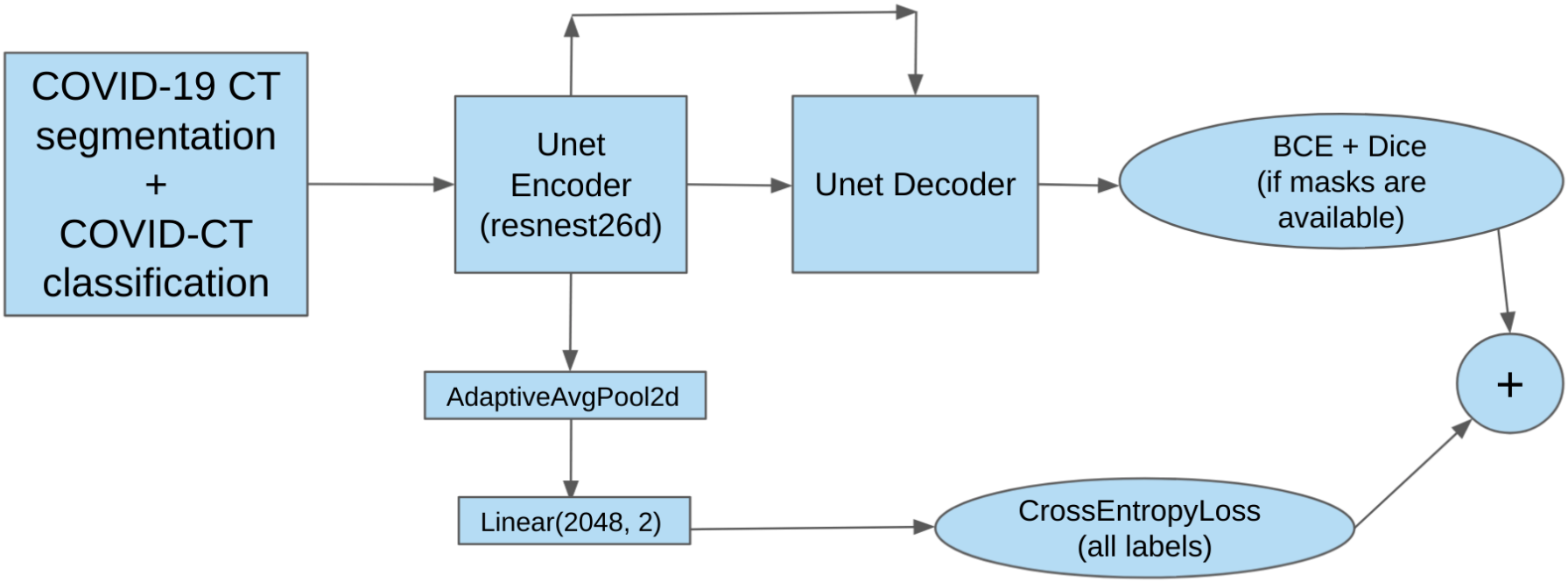


Segmentation Dataset

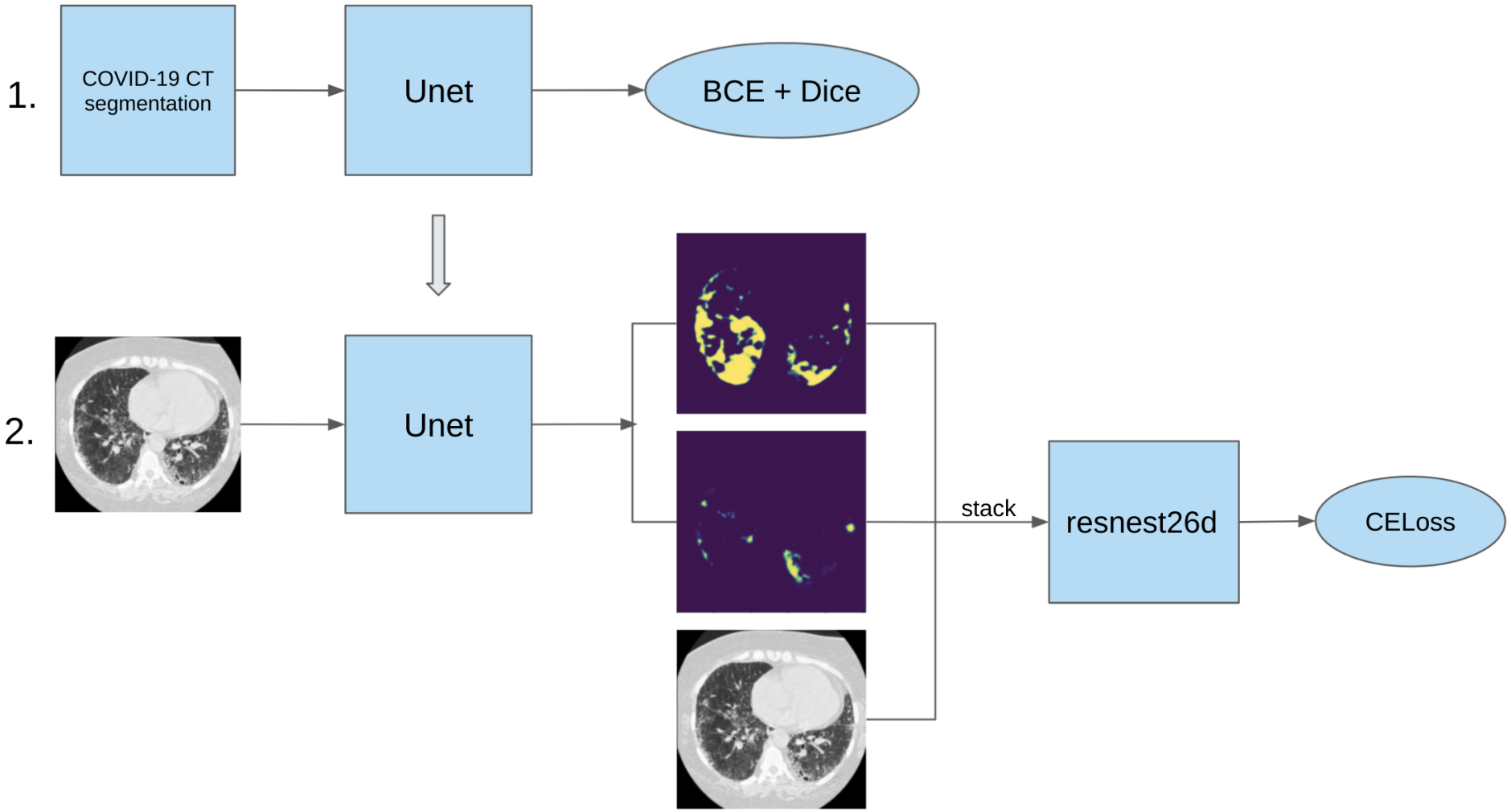
- COVID-19 CT segmentation dataset (http://medicalsegmentation.com/covid19): 100 axial CT images from more than 40 patients with COVID-19.
  Training images – 100 slices 512x512 size
  Training masks – 100 masks with 4 channels: ground glass, consolidations, lungs other, background



Joint Model


COVID-19 CT segmentation + COVID-CT classification
Unet Encoder (resnest26d)
Unet Decoder
BCE + Dice (if masks are available)
+
AdaptiveAvgPool2d
Linear(2048, 2)
CrossEntropyLoss (all labels)

Two-Stage Method



Results

- Test set scores:

	Accuracy(%)	F1-score(%)
My classification baseline	83.7	82.5
Joint Model	84.7	83.0
Two-Stage Method	85.7	84.5
DenseNet-169 from [2]	83	81
DenseNet-169 SSL from [2]	86	85

Conclusions

- We developed two methods for COVID-19 classification using classification and segmentation data and compared them with a strong baseline
- In further work it might be necessary to test these methods on larger dataset
- Also it would be interesting to do research on how can classification data improve segmentation task