Resembling COVID-19

Using Generative Adversarial Networks (GAN's) to create CT-Scans of COVID-19 infected lungs

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Agenda

- Goal
- Generative Adversarial Network (GAN)
- Data
- Methods
- Results
- Conclusion & Future Work

Goal

- Small open source datasets with 356 COVID-19 lung CTs
- Create new COVID-19 lung CTs images by using Generative Adversarial Network

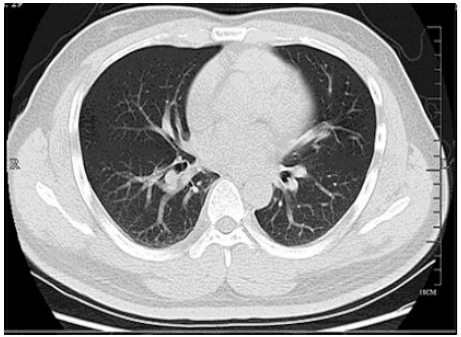


Fig. 1: CT of a lung affected by COVID-19 (left), CT of a healthy lung (right)

Generative Adversarial Networks (GAN's)

- Two competing deep neural networks
  - Generator (Image generator)
  - Discriminator (Classifier)
- Networks trying to optimize itself
- Generator can learn any data distribution

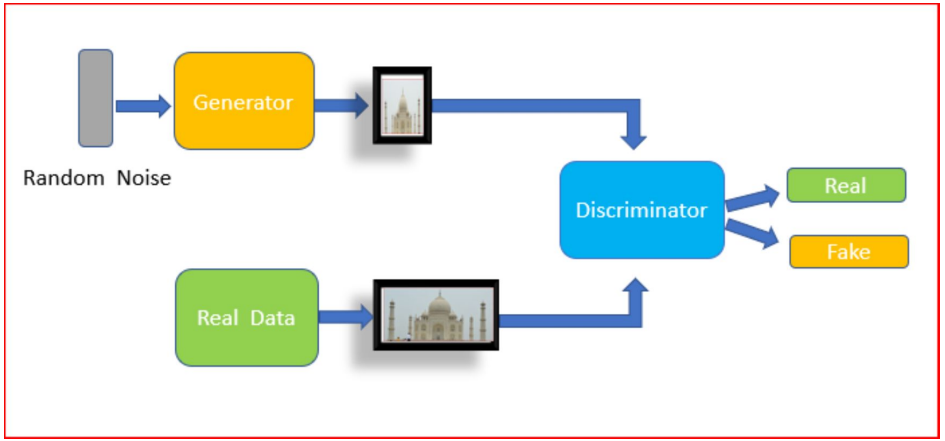


Fig. 2: Structure of a Generative Adversarial Network (GAN)

Data

- 750 CT scans, 316 with COVID-19 https://www.kaggle.com/luisblanche/covidct
- 40 CT scans with COVID-19 from https://ieee8023/covid-chestxray-dataset
- easily readable image formats
- different sizes/resolutions
- some with additional image-element (e.g. x-ray), that had to removed

  -> 356 CT scans as input for a GAN

Meanwhile there are more CT-datasets available. For this task and with respect to the available resources, the GAN input was restricted to these scan.

Methods

- Starting point: https://www.tensorflow.org/tutorials/generative/dcgan (as a blueprint)
- Write some code to get the CT scans
- Different parameters were test to produce better results such as:
  - Testing activation functions (Relu, LeakyRelu) -> LeakyRelu (slide 7)
  - No. of hidden layers for generator and discriminator (11/8)
  - Testing learning rates: 1E-3 to 1E-5 -> 1E-4 turned out to be the best choice
  - Testing for dropout/no dropout: no dropout
  - Epochs: as much as possible
  - Batch size: depending on resources (as by now)

Results

500 epochs, learning rate 1E-4, resolution 28x28

ReLu

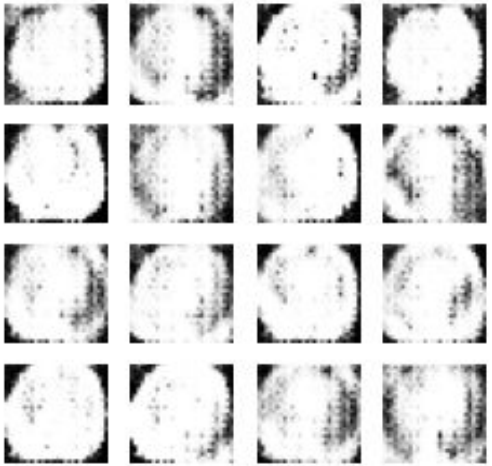
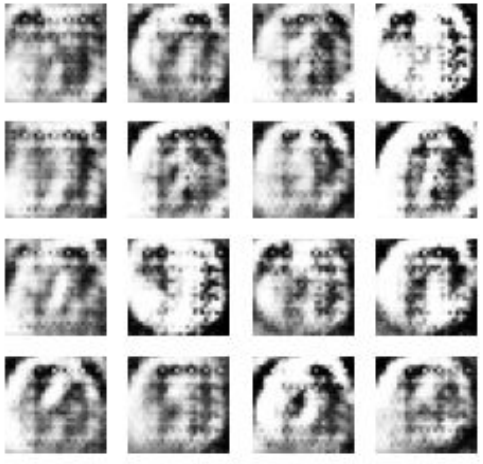


Fig. 3: Results after 500 epochs with ReLu activation function (left) and LeakyRelu activation function (right)

LeakyReLu



Results

learning rate 1E-4, resolution 336x504, no dropout

2250 epochs

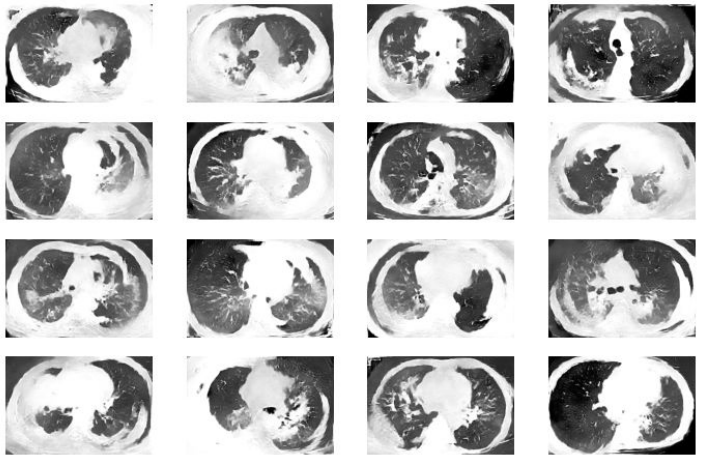
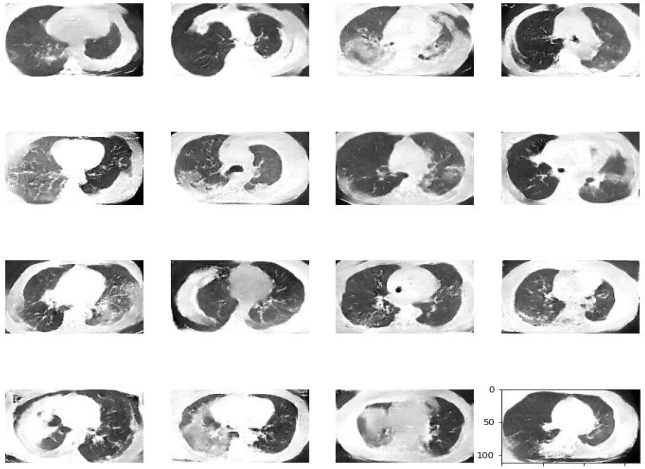


Fig. 4: Results after 1000 (left) and 2250 (right) epochs

1000 epochs

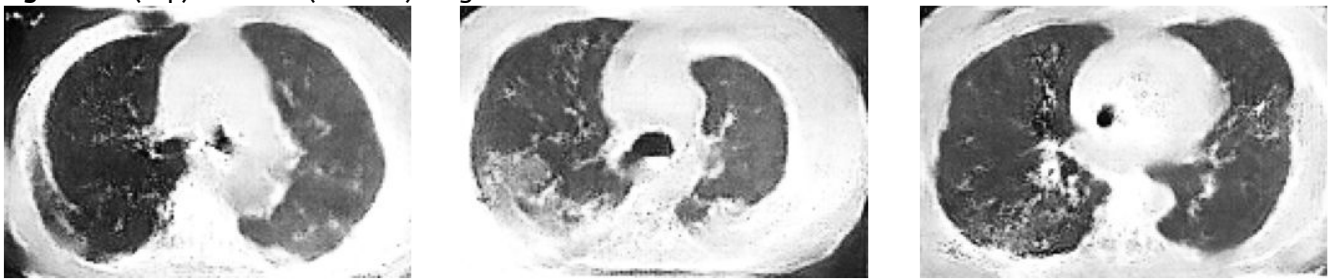


Comparison real to GAN-generated images

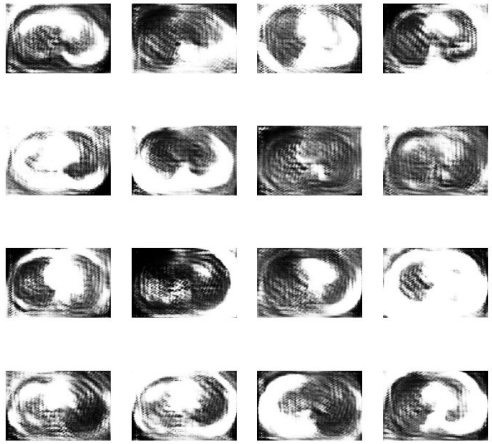
Real

Fig. 5:Real (top) and fake (bottom) lung CT scans

GAN



Results



Conclusion and Future Work

- Created new CT Scans
- Better results through:
  - larger dataset
  - more computational resources
- Easily extensible code
- Generated images can be used for future covid-19 projects