

# Resembling COVID-19

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

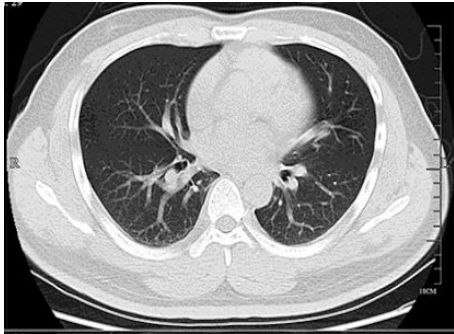
Dieter Hoogestraat, Felix Facklam, Ali Farooq @opencampus Tensorflow SoSe2020

# Agenda

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

# Goal

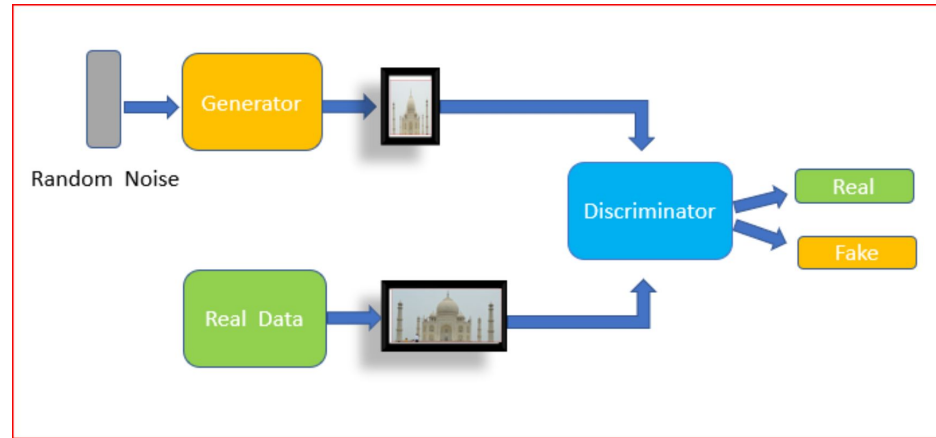
- Small open source datasets with 356 COVID-19 lung CTs
- Create new COVID-19 lung CTs images by using Generative Adversarial Network



**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 be 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 scans.

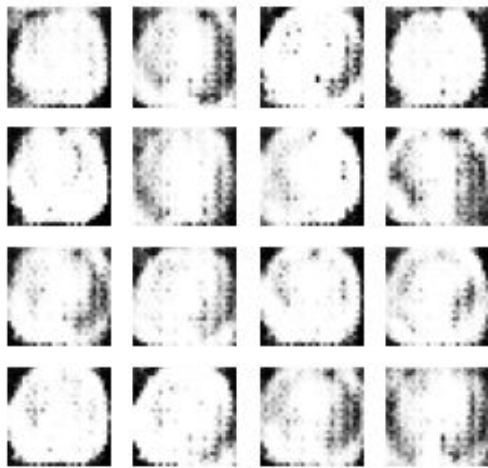
# Methods

- Starting point: <https://www.tensorflow.org/tutorials/generative/dcgan> (as a blueprint)
- Write some code to get the CT scans
- Different parameters were tested 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

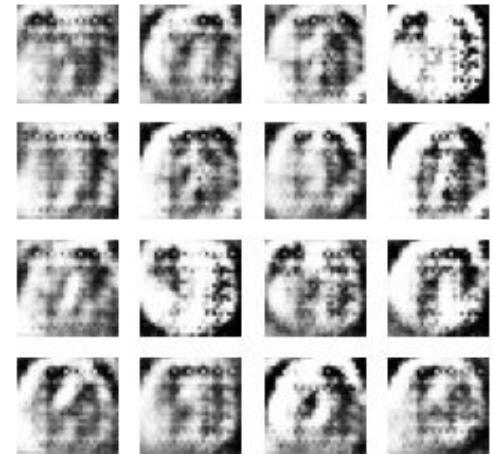
500 epochs, learning rate 1E-4, resolution 28x28

## ReLu



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

## LeakyReLu

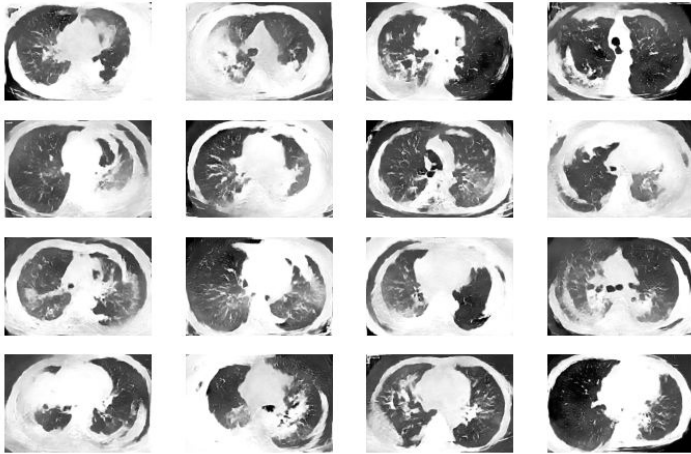




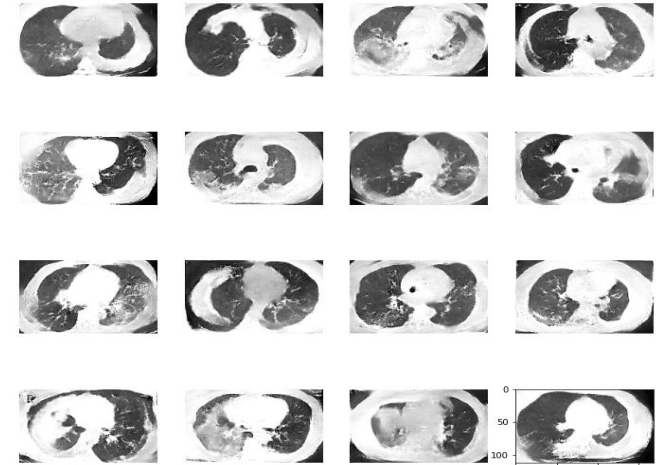
# Results

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

## 2250 epochs



## 1000 epochs



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



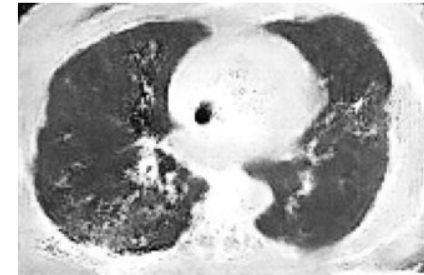
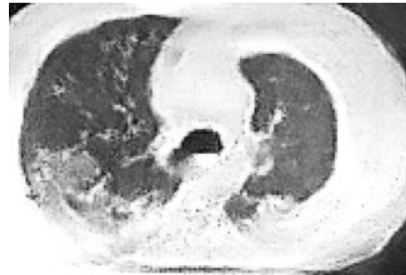
# Comparison real to GAN-generated images

Real

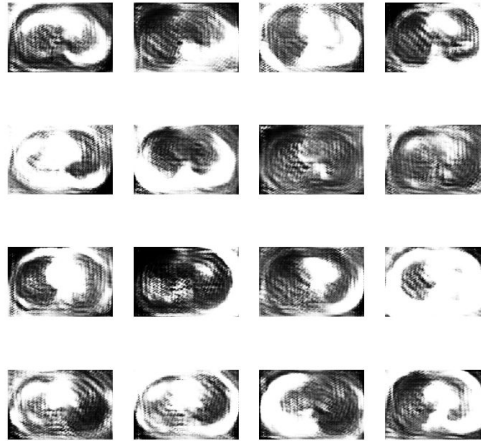


Fig. 5: Real (top) and fake (bottom) lung CT scans

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