

# CoronaHack - AI vs. Covid-19

#coronahack-first-diagnosis

## AI Will Diagnose You Now



### Team members:

Alex Hall  
David Cato  
John Nganda  
**Netzahualcoyotl Hernandez (presenter)**  
Simon Arridge  
Sophie McCall  
Tahmina Zebin  
Vyon Christodoulou

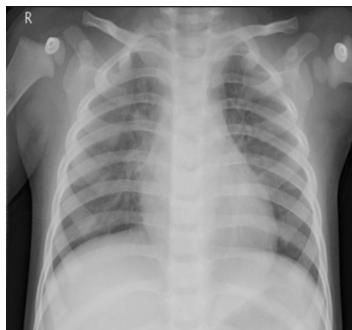
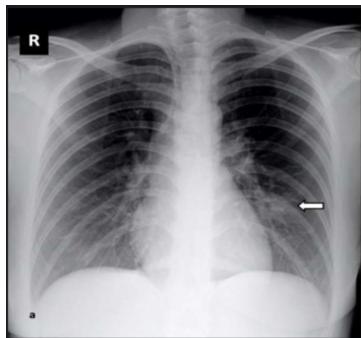
### Guest members:

Keene Chen  
Mahmudul Hasan

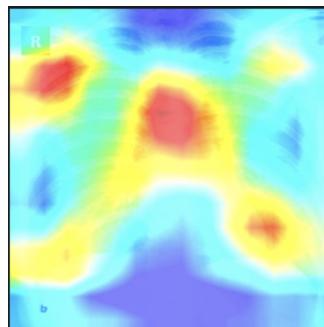


J Schmidhuber 2020

## PHYSICIAN OBSERVATION



## AI OBSERVATION



+

+

+

## (Physician + AI)

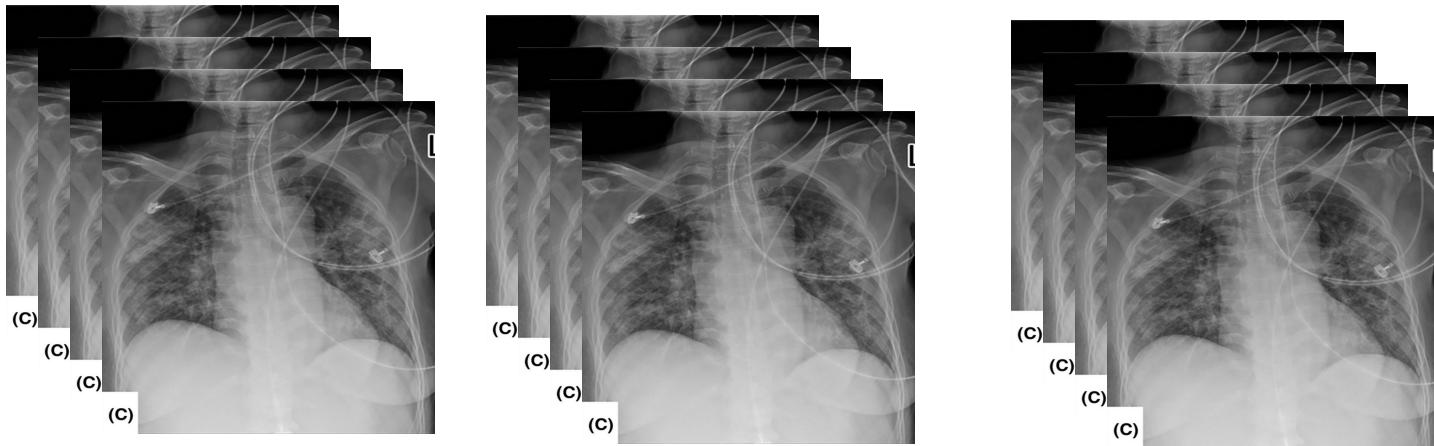


= Covid-19

= Healthy

= Pneumonia

# What does AI need to work?



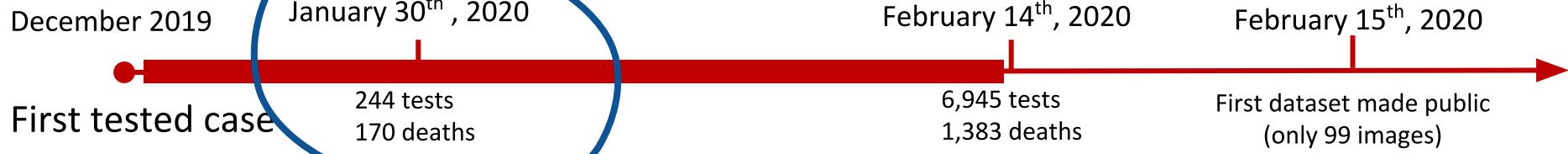
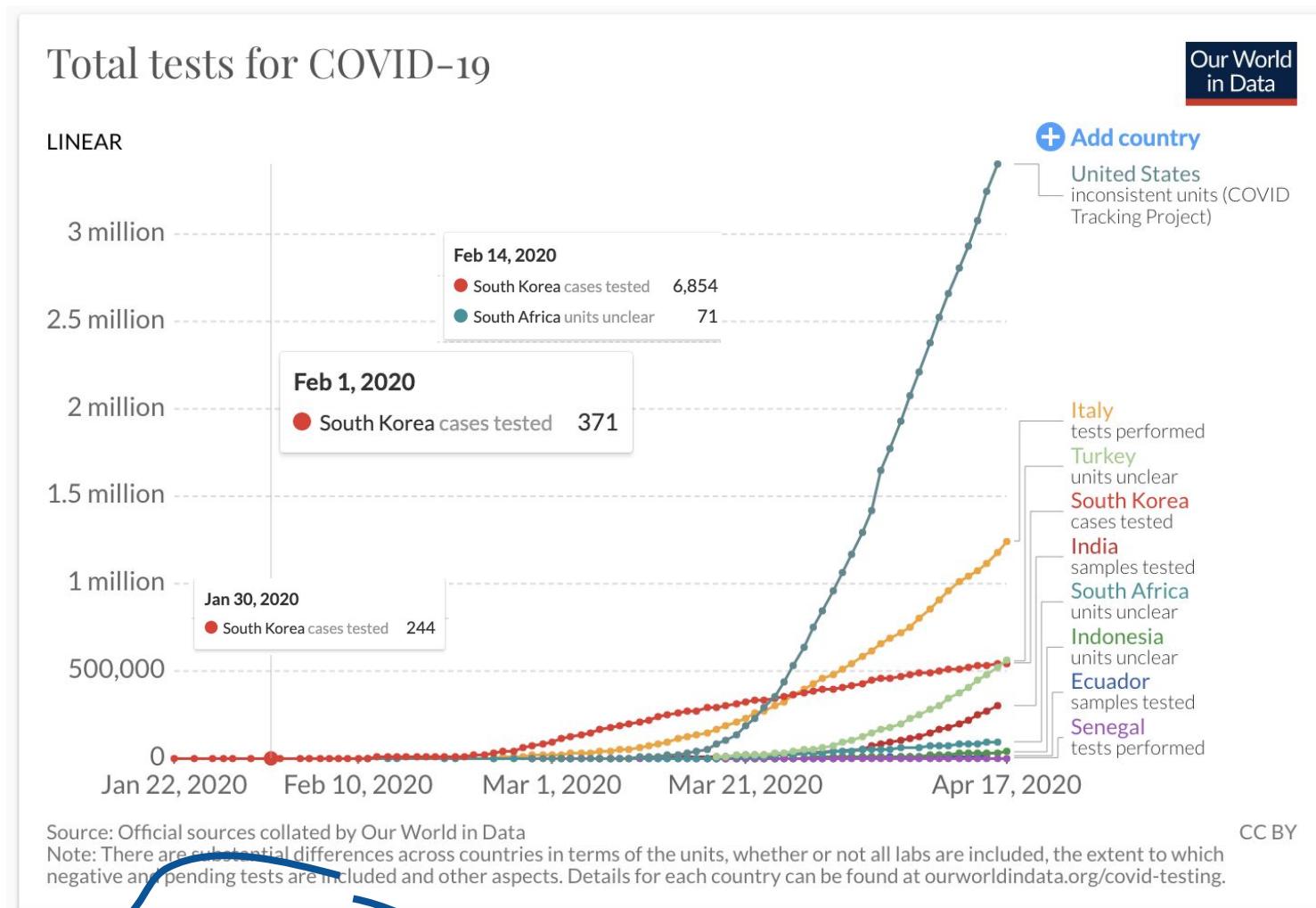
- ImageNet
- AlexNet
- GoogleNet/Inception
- VGG

These AI networks are trained  
with about  
15 million of images

# Covid-19

- Covid-19 is a virus that has recently emerged. Although, it has spread world-wide, it is still a new phenomenon from which **we have a limited amount of data.**

# Covid-19 (Data availability)

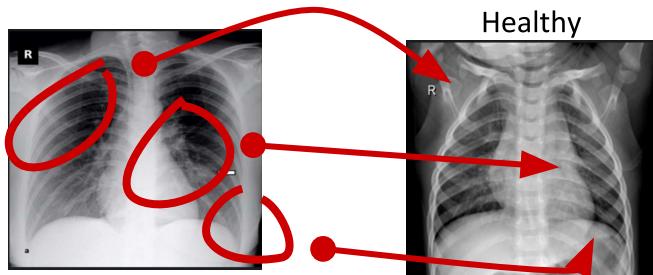
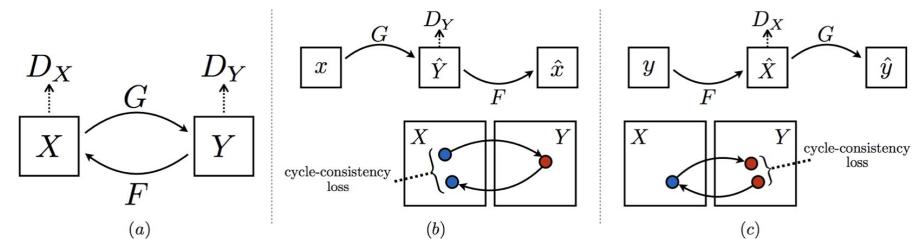
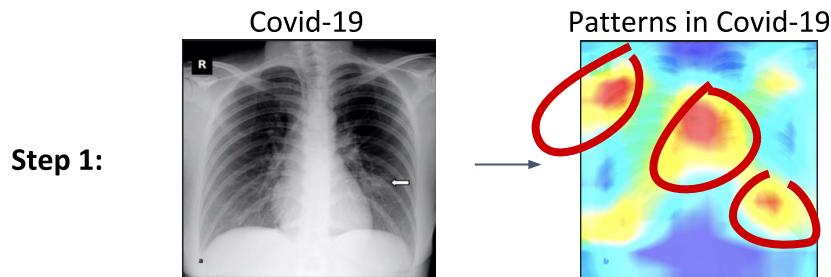
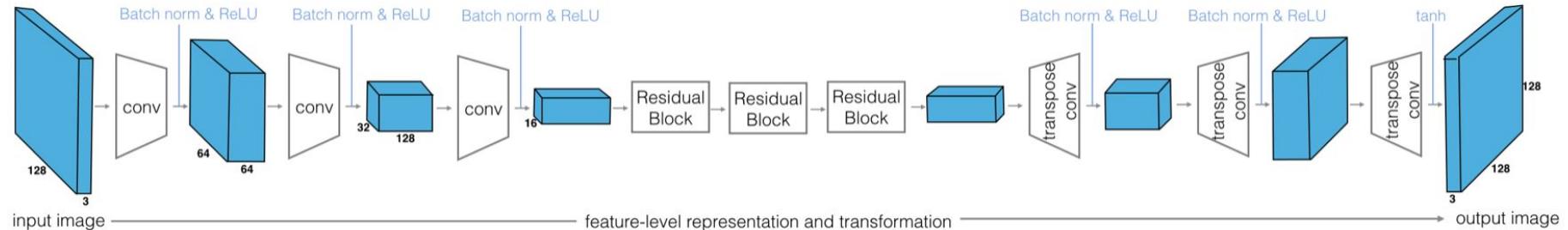


# Objectives

- Our team targets to explore alternative ways to **optimise the insufficient quantity of Covid-19 images.**
  - Explore the benefit of **GAN to create synthetic images** of patients with Covid-19.
    - POC under a **CNN heat maps to detect Covid-19.**
    - POC of a **user-friendly application** that receives an X-Ray image and calculates the probability of being infected with Covid-19.

# GAN to create synthetic images

Generative Adversarial Networks



=

An image that reflects how a healthy patient could look like if were infected with Covid-19.

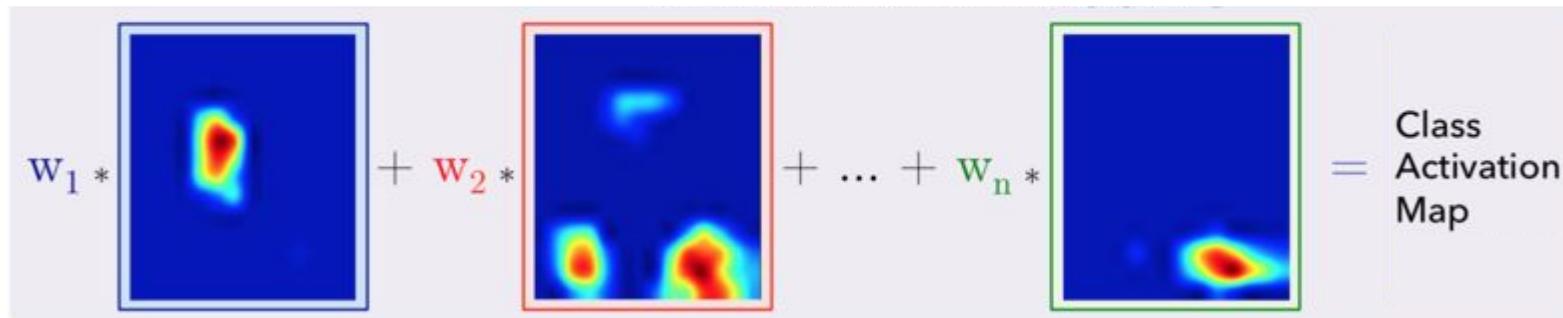
# GAN to create synthetic images (results)

Tuples of two related images: **original** (healthy) and **generated** (how the healthy patient will look like if were infected with Covid-19)



# CNN to detect Covid-19 utilising **heat maps** (results)

Convolutional Neural Network



## Experiments:

1. Classifying images as covid-positive or covid-negative (binary classifier).
  - i. only originals (Covid: 127, Normal: 200, Pneumonia: 300 )
  - ii. 10 original + 100 generated
  - iii. 99 original + 99 generated
2. Classifying images as ‘normal’, ‘covid-positive’ or ‘pneumonia’ (multiclass classifier).
  - i. only originals (Covid: 127, Normal: 200, Pneumonia: 300 )
  - ii. ...
  - iii. ...

# CNN to detect Covid-19 utilising **heat maps** (results)

## 1. Classifying images as covid-positive or covid-negative (**binary classifier**).

i) only originals  
(f1-score: 98.5%)

Predicted Class			
		covid	normal
normal	covid	26	0
	normal	1	59
True Class		covid	normal

iii) 10 original + 100 generated  
(f1-score: 100%)

Predicted Class			
		covid	normal
normal	covid	22	0
	normal	0	60
True Class		covid	normal

iv) 100 original + 100 generated  
(f1-score: 98%)

Predicted Class			
		covid	normal
normal	covid	40	0
	normal	2	58
True Class		covid	normal

## 2. Classifying images as ‘normal’, ‘covid-positive’ or ‘pneumonia’ (**multiclass classifier**).

i) only originals  
(f1-score: 95.66%)

Predicted Class				
		covid	normal	pneumonia
normal	covid	26	0	0
	normal	0	58	2
	pneumonia	1	4	55
True Class		covid	normal	pneumonia

iii) 10 original + 100 generated  
(f1-score: XX%)

We needed more time to finish  
this table :)

iv) all original + 100 generated  
(f1-score: 94.66%)

Predicted Class				
		covid	normal	pneumonia
normal	covid	41	1	4
	normal	0	58	2
	pneumonia	0	2	58
True Class		covid	normal	pneumonia

# Proof of concept

Live demo **available for everyone** to test:

<http://jrn.pythonanywhere.com/>

user: coronahack  
pass: Covid19Hack

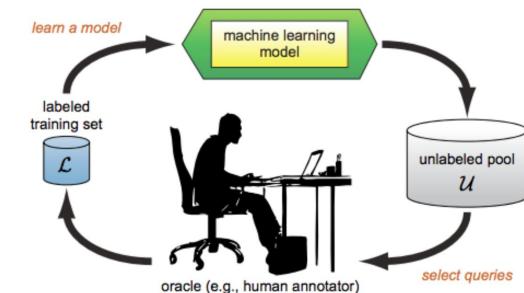
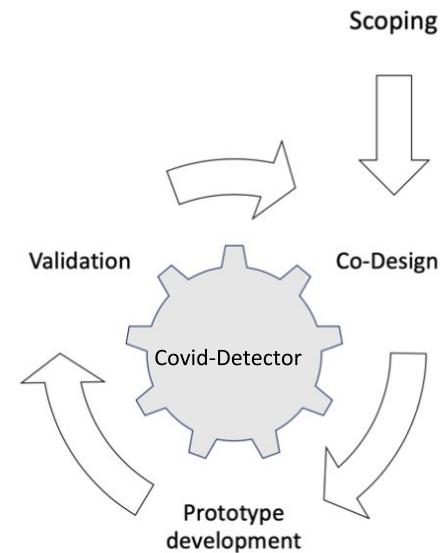
# Further development (Research)

- **Hands-on:**
  - Conduct a more robust analysis to **improve the GAN model** (synthetic images).
  - Conduct a more robust analysis on our classification model by **utilising a larger number of classes** to discriminate Covid-19.
- **Research pathway:**
  - Explore **other GAN techniques** (e.g., CGAN, Wasserstein GAN, Style GAN)
  - Explore the use of **bounding box annotation** to improve our **heat map** classification model.
- **Research publications:**
  - The impact of synthetic images in unbalanced datasets to classify Covid-19.
  - CNN for heat map + bounding box annotation to detect Covid-19 in X-Ray images.

# Further development (Implementation)

- **Integration** of our AI as a **component of the medical systems**.

- We propose to adopt an “iterative and cycle production model” **in collaboration with the medical expertise**.
- As Covid-19 might mutate, **we propose that the AI adapts** under an active learning approach, in which the AI is re-trained as new X-Ray images are available.



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