

# AI Marshal to Gratis COVID-19 Assessment

Ujjawal K. Panchal  
OWASP, Ahmedabad

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# Identifying our Target

- ▶ S.A.R.S. Cov. 2 (Severe Acute Respiratory Syndrome Coronavirus 2) causes COVID-19 (COronaVIrus Disease 2019).
- ▶ Some Commonly Seen Symptoms:
  1. Fever.
  2. Cough.
  3. Respiratory Illnesses.
  4. Pneumonia (Only in severe cases).
- ▶ It is a WHO recognized **pandemic**.

# Pandemics

Pandemic	Years	Places	Deaths
Influenza Epidemic	1200 BC.	Babylon, Asia, Mesopotamia	?
Plague of Justinian	541- 542 AD.	Europe, Asia	50% of Europe's Population.
Black Death	1346- 1353 AD	Europe, Asia, Africa	60% of Europe's Population.
SARS. CoV.-1	2002- 2004	Worldwide	774
SARS. CoV.-2	2019 - Present	Worldwide	433,000+ (upd. 14 June)

Table: Some Past Pandemics



Figure: Plague Panel: The Triumph of Death. (1635). Germany.

# Some Heuristics Metrics on Pandemics

- ▶  **$R_0$  Value:** An average number of cases, an infected person will cause in their infection period.

$$R_0^{\text{Measles}} \in [12, 18] \quad [\text{Guerra et al.}]$$

$$R_0^{\text{SARS-CoV.2}} \approx 5.7 \quad [\text{Sanche et al.}]$$

$$R_0^{\text{CommonCold}} \in [2, 3] \quad [\text{Freeman et al.}]$$

$$R_0^{\text{SARS}} \in [0.19, 1.08] \quad [\text{Chowell et al.}]$$

$$R_0^{\text{MERS}} \in [0.3, 0.8] \quad [\text{Kucharski et al.}]$$

# Effects of Effective Containment

Figure: [Wikimedia-RCraig09]

# Effects of Mitigation

Figure: [Wikimedia-RCraig09]

## Effects of Inadequate Mitigation

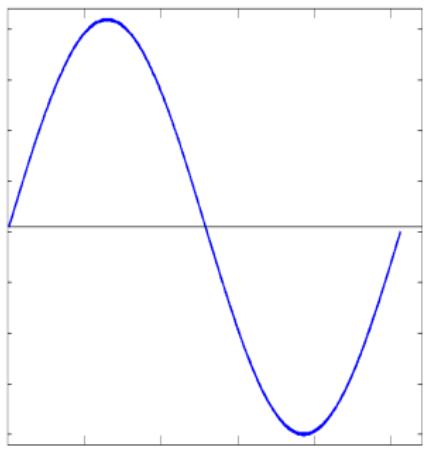
Figure: [Wikimedia-RCraig09]

## Our Problem Statement

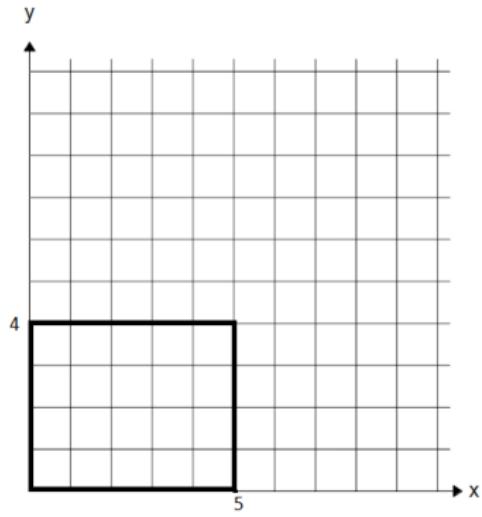
- ▶ To aid Mitigation and limit the spread of the virus by means of AI based prognostic testing using Chest Xray images.
  
- ▶ Some Advantages over conventional testing:
  1. Extremely cheap (potentially free).
  2. Results of test available in a few seconds.
  3. Potential to conduct Millions of test in parallel.
  4. Convenient Scalability.

# What is an Image?

- ▶ An Image is a 2D Signal in space with  $f(x, y) \in [0, 255]$ .



(a) 1d Sine Signal as a function of angle



(b) A 5x4 2d Image. As a function of space.

# Supervised Machine Learning Classification

- ▶ For a given  $x$  corresponding to class  $y$ ,  $x \rightarrow h_{\theta}(x) \rightarrow \hat{y}$ .

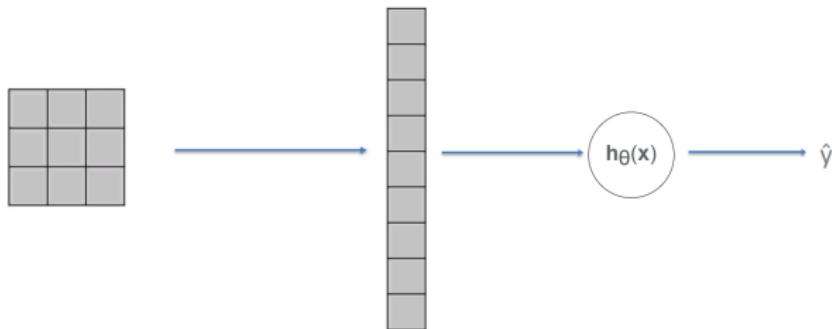


Figure: Supervised Learning Model  $h_{\theta}(x)$

- ▶ In classification scenario, such as COVID-19 or not COVID-19, output  $y$  has to be in a class  $C$ .  $C = \{c_1, c_2, \dots, c_n\}$ . For COVID-19, not COVID-19 Xray image classification,  $C = \{0, 1\}$

# First Weight Adaptive Neural Network: Rosenblatt's Perceptron

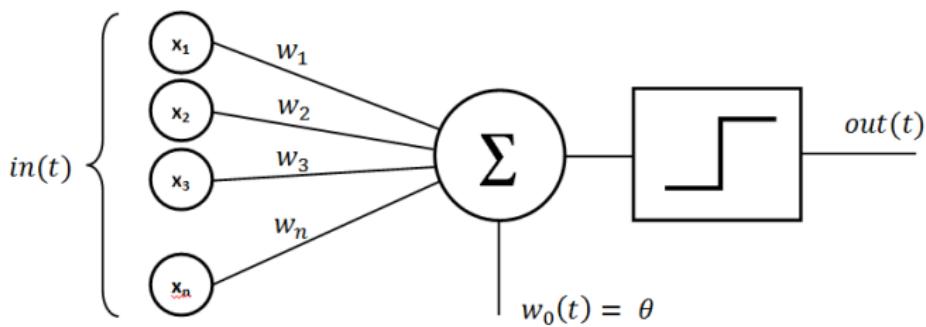


Figure: [Rosenblatt-1958]



$$\Sigma := w_0 + w_1 x_1 + w_2 x_2 + \dots + w_n x_n \quad (1)$$



$$out(t) := \sigma(\Sigma); \quad \sigma(x) = \frac{1}{1 + e^{-x}} \quad (2)$$

Does this Chest Xray Image show presence of COVID-19?

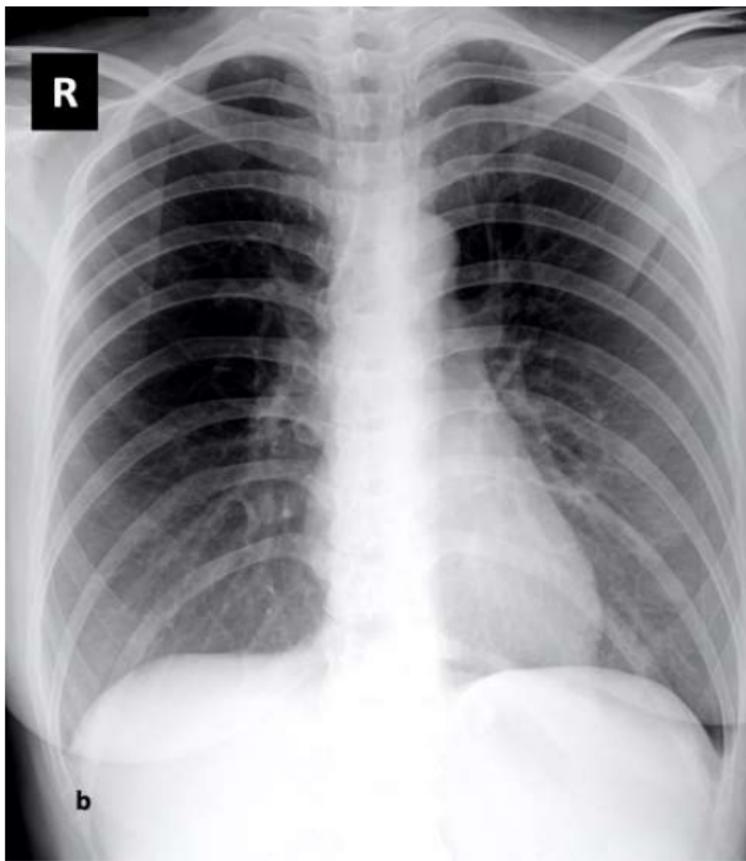


Figure: Chest Xray Image of a COVID-19 Positive patient.

# Power of Feature Engineering

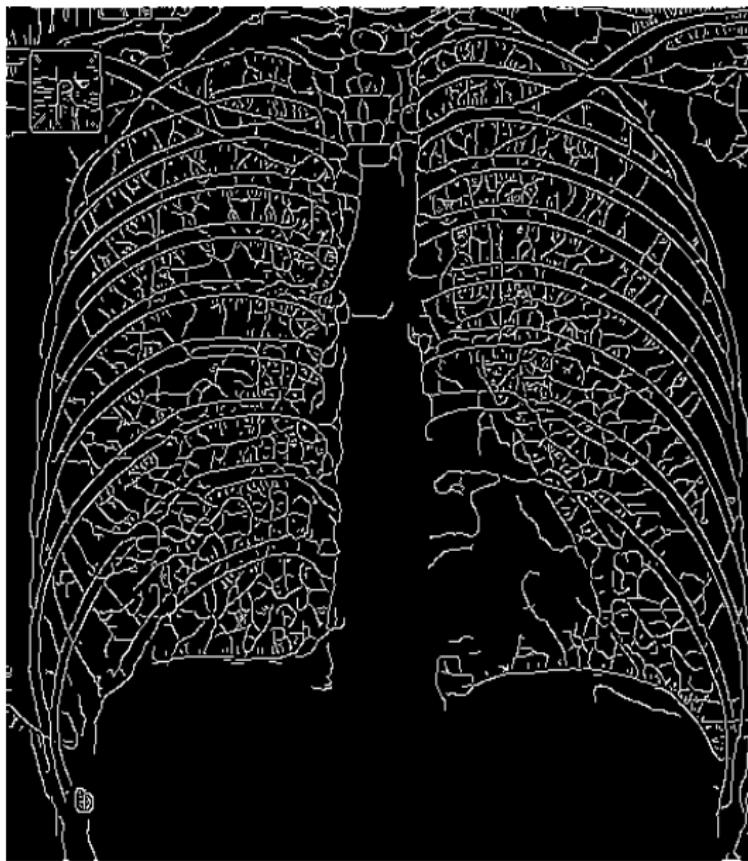


Figure: using [EPFL Biomedical Imaging Group's Ridge Detector]

# References

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