# Covid 19-Xray Image Segmentation Using Thresholding And K-Means Clustering

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Medical Image Analysis

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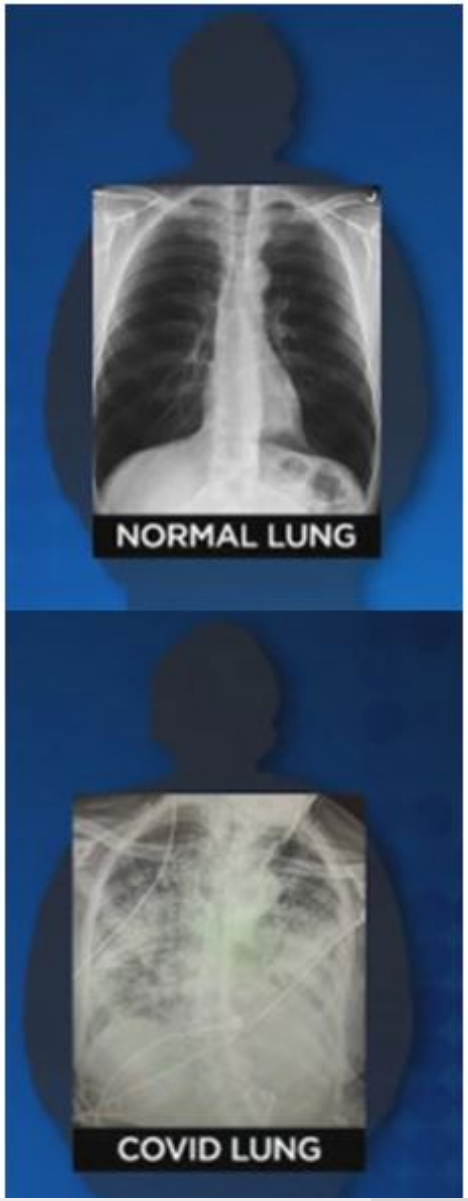
# Outline

# Introduction

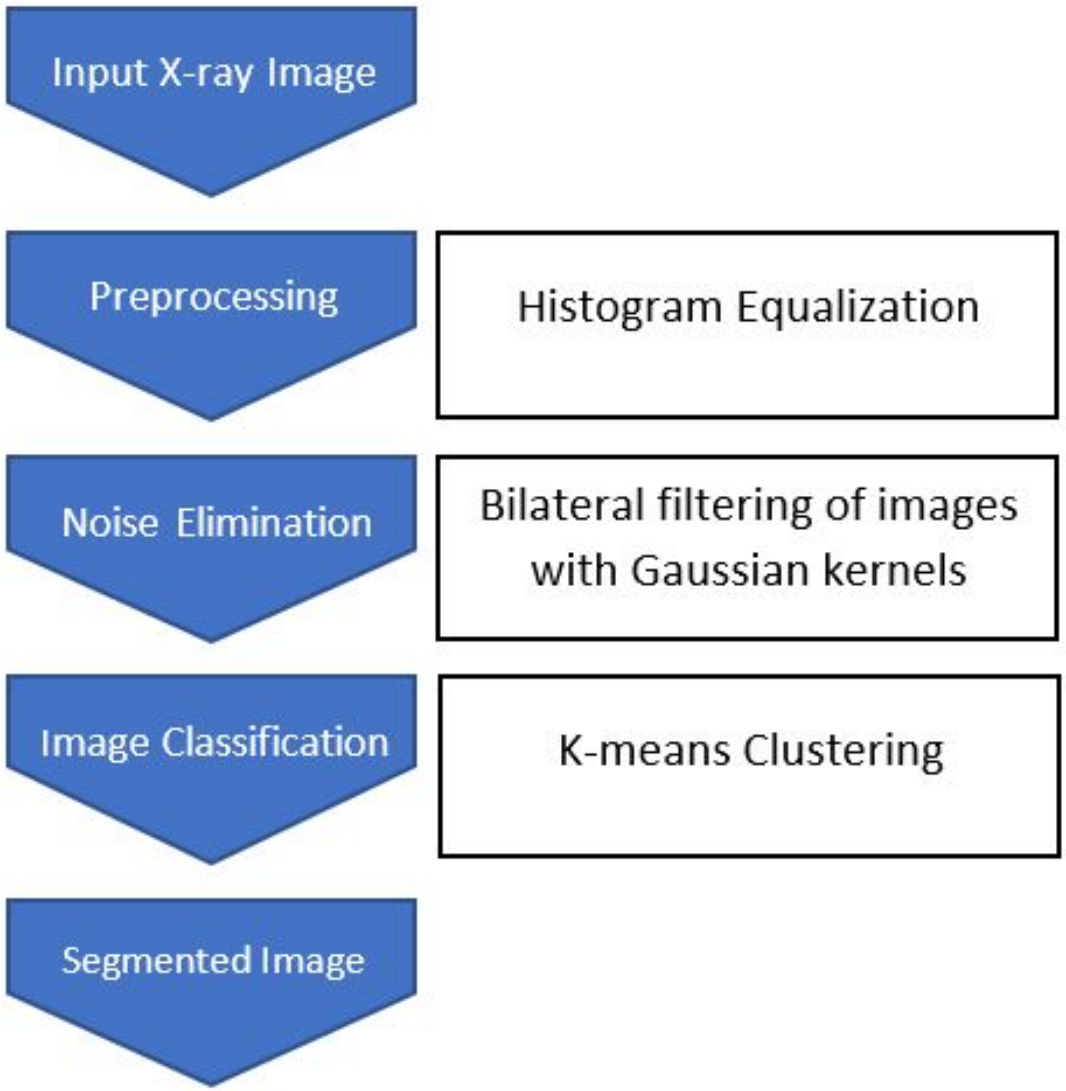
- The novel coronavirus disease 2019 (COVID-19) constitutes a public health emergency globally and causes severe inflammation in your lungs.
- Chest X-ray is among the most commonly used imaging modalities to identify COVID-19 infections and other various pulmonary diseases due to its low radiation, free of side effects, economic feasibility.
- Extraction of lung areas from the X-rays by accurately detecting lung boundaries is an important step, especially in determining whether the lung is normal or abnormal.



# Primary goal

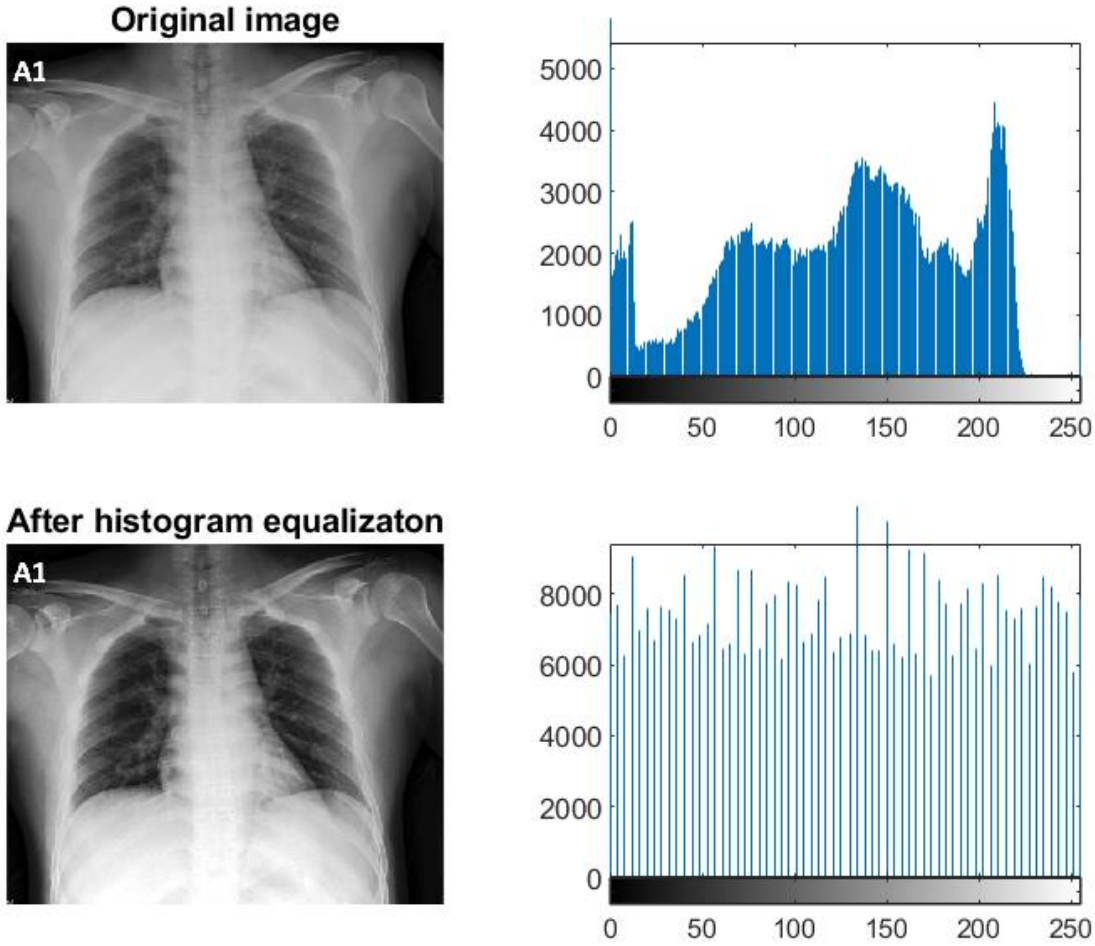
- This project proposes two unsupervised learning method for lung segmentation of COVID 19 patients based on thresholding and k means clustering.
- This computational procedures for image preparation can be used for further analysis by medical specialists.
- Three-stage computational procedure includes
  - **Pre processing** - X-ray images are typically low resolution, and the pixel intensity distribution can have wide verities due to patients age and configuration of X-ray capturing devise. Therefore, image pre processing will be carried out to improve the quality of the image and enhance significant areas.
  - **Noise elimination** - Noise elimination techniques are used to eliminate noise occurred in the pre processing steps and initial steps by preserving the details of image.
  - **Classification** - Proposed two classification methods local threshold method and k-means clustering method.

# Method Based on K means Clustering



# Image Preprocessing Using Histogram Equalization

- Histogram equalization is a method to adjust the contrast of an image by modifying the intensity distribution of the histogram.



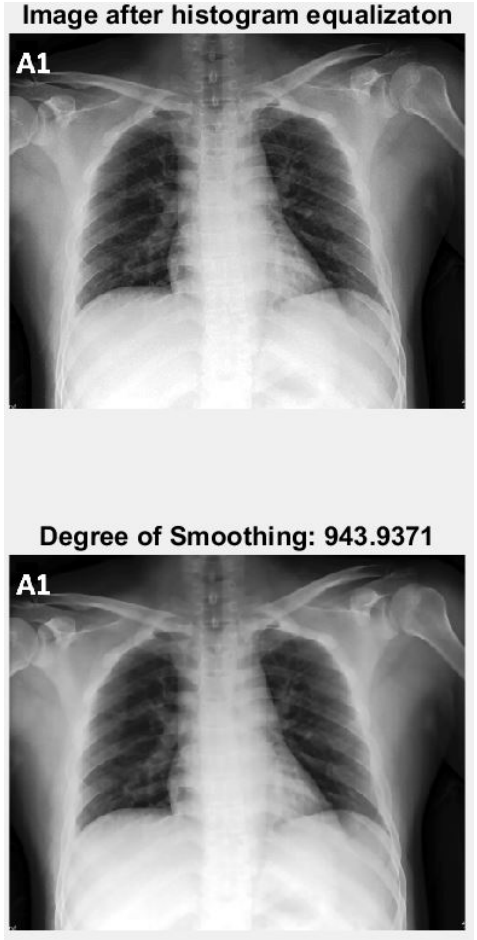
# Noise Elimination Using Bilateral filtering

## Gaussian filtering

2-D convolution operator that is used to 'blur' images and remove detail and noise. The Gaussian outputs a 'weighted average' of each pixel's neighborhood, with the average weighted more towards the value of the central pixels.

## Bilateral filtering

The bilateral filter is also defined as a weighted average of nearby pixels, in a manner very similar to Gaussian convolution. The difference is that the bilateral filter takes into account the difference in value with the neighbors to preserve edges while smoothing.

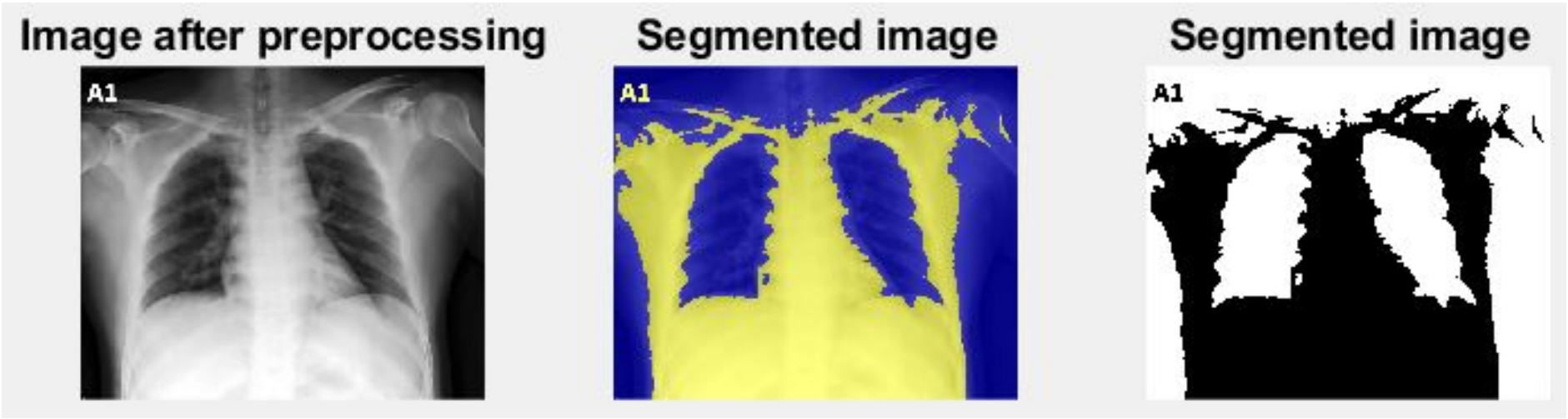


# K Means Clustering For Image segmentation

The K-means algorithm clusters data by trying to separate pixels in 2 groups of equal variance, minimizing within-cluster sum-of-squares.

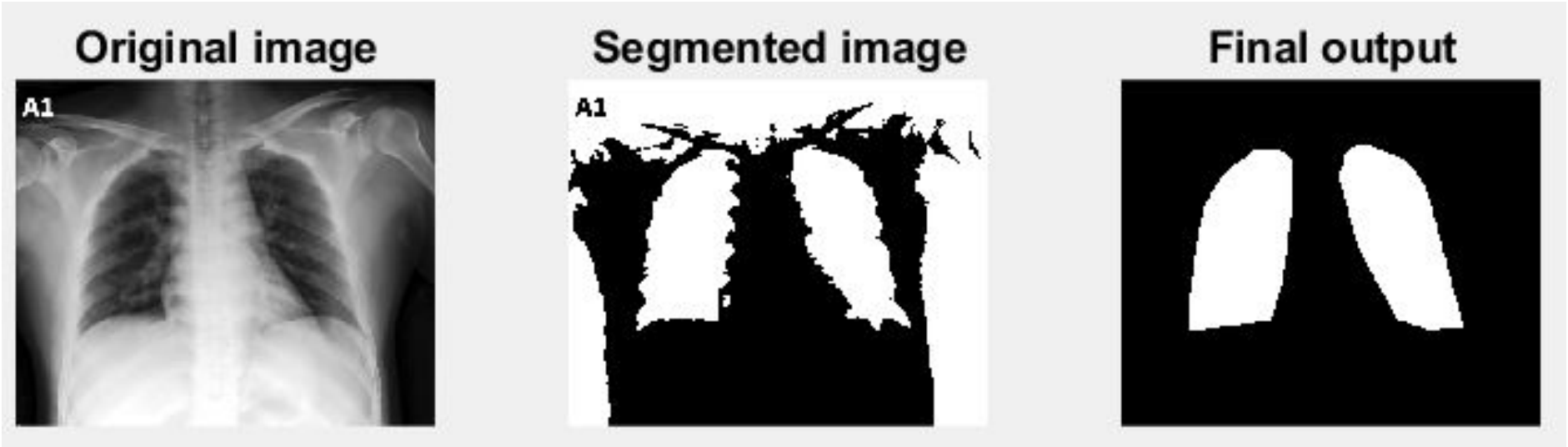
**Algorithm**

- Randomly assign objects to 2 nonempty initial partitions
- Compute the centroids of the clusters of current partitioning
- Assign each object to the cluster with nearest centroid
- Repeat step 2 and 3, Stop when the assignment does not change



# Convex Hull For Border Detection

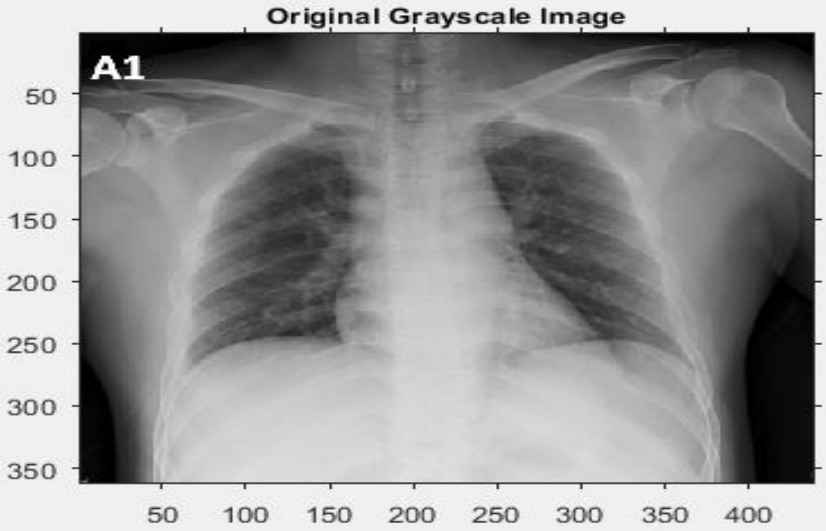
- Convex hull (CH) is basically an important geometrical problem that could be solved computationally. The problem is all about constructing, developing, articulating, circumscribing or encompassing a given set of points in plane by a polygonal capsule called convex polygon.
- This algorithm search the border points, and help to determine an outline of the lung's boundaries.

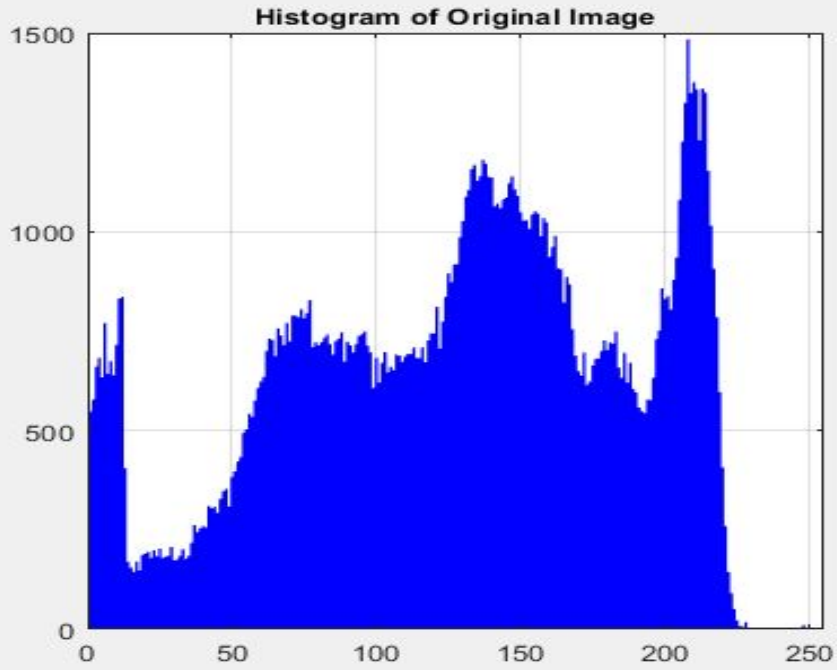


# Method Based On Thresholding

## Pre-processig

- Images are converted from RGB to gray scale.



# Thresholding Using Otsu's Method (Contd.)

- Classify the pixel into two classes, $C_1$ and $C_2$ by a threshold at level $T$.
- The optimal T minimizes the within class variance $\sigma_W^2$, or equivalently, maximize the between class variance $\sigma_B^2$, where $\sigma_W^2$ and $\sigma_B^2$ defined as

$$\sigma_W^2 = w_1\sigma_1^2 + w_2\sigma_2^2$$

$$\sigma_B^2 = w_1(\mu_1 - \mu_L)^2 + w_2(\mu_2 - \mu_L)^2 = w_1w_2(\mu_2 - \mu_1)^2$$

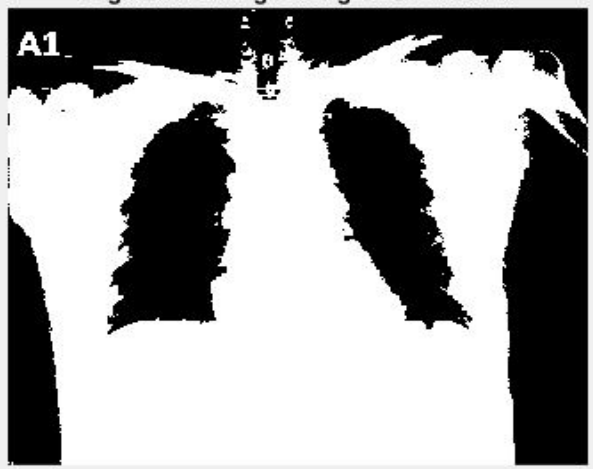
where $\sigma_1^2$ and $\sigma_2^2$ are class variances, $\mu_1$ and $\mu_2$ are class mean levels, and $w_1$ and $w_2$ are the probabilities of class occurrence.

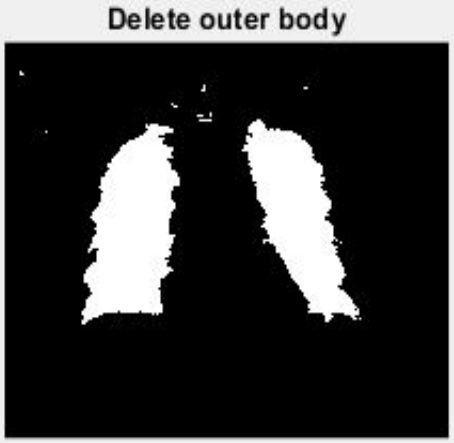
# Thresholding Using Otsu's Method (Contd.)

- If $J(x, y)$ be the thresholded version of the grey-level image $I(x, y)$ at threshold T,

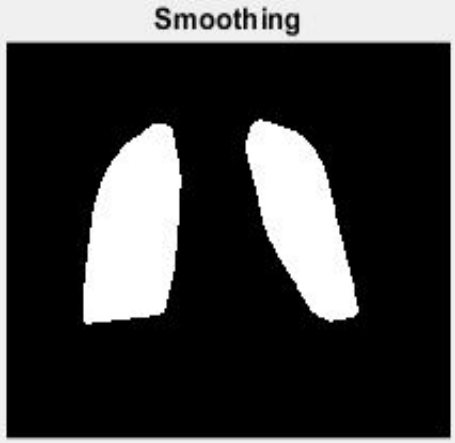
$$J(x,y) = \begin{cases} 1 & if \;\; I(x,y) > T \\ 0 & if \;\; I(x,y) \leq T \end{cases}$$

# Thresholding Using Otsu's Method (Contd.)





# Discussion

- This project proposes two unsupervised learning method for lung segmentation of COVID 19 patients based on thresholding and k means clustering.
- Obtained segmented X-ray image will be helpful in the medical diagnosis by medical specialists
- Method is incapable of extracting lung region associated with heart from the X-ray image.

# References


- Aleksandr Zotin, Yousif Hamad, Konstantin Simonov, Mikhail Kurako (2019) "Lung boundary detection for chest X-ray images classification based on GLCM and probabilistic neural networks", *Procedia Computer Science*,Vol. 159, pp 1439-1448,
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