## Requirements

- Machine Learning Understanding
- Python 3.5+
- Python libraries : Scikit Learn, Pandas, Numpy, OpenCV, Skimage, Matplotlib

# 1 Introduction

This is the final project for the ML Course. This is a 10 mark project. The aim of the project is to use K Means Clustering to perform image segmentation.

# 2 Description

## 2.1 Image Segmentation

Image segmentation is the process of partitioning an image into meaningful segments/partitions.The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. Pixels in each partition share same properties.

## 2.2 K Means Clustering for segmentation

K means clustering acts like a partitioning algorithm. The same ideology can be applied images. The simple explanation of steps are:

- Randomly select k pixels to be cluster centers
- For each pixel in the data set, associate it with the cluster which has its center closest to the pixel.
- Calculate new cluster centers by averaging all pixels in a cluster
- Repeat second and third step for a particular number of iterations

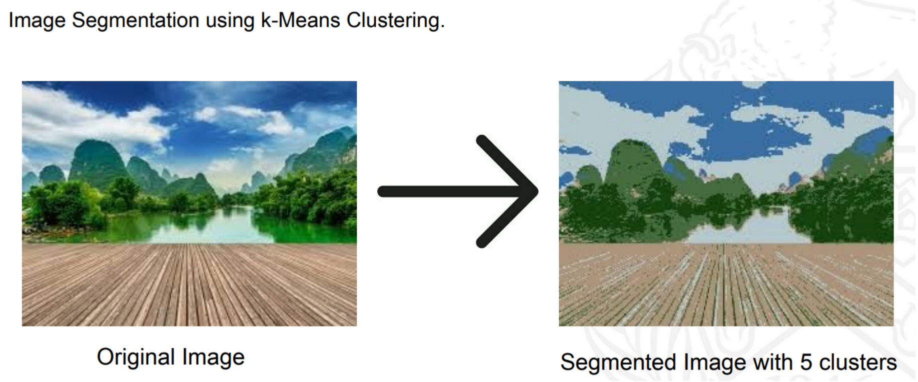


Image Segmentation using k-Means Clustering.
Original Image
Segmented Image with 5 clusters

Figure 1: Example of K Means clustering

Image credit to Sneha Panicker's PPT SUNY Buffalo

# 3 Problem Statement

This project is one where you will implement K Means clustering from scratch and use it to perform image segmentation. The K Means Class in python should be written from **scratch**. Scikit Learn based KMeans or OpenCV based Kmeans modules can be used for testing purposes only, i.e, to see how the output actually should turn up to be.

### 3.1 The KMeans Clustering Class

This subsection describes the functions in the KMeans Clustering class.

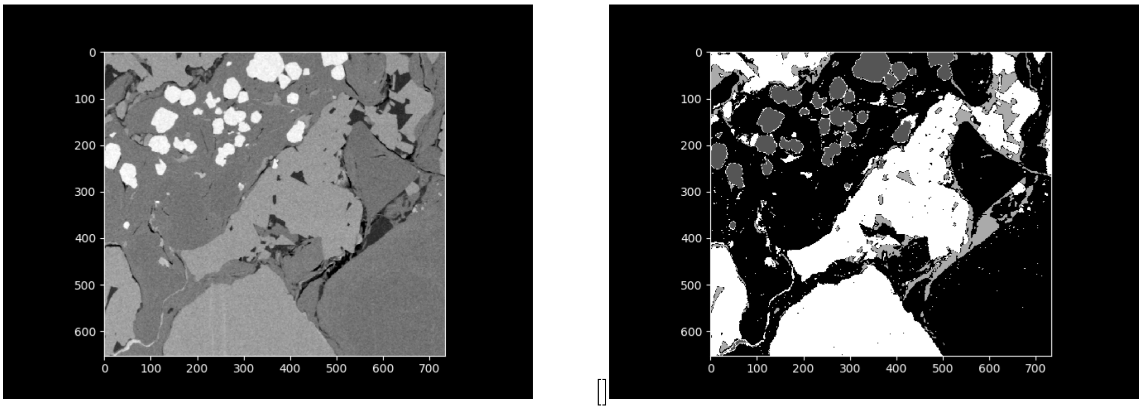
**NOTE : IT IS NOT NECESSARY TO USE THE CLASS DEFINITION AND DEFINE THE SAME FUNCTIONS AS BELOW. THIS SERVES JUST AS AN UNDERSTANDING POINT TO PLAN YOUR CLASS DEFINTION**

The functions inside the KMeans Clustering class are described as below:

```
class KMeansClustering:

    # X : Input Data array/ Dataset
    # Define a max_iterations
    # Define number of examples and features from X

    # Intialize the __init__ function
    def __init__(self, X, num_clusters):

    # Initialize the random centroids
    def initialize_random_centroids(self, X):

    # Create clusters and  use euclidean distance with the centroids
    def create_clusters(self, X, centroids):

    # Calculate new centroids by looping and taking average to find new centroids
    def calculate_new_centroids(self, clusters, X):

    #Predict new clusters
    def predict_cluster(self, clusters, X):

    # Plotting figure
    def plot_fig(self, X, y):

    # Putting it all together to fit it for the data
    def fit(self, X):
```

### 3.2 Applying to image

Once the above class has been defined, you will use it to segment images. The example below is a .tif medical image. You can use OpenCV or skimage IO to load the image.You will then use the class and segment the image. You can use any image for segmentation.
**Clue : Please note the shape of the array which is built from the image. Some reshaping may be required and changes to be applied on the original image may be required.**



[] []

Figure 2: Input Image and Output Segmented Image

### 3.3 Extras

Finding the right K value is an important process. It can be done using ”Elbow method”. You can try finding the right K value for your image. It is also useful to observe the clarity in segmentation as k values and the number of clusters increase.

## 4 Report

A simple report containing the following can be submitted:

- Name, SRN, Section
- Code : Direct python or jupyter notebook screenshots
- Results: Original and Segmented Image
- What you observed as K changes. Image outputs with different K values and cluster values will be appreciated.

## 5 Contact for Doubts:

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