# assignment03

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## 1 This script demonstrates K-means algorithm

## 2 Name : Ji-Su Lee

## 3 Student ID : 20141718

## 4 github link : https://github.com/Jisu-Lee/HII/tree/master/assignment03

## 5 import packages for plotting graphs and manipulating data:

```
In [11]: import numpy as np
         import matplotlib.pyplot as plt
         import random
         import matplotlib.cm as cm
```

## 6 define function to generate random point cluster

```
In [12]: def generatePointCluster(nCluster, nPoint):
             a = np.random.rand(2, nCluster * nPoint)
             for i in range(nCluster):
                 x_m = np.mean(a[0][i*nPoint:(i+1)*nPoint])
                 y_m = np.mean(a[1][i*nPoint:(i+1)*nPoint])
                 x_c = np.random.rand()*500 - 250
                 y_c = np.random.rand()*500 - 250
                 for j in range(i*nPoint, (i+1)*nPoint):
                     a[0][j] = (a[0][j] - x_m)*100 + x_c
                     a[1][j] = (a[1][j] - y_m)*100 + y_c
             return a
```

## 7 define function to compute distance between two points

```
In [13]: def computeDistance(x1, y1, x2, y2):
             dsquare = np.square(x2-x1) + np.square(y2-y1)
             return np.sqrt(dsquare)
```

## 8 function to make distance list

```
In [14]: def makeDistList(nCluster, pointList, cenList):
             distList = []
             for i in range(len(pointList[0])):
                 cenDist = []
                 for j in range(nCluster):
                     cenDist.append(computeDistance(pointList[0][i], pointList[1][i], \
                                                    cenList[j][0], cenList[j][1]))
                 distList.append(cenDist)
             return distList
```

## 9 define function to initialise label

```
In [15]: def initialiseLabel(nCluster, nPoint):
             a = []
             for i in range(nCluster*nPoint):
                 a.append(random.randint(1, nCluster)-1)

             return a
```

## 10 define function to compute centroid

```
In [16]: def computeCentroid(nCluster, nPoint, pointList, labelList):
             a = []
             res = []
             #initialise list [sum_x, sum_y, num]
             for i in range(nCluster):
                 a.append([0, 0, 0])
             for i in range(nCluster*nPoint):
                 a[labelList[i]][2] += 1
                 a[labelList[i]][0] += pointList[0][i]
                 a[labelList[i]][1] += pointList[1][i]
             # get centroid by calculating mean value
             for i in range(nCluster):
                 if(a[i][2] == 0):
                     res.append([np.random.rand()*500 - 250, np.random.rand()*500 - 250])
                 else:
                     res.append([a[i][0]/float(a[i][2]), a[i][1]/float(a[i][2])])

             return res
```

## 11 define fuction to assign label

```
In [17]: def assignLabel(nAllPoints, distList):
             res = []
             for i in range(nAllPoints):
                 res.append(0)
             for i in range(nAllPoints):
                 res[i] = distList[i].index(np.amin(distList[i]))
             return res
```

## 12 define function to compute energy

```
In [18]:  # param : number of all points, list of points, list of centroid for each clusters,
          # list of label for each points
         def computeEnergy(nAllPoints, pointList, cenList, labelList):
             energy = 0
             for i in range(nAllPoints):
                 energy += np.square(computeDistance(pointList[0][i], pointList[1][i], \
                                                     cenList[labelList[i]][0], \
                                                     cenList[labelList[i]][1]))
             energy = float(energy)/nAllPoints
             return energy
```

## 13 initial input : setting k and number of points

## 14 k = 3

## 15 number of points = 100

```
In [45]: nCluster = 3
         nPoints = 100
         nAllPoints = nCluster*nPoints
         psPointList = generatePointCluster(nCluster, nPoints)
         label_0 = initialiseLabel(nCluster, nPoints)
```

## 16 setting color array to visualize labels

```
In [46]: colors = ['b', 'g', 'r', 'c', 'm', 'y', 'k', 'w']
```

## 17 attempt 1 : show initial data, label and initial centroid

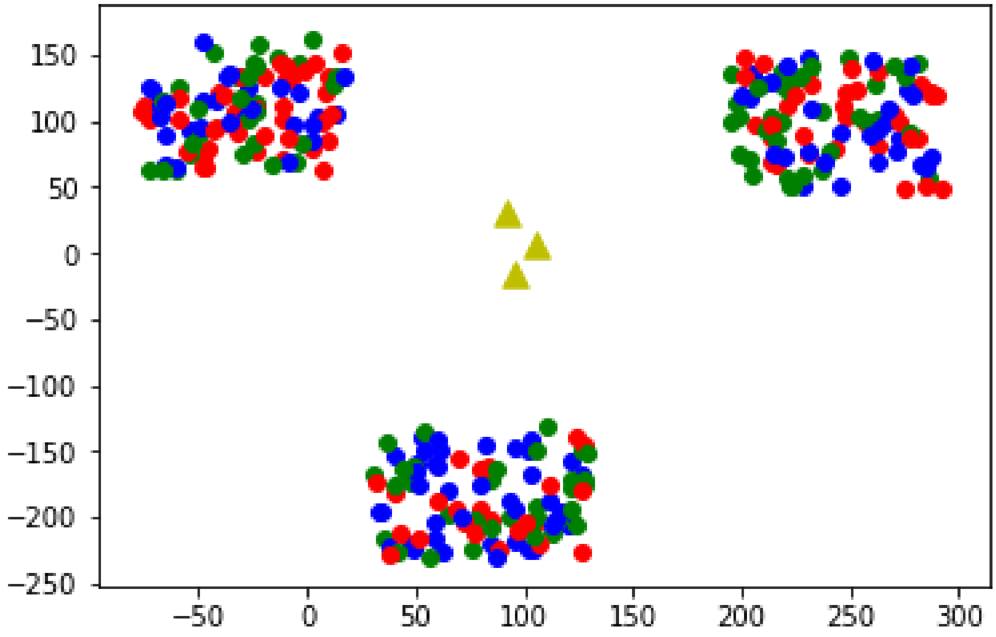
## 18 (centroid is shown as a yellow triangle)

## 19 graph shows random centroid and labels

```
In [47]: # compute centroid, distance, and energy
         cen_0 = computeCentroid(nCluster, nPoints, psPointList, label_0)
         dist_0 = makeDistList(nCluster, psPointList, cen_0)
         energy = computeEnergy(nAllPoints, psPointList, cen_0, label_0)
```

```
# shows energy
print("energy : ", energy)
# plotting graph
for j in range(nAllPoints): # visualize points
    plt.scatter(psPointList[0][j], psPointList[1][j], c=colors[label_0[j]])
for j in range(nCluster):   # visualize centroids
    plt.scatter(cen_0[j][0], cen_0[j][1], s=90, marker='^', c='y')
plt.show()
# update label
label_0 = assignLabel(nAllPoints, dist_0)
```

```
energy :  32273.195614681044
```

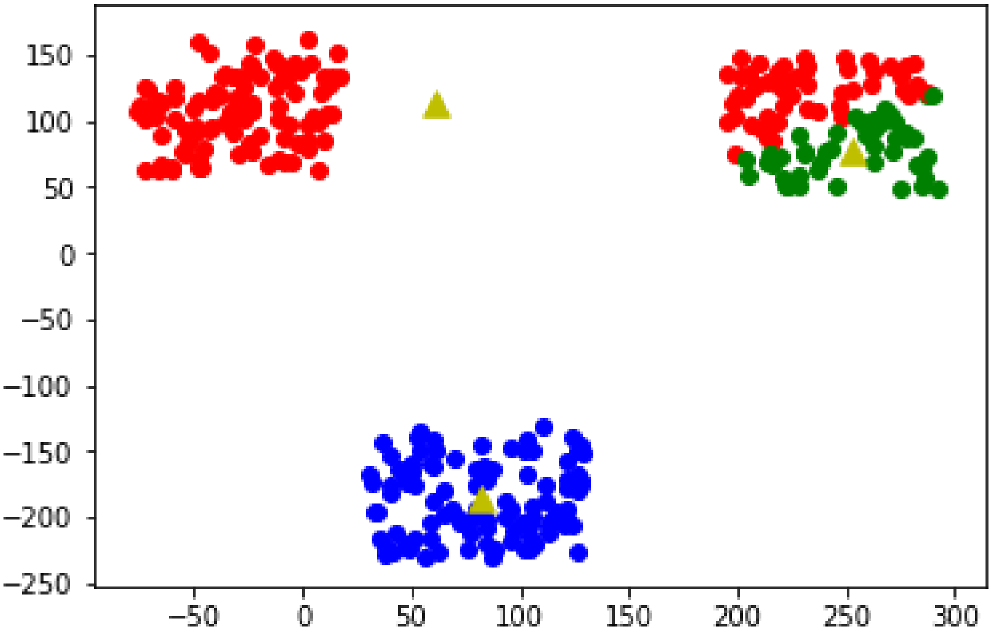


## 20 attempt 2 : left two clusters are finely distinguished, but the right top one is not clearly clustered

## 21 (code is skipped, because for each graph code is same as [47])

In [48]:

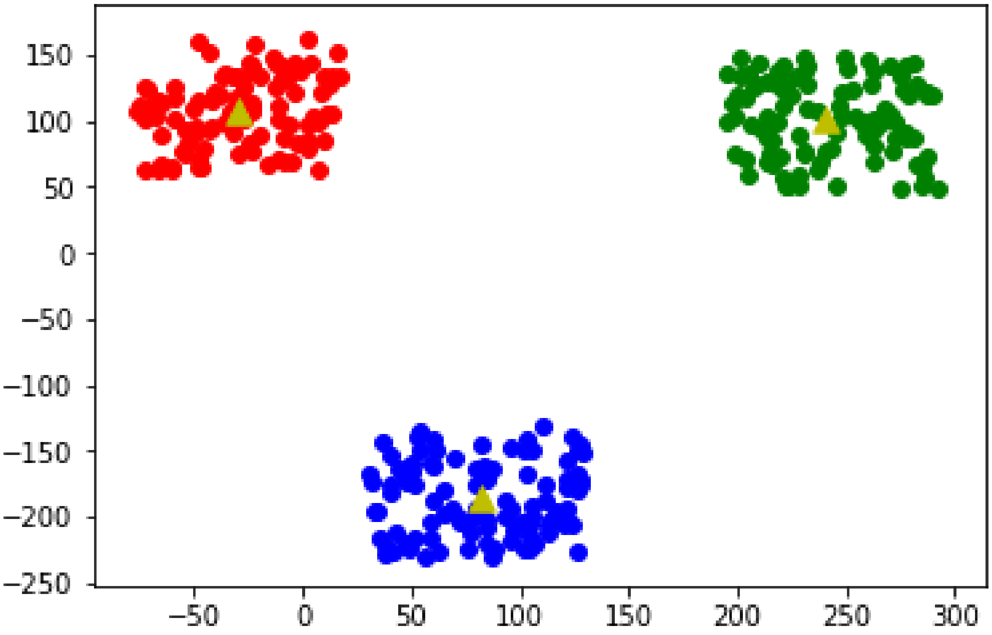
```
energy :  9174.813247798718
```



## 22 attempt 3 : clustering completed.

In [49]:

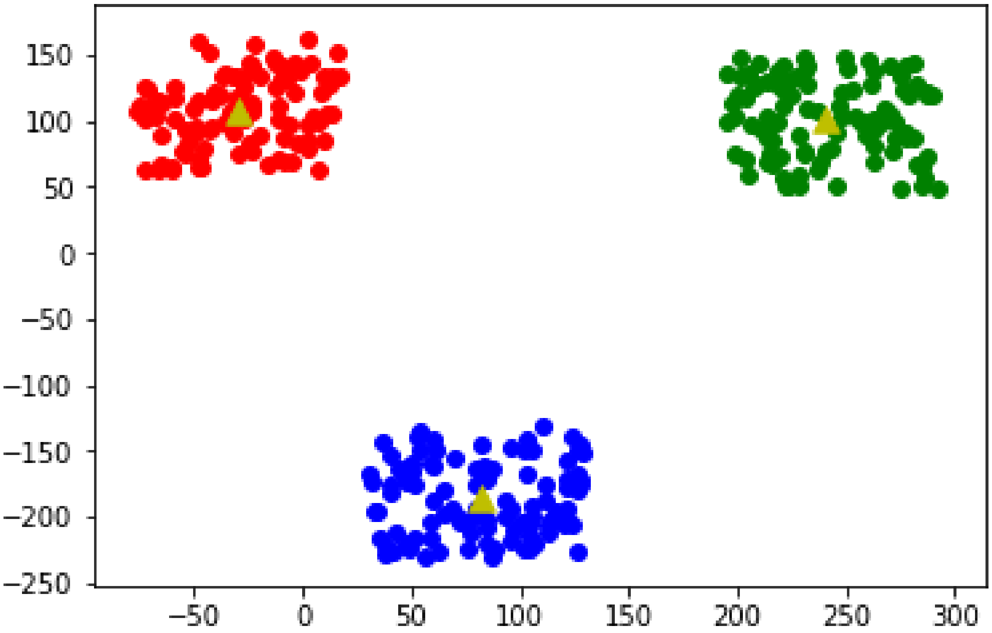
```
energy :  1563.5676942304583
```



## 23 attempt 4 : Energy converges to 1563.56

In [51]:

```
energy :  1563.5676942304583
```


150
100
50
0
−50
−100
−150
−200
−250
−50
0
50
100
150
200
250
300