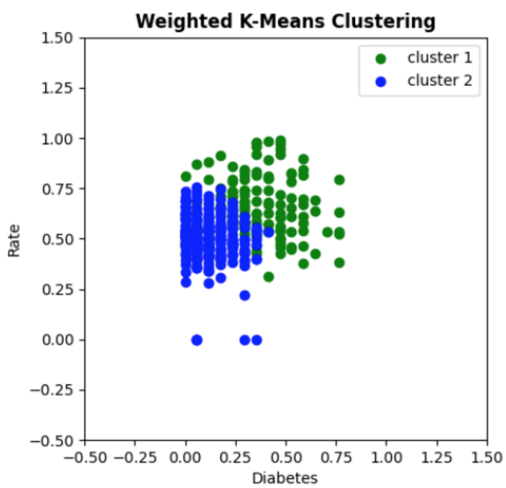
CS-4033
Roman Munoz
Dr. Chao, Lan

Homework 6

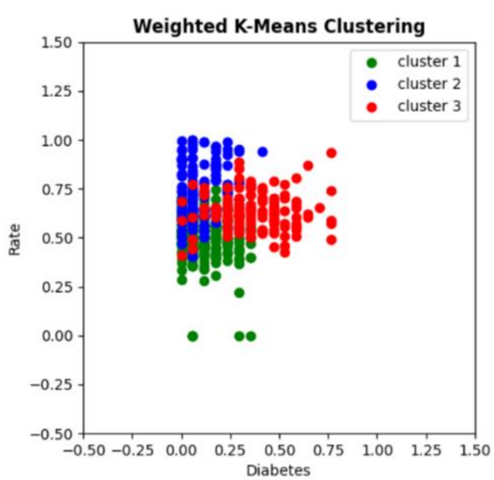
K-Means Clustering:

K=2, W=0.1



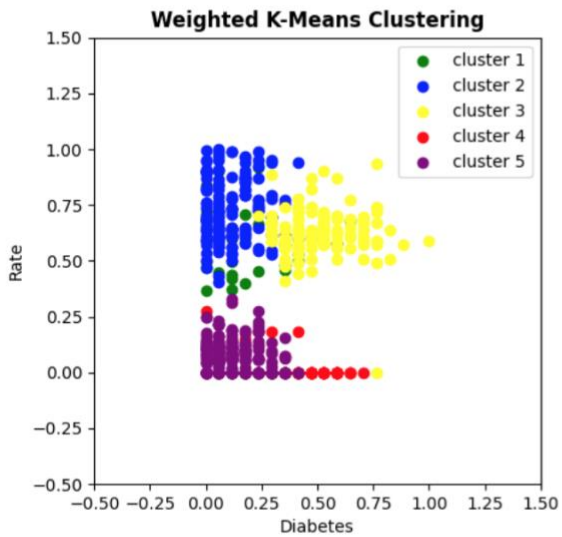
Random Index Predict: 0.9353494847852506
Davies-Bouldin Index Predict: 0.9556518456928808

K=3, W=0.1



Davies-Bouldin Index Predict: 0.9571097565104169
Random Index Predict: 0.9390463676253826

K=5, W=0.1



Davies-Bouldin Index Predict: 0.928053467686902
Random Index Predict: 0.9085862316645164

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1) $\min \sum_{i=1}^{n} \sum_{j=1}^{k} \mathbb{I}_{ij} w_i \| x_i - c_j \|^2$

$\mathbb{I}_{ij} = \begin{cases} 1 & \text{if } x_i \in c_j \\ 0 & \text{if } x_i \notin c_j \end{cases}$

w_i is a weight of instance x_i, and K is randomly initialized.

First we fix c_j and optimize $\mathbb{I}_{ij}$, and step X is not changed

$\forall i: \mathbb{I}_{i1} w_1 \| x_i - c_1 \|^2 + \mathbb{I}_{i2} w_2 \| x_i - c_2 \|^2 + \ldots + \mathbb{I}_{ik} w_k \| x_i - c_k \|^2$

Second we fix $\mathbb{I}_{ij}$ and optimized c_j.

$$\frac{\partial J(c_t)}{\partial c_t} = \frac{\partial}{c_t} \sum_{i=1}^{n} \mathbb{I}_{it} w_t \| x_i - c_t \|^2$$

$$= \sum_{i=1}^{n} \mathbb{I}_{it} w_t \cdot (x_i - c_t) \cdot 2(-1) = 0$$

thus,

$$c_t = \frac{1}{\sum_{i=1}^{n} \mathbb{I}_{it} \cdot w_t} \cdot \sum_{i=1}^{n} \mathbb{I}_{it} \cdot w_t \cdot x_i$$

In this final step we differentiated w.r.t. c_t, where c_t is a centroid, and w_t is the weight of instance x_i which remained unchanged during this last optimization.

-> Now we apply the algorithm until there is no change to the centroids is not changing. i.e assignment of data points to clusters is not changing.
Then assign different weights on X for optimal results.