Unsupervised Learning: K-Means Algorithm

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Group 3

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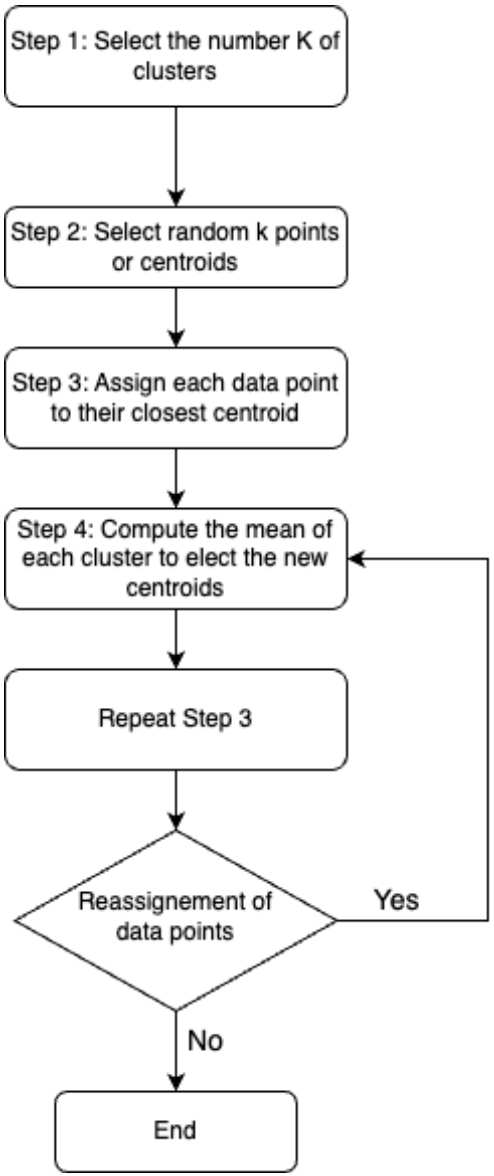
Introduction

Clustering is a technique that group simular objects such that the objects in the same group are more similar to each other.

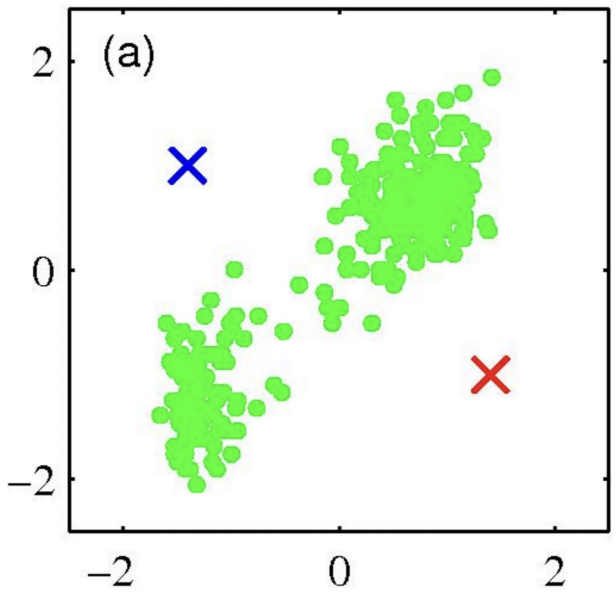
- Direct partitioning: we seek to partition the observations into a prespecified K number of clusters.
- Hierarchical clustering: we do not know in advance how many clusters we want.

How does K-Means works?

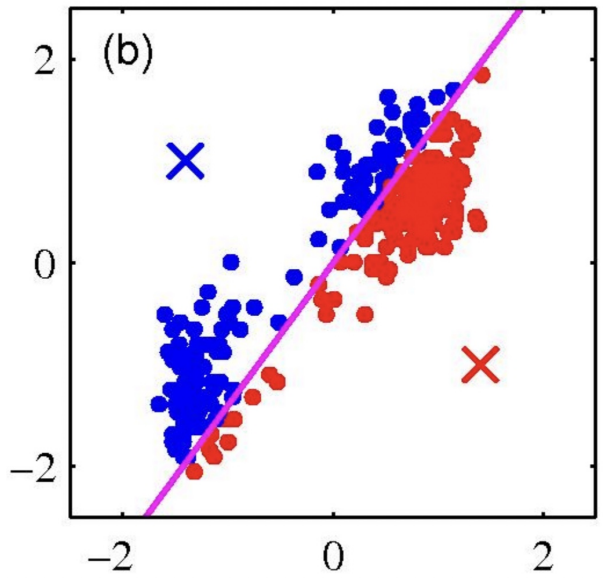


How K-Means works?

[a]

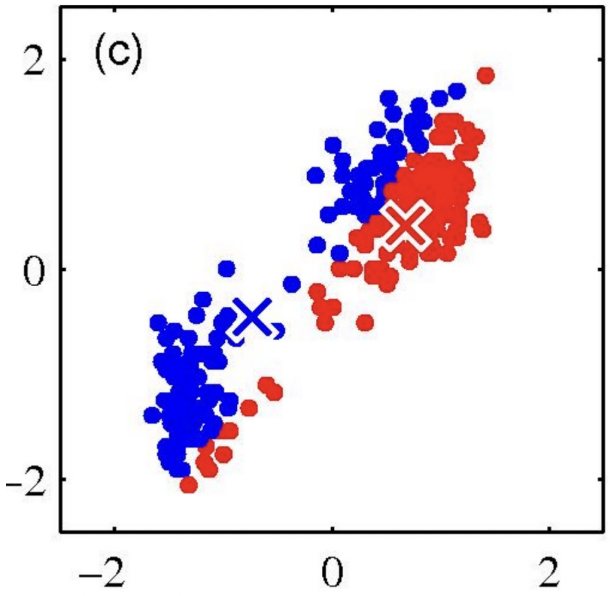


[b]

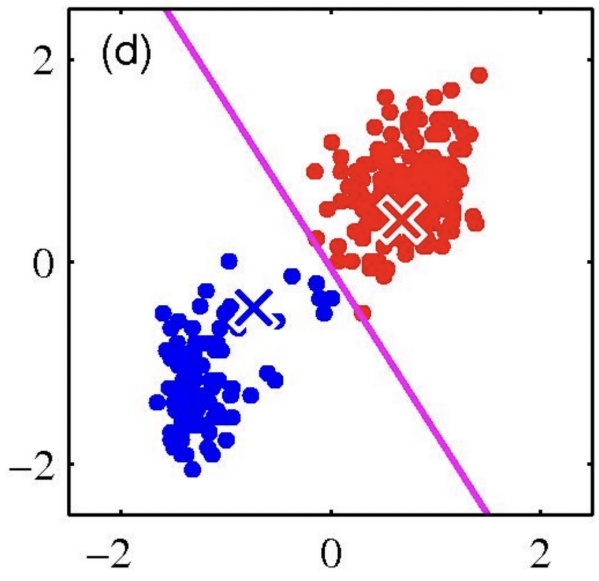


How does K-Means works?

[c]



[d]



Methods to choose the optimal number of clusters

- Elbow Method
- Silhouette analysis

The Elbow Method: Minimization of WCSS

The objective function is given by:

$$argmin_S \sum_{i=1}^{k} \sum_{x \in S_i} ||x - \mu_i||^2 \tag{1}$$

where $S = \{S_1, S_2, ..., S_k\}$,
μ_i is the centroid in the cluster i

Choose the number of clusters

The Silhouette Analysis

- We compute the silhouette coefficient for each data point.

$$S(i) = \frac{b(i) - a(i)}{max\{b(i), a(i)\}} \tag{2}$$

where $a(i)$ is the average distance between i and all other points in the same cluster as i.
$b(i)$ is the average distance from i to all clusters to which i does not belong

- For each value of k, we compute:

$$Average(silhouette)_k = mean\{S(i)\} \tag{3}$$

Pros and cons of K-Means Algorithm

Pros

- Linear time complexity and can be used with large datasets conveniently.
- Easy to implement
- Easy to interpret the clustering results

Cons

- Results will differ based on random centroid initialization.
- Sensitive to outliers
- Assume each cluster has roughly equal number of observations

Implementation

IMPLEMENTATION

Conclusion

- Powerful and widely-used clustering algorithm that can be used to group data into similar clusters.
- It works by iteratively optimizing the placement of k centroids that represent the center of each cluster.
- Sensitivity to initial cluster centroids and its assumption that clusters have a spherical shape.
- Customer segmentation
- Understand what the visitors of a website are trying to accomplish
- Pattern recognition
- Data compression

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THANKS

FOR

LISTENING