DICE
ANALYTICS

DATA SCIENCE & MACHINE LEARNING COURSE

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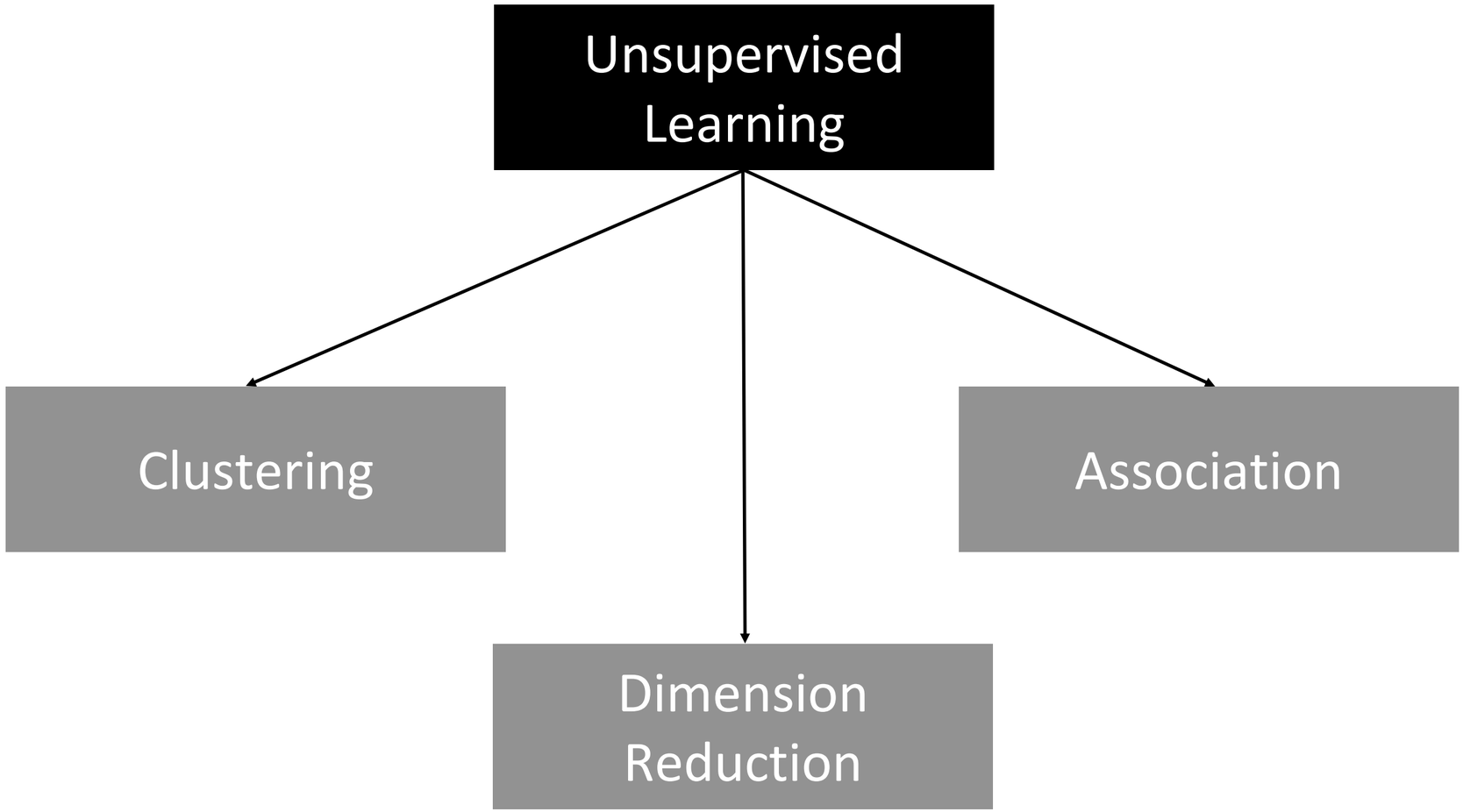
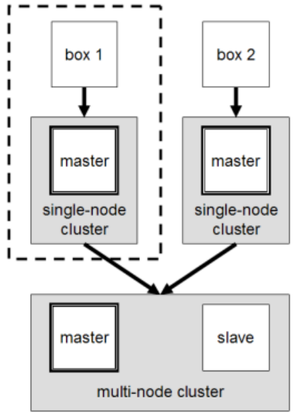
Unsupervised Learning

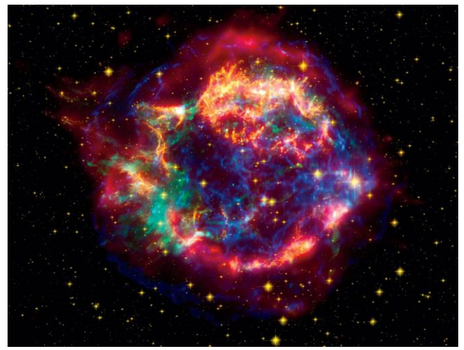
Types of Unsupervised Learning



Clustering

- Finding hidden groups in data.
- Algorithms : K-Means, DBSCAN, Hierarchical etc.
- Examples :
    1. Market Segmentation
    2. Social Network Analysis
    3. Organize Computing
    4. Astronomical Data Analysis





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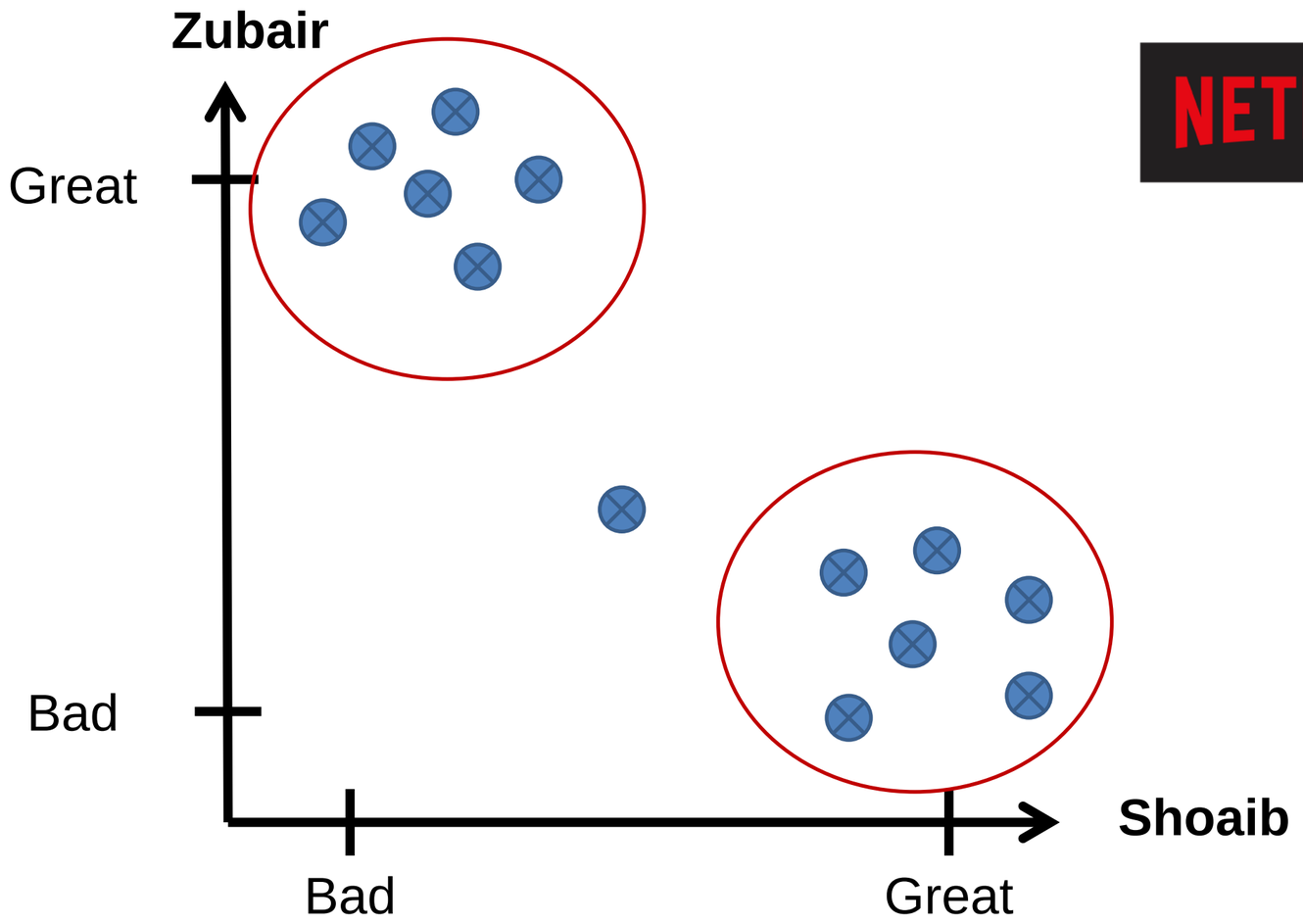
Clustering Movies Example



NETFLIX

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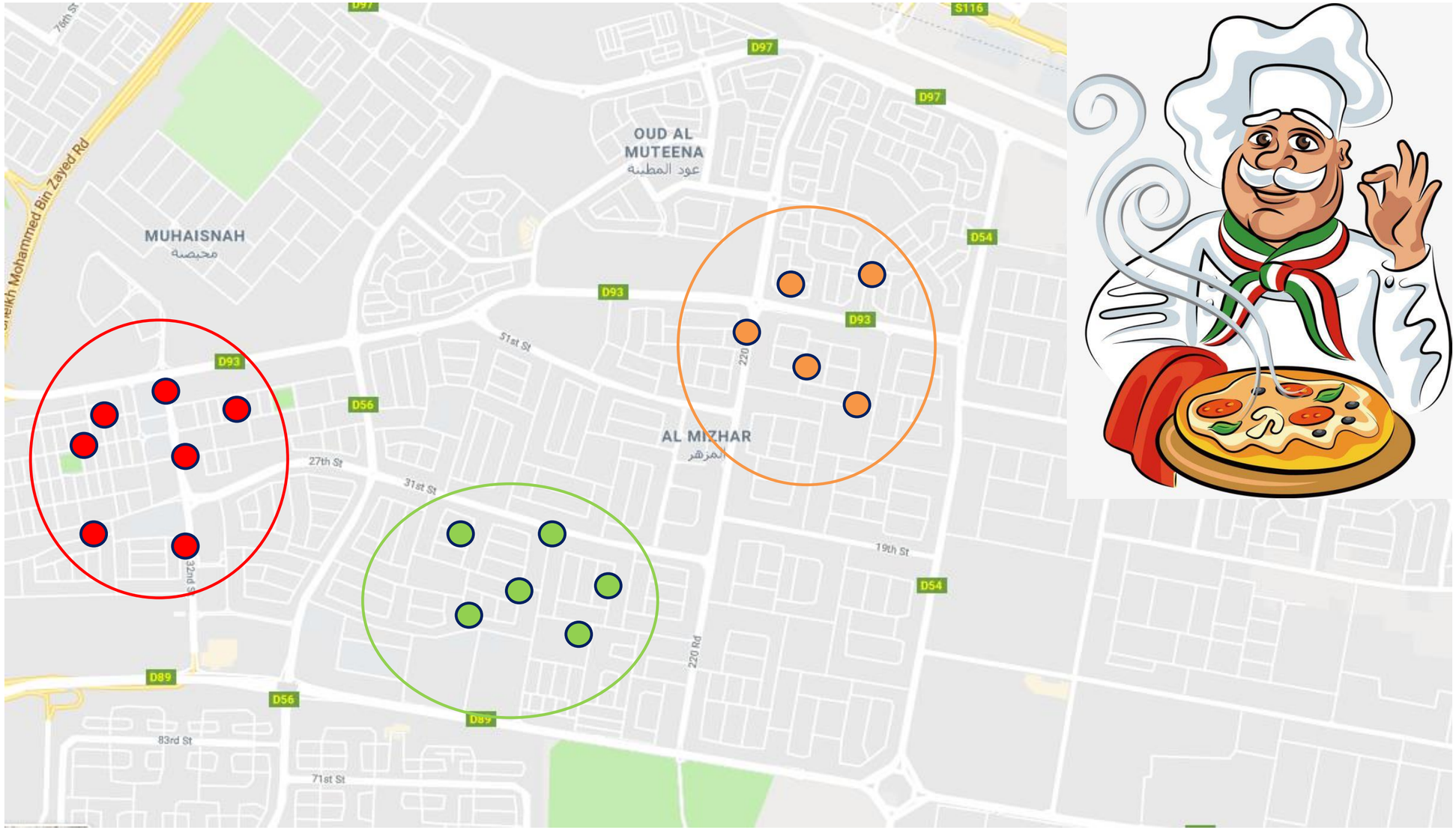

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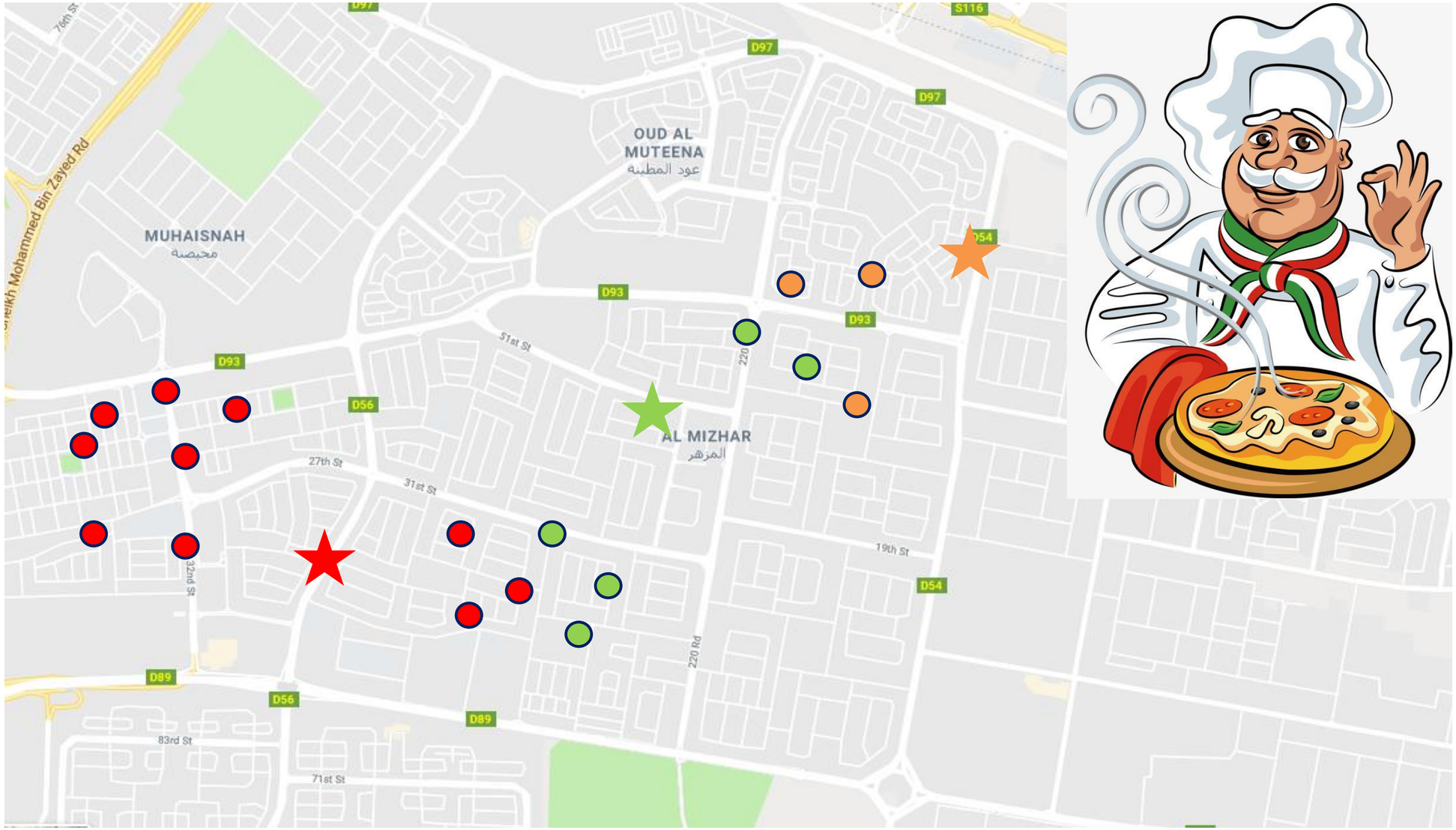

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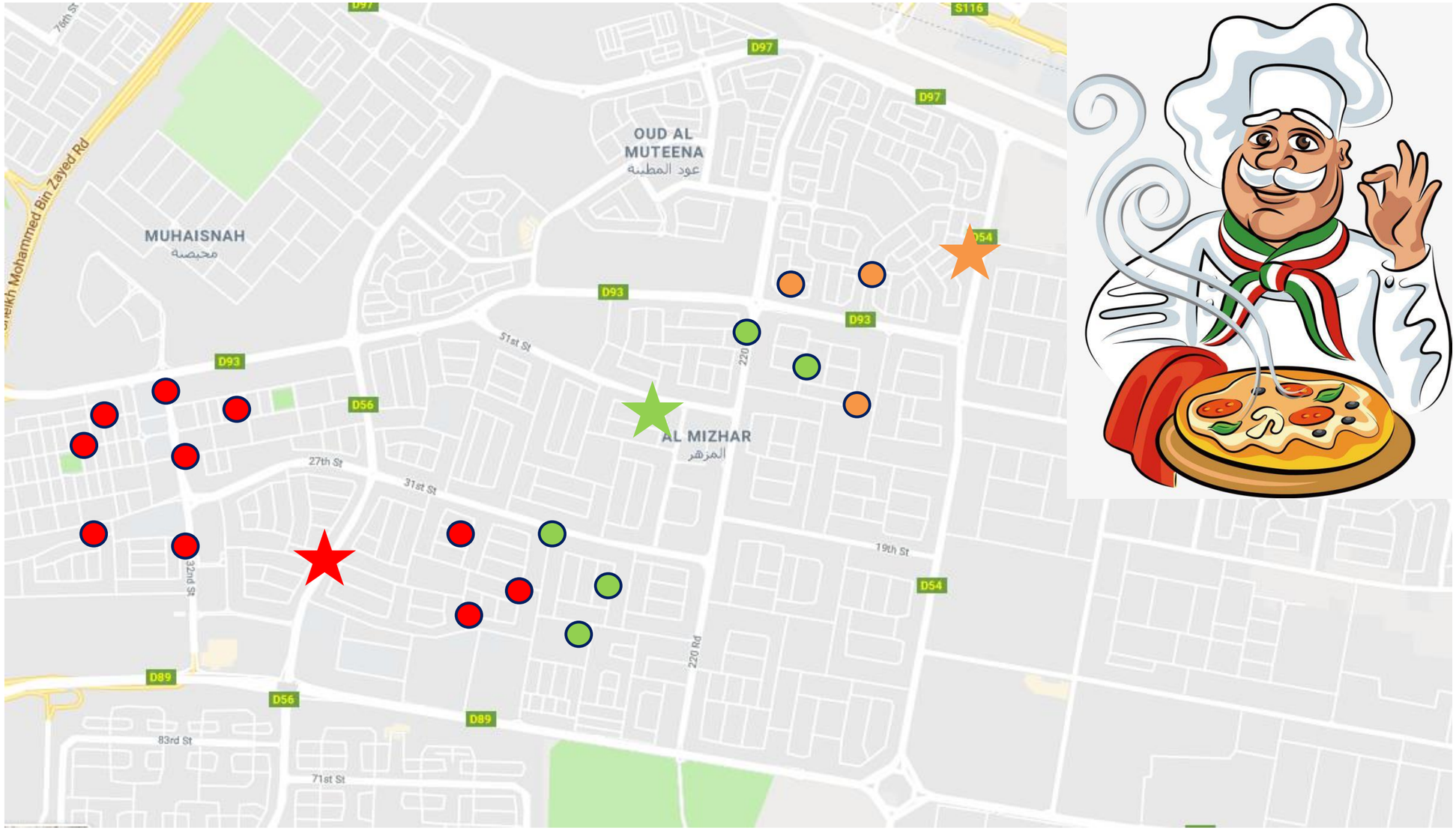

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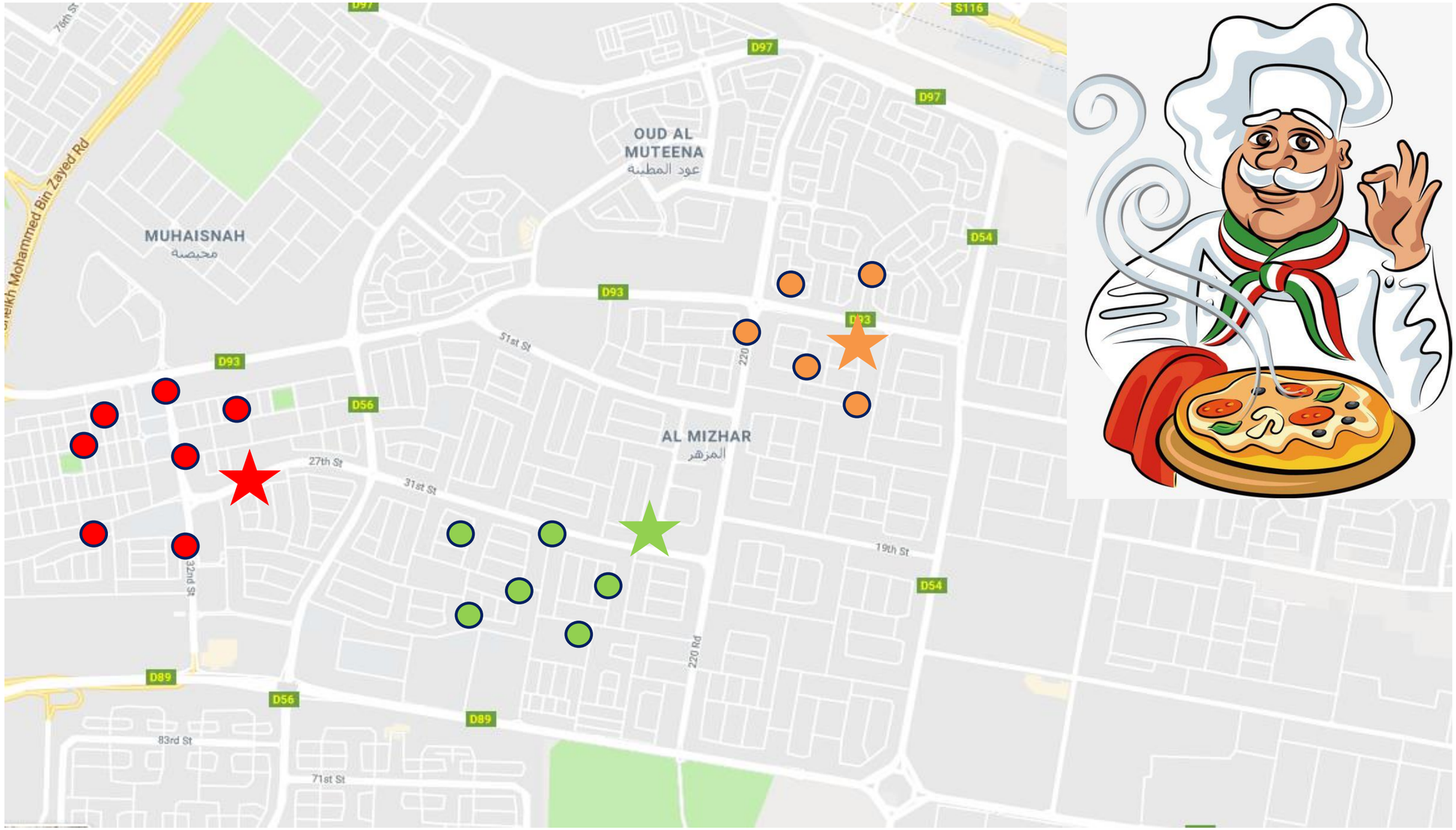
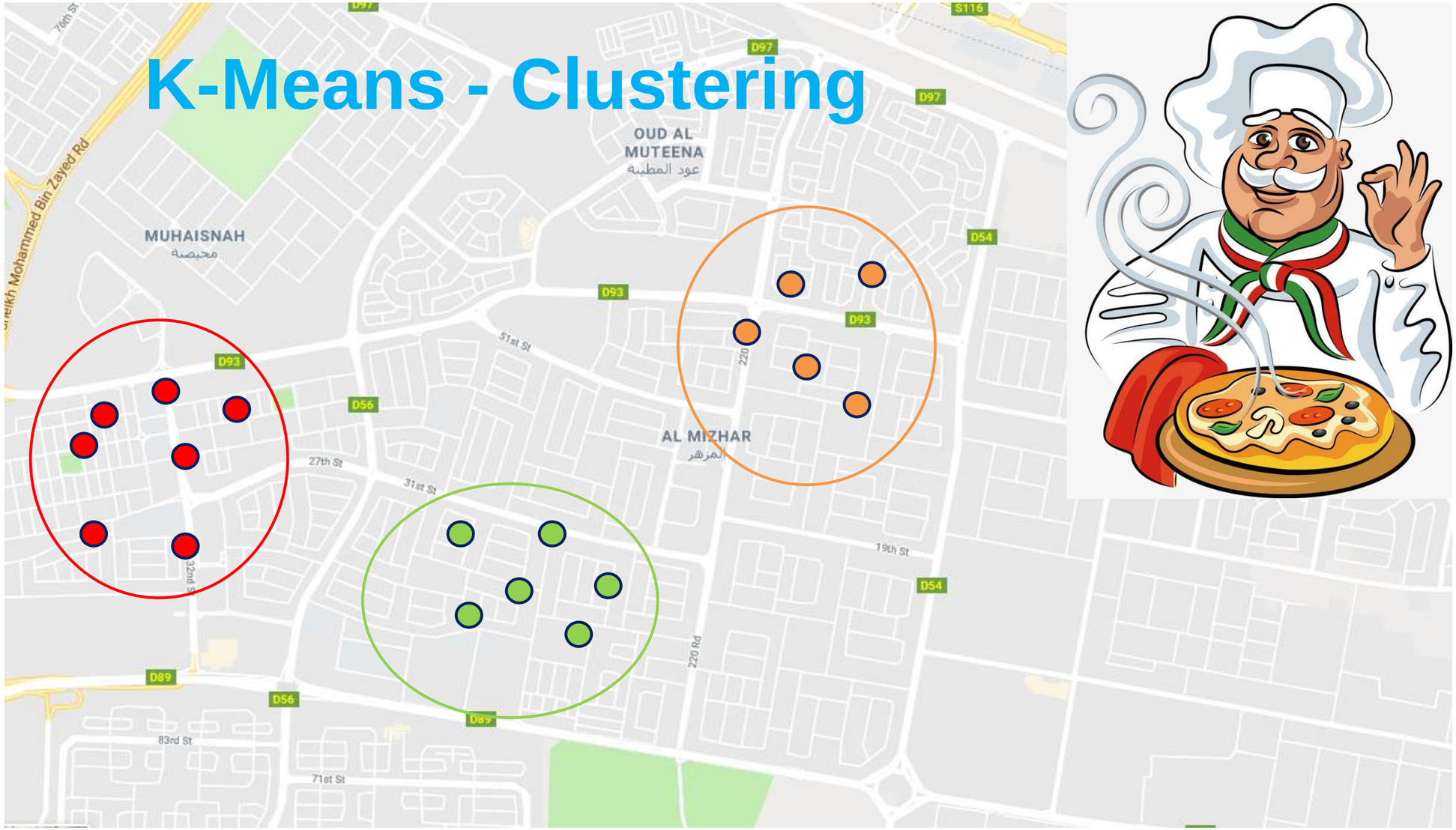


K-Means - Clustering



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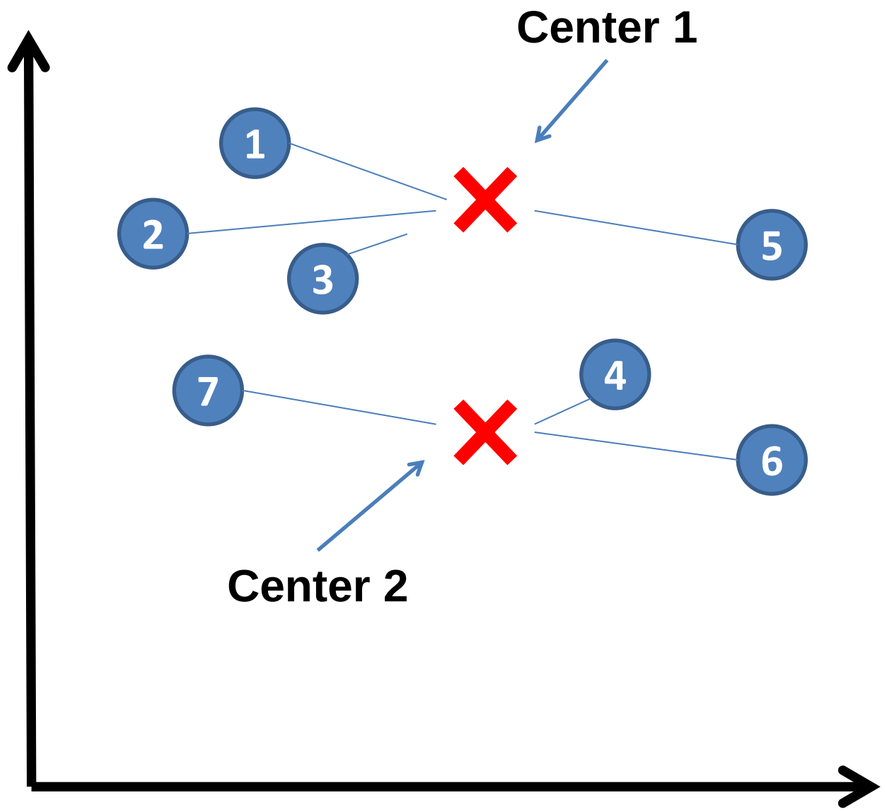
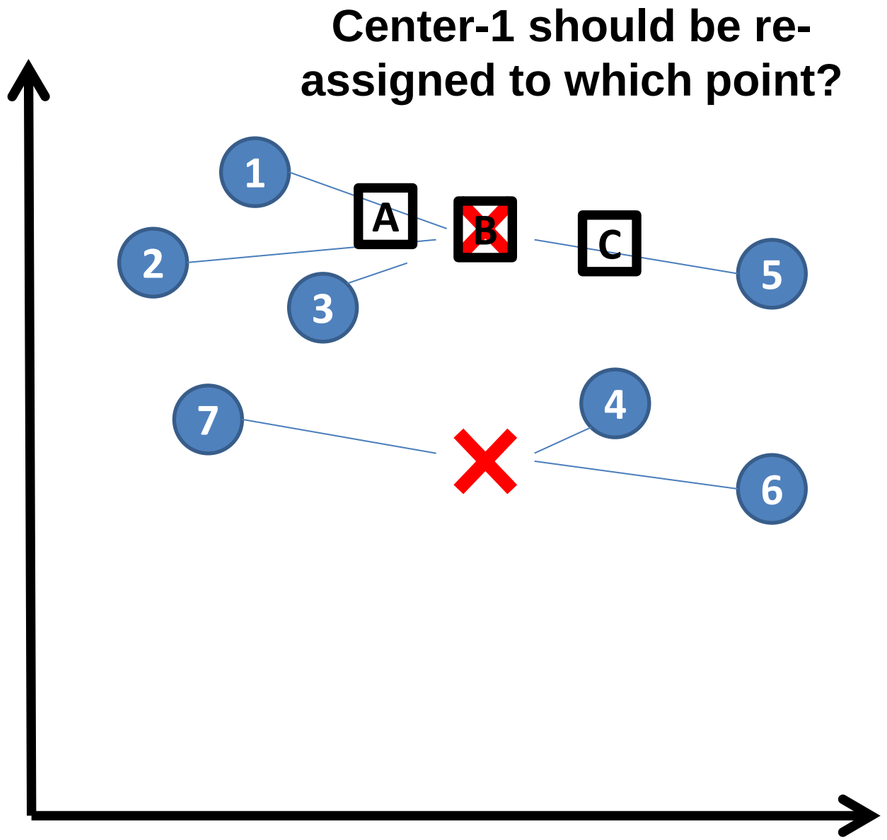
K-Means Algorithm



KMeans Steps

1) Assign
2) Optimize

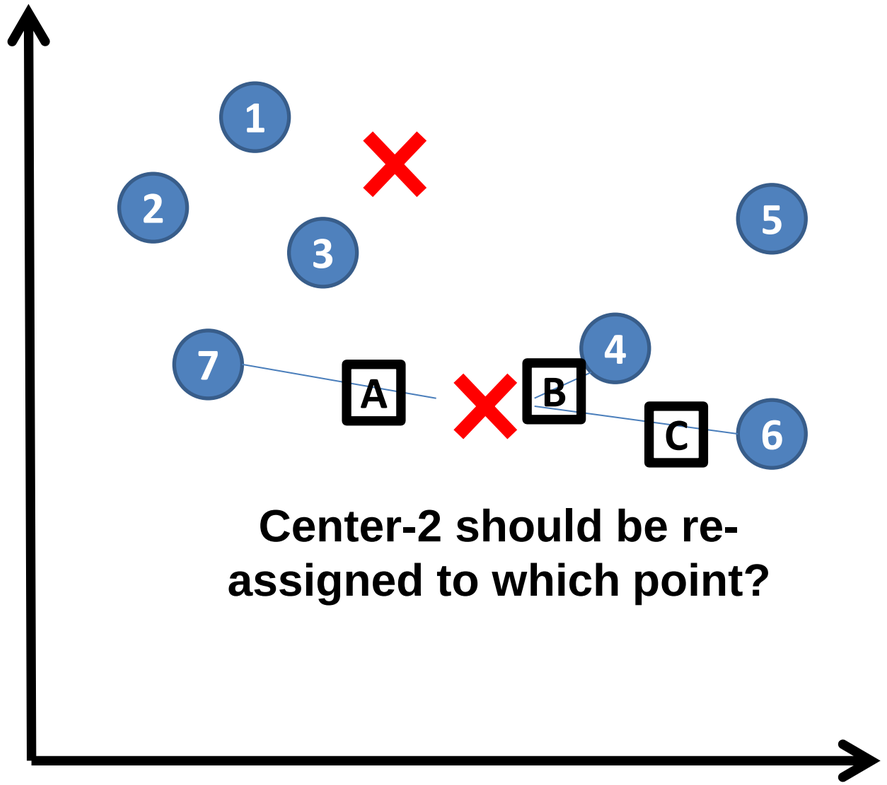
K-Means Algorithm



KMeans Steps

1) Assign
2) Optimize
3) Re-Assign

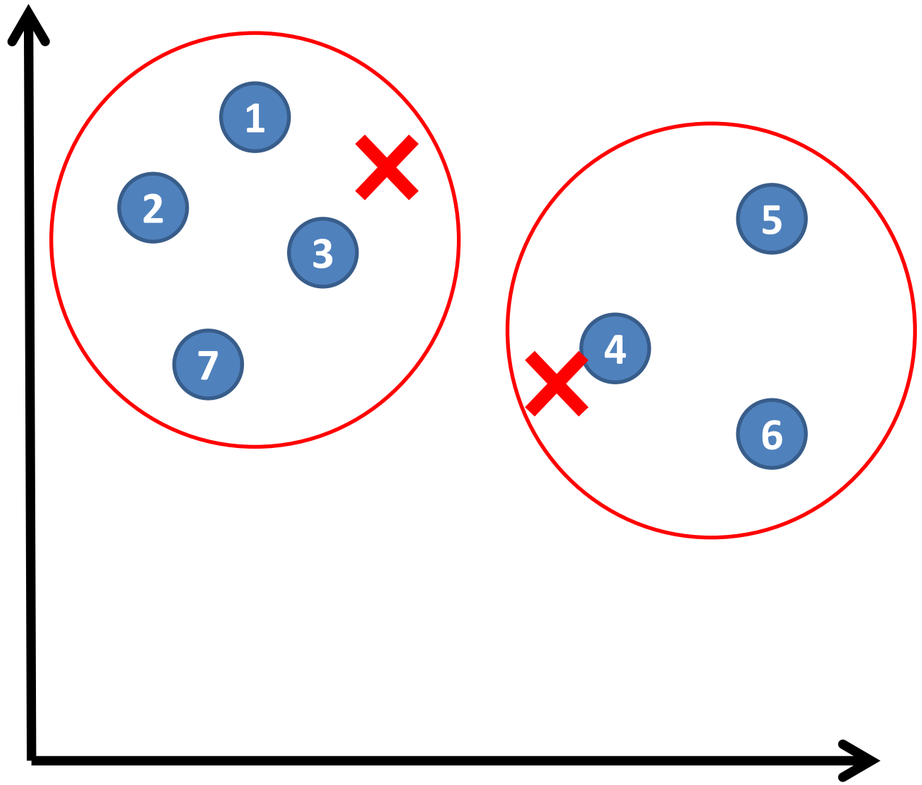
K-Means Algorithm



KMeans Steps

1) **Assign**
2) **Optimize**
3) **Re-Assign**

K-Means Algorithm



$$J = \Sigma_{n=1}^{N} \Sigma_{k=1}^{K} \left\| x_n - \mu_k \right\|^2$$

KMeans Steps

1) **Assign**
2) **Optimize**
3) **Re-Assign**
4) **Re-Optimize**

Continued Till Minimum Cost Function

K-Means Playground

https://www.naftaliharris.com/blog/visualizing-k-means-clustering/

K-Means in scikit-learn

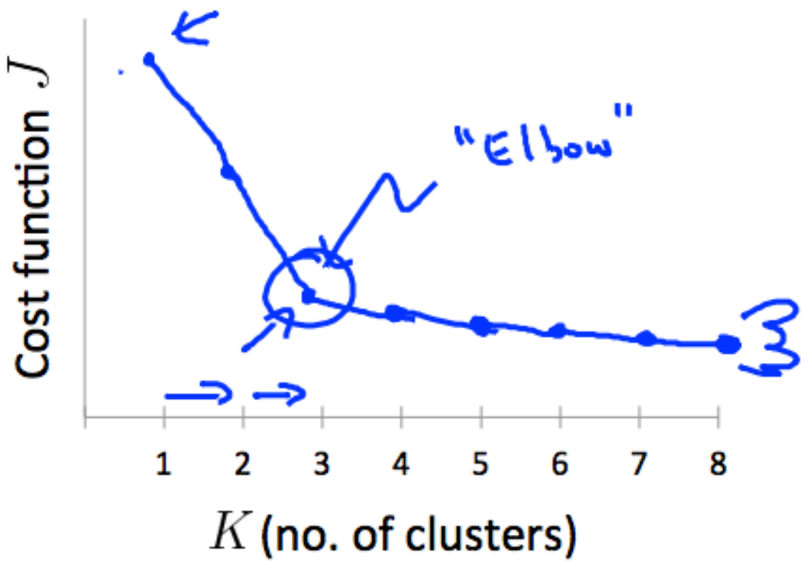
class `sklearn.cluster.` **`KMeans`** (*n_clusters=8, init='k-means++', n_init=10, max_iter=300, tol=0.0001, precompute_distances='auto', verbose=0, random_state=None, copy_x=True, n_jobs=None, algorithm='auto'*)

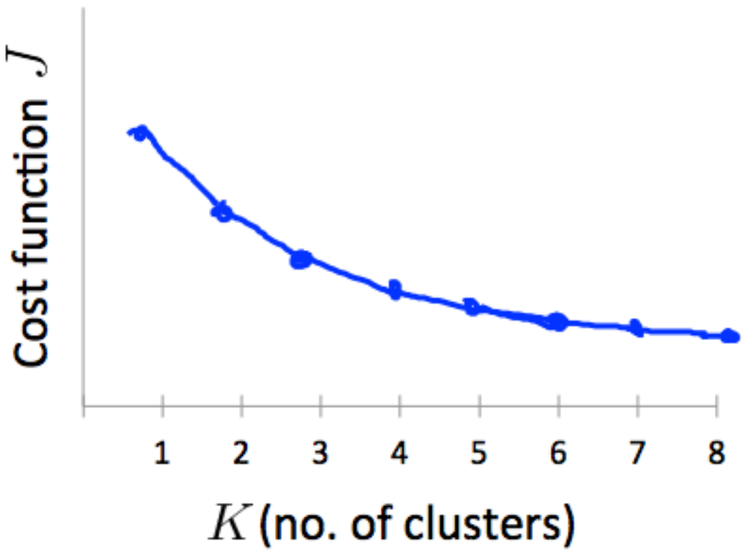
```
>>> from sklearn.cluster import KMeans
>>> import numpy as np
>>> X = np.array([[1, 2], [1, 4], [1, 0],
...               [10, 2], [10, 4], [10, 0]])
>>> kmeans = KMeans(n_clusters=2, random_state=0).fit(X)
>>> kmeans.labels_
array([1, 1, 1, 0, 0, 0], dtype=int32)
>>> kmeans.cluster_centers_
array([[10.,  2.],
       [ 1.,  2.]])
```

https://scikit-learn.org/stable/modules/generated/sklearn.cluster.KMeans.html

How much K? (Elbow)

Elbow method:





by Andrew Ng

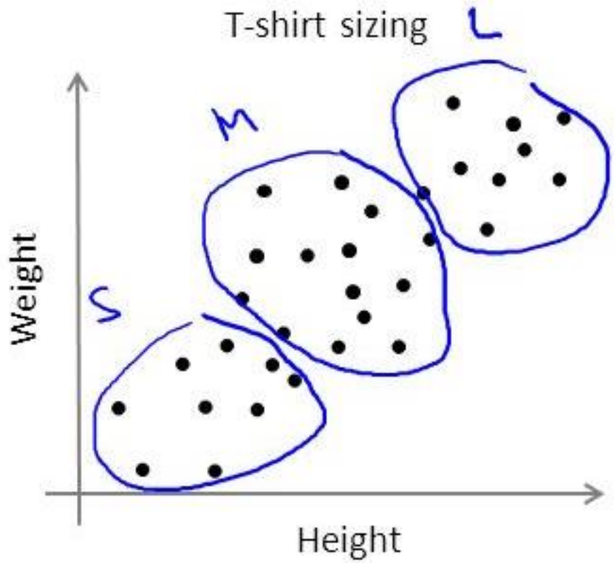
How much K? (Elbow)

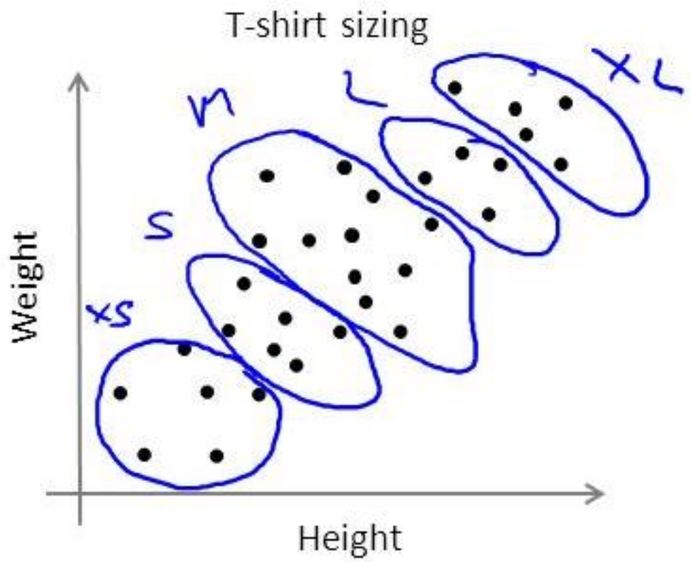
Sometimes, you're running K-means to get clusters to use for some later/downstream purpose. Evaluate K-means based on a metric for how well it performs for that later purpose.

K=3 S, M, L

K=5 XS, S, M, L, XL

E.g.





by Andrew Ng

Cluster Validation – Internal Indices

Measure the fit between data and the structure using only the data

Metric	Range	Available in sklearn
Silhouette Index	[-1,1]	Yes
Calinski-Harabasz		No
BIC		No
Dunn Index		No

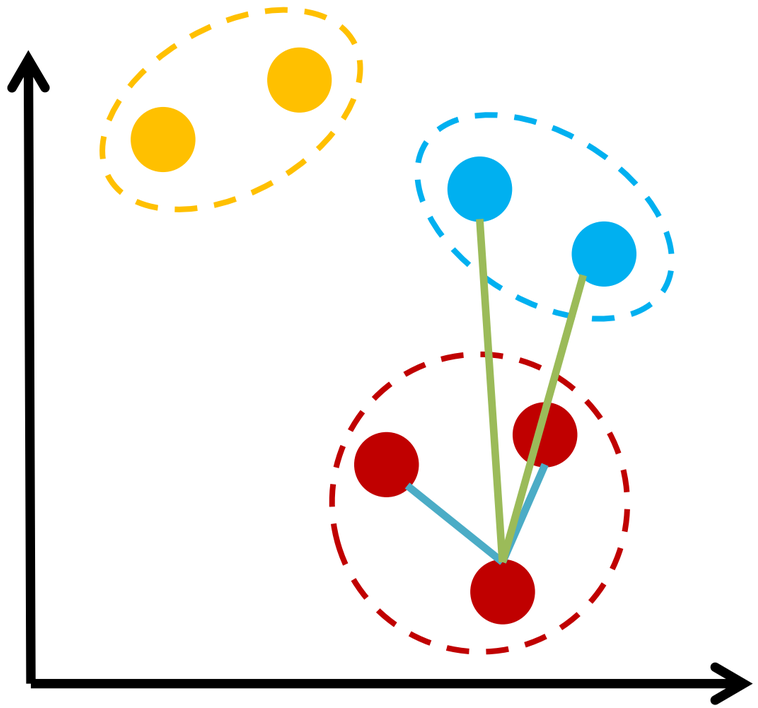
Source: Udacity Machine Learning Nano-Degree

Cluster Validation – Internal Indices

Silhouette Coefficient
Between -1 and 1

$$S_i = \frac{b_i - a_i}{\max(b_i, a_i)}$$

Clustering Result



a = average distance to other samples in same cluster

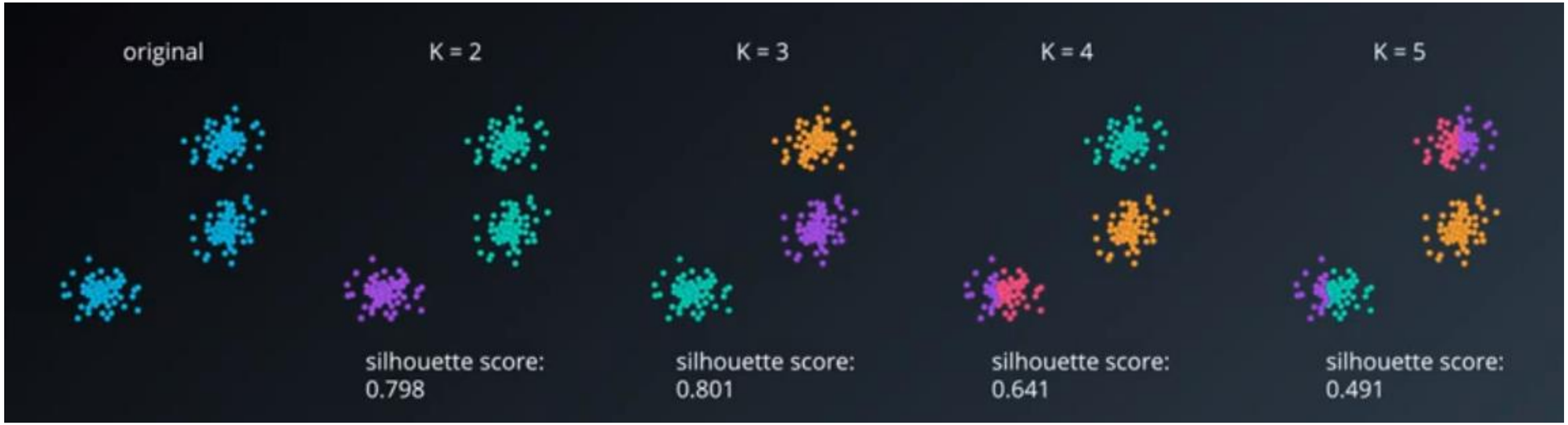
b = average distance to other samples in closest neighboring cluster

$$S = \text{Average}(S_1, S_2, S_3 \ldots, S_n)$$

Source: Udacity Machine Learning Nano-Degree

Cluster Validation – Internal Indices

Silhouette Coefficient – Finding K



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