





درس ۱۷

خوشەبندى فازى

**Fuzzy Clustering** 

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# **Fuzzy Clustering Algorithms**







# What is Clustering?



# Crisp & Fuzzy Clustering



# **C-Means** Clustering

Fixed number of clusters. One centroid per cluster.

Each data point belongs to the cluster corresponding to the closest centroid.



#### **C-Means** Clustering



$$J = \sum_{i=1}^{c} J_i = \sum_{i=1}^{c} \left( \sum_{k, x_k \in G_i} d(\mathbf{x}_k - \mathbf{c}_i) \right)$$

# C-Means Clustering



#### Fuzzy C-Means Clustering

Fixed number of clusters. One centroid per cluster.

Clusters are fuzzy sets.

Membership degree of a point can be any number between 0 and 1.

Sum of all degrees for a point must add up to 1.



C-Means 
$$J = \sum_{i=1}^{c} J_i = \sum_{i=1}^{c} \left( \sum_{k, x_k \in G_i} d(x_k - c_i) \right)$$
  
Fuzzy  
C-Means  
(FCM)  $J = \sum_{i=1}^{c} J_i = \sum_{i=1}^{c} \sum_{j=1}^{n} u_{ij}^m d_{ij}^2$   
membership  
degree

#### Fuzzy C-Means Clustering





Note: formulas are result of the method of Lagrange multipliers as applied to aforementioned cost function



