C4.5 and the K-Means Clustering Algorithms

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MATH 4200

Final Project

Outline

- Introduction to the C4.5 Algorithm
- Introduction to the K-Means Clustering Algorithm
- Dataset Overview
- Description of the Experiment

Outline cont.

- Graph of Experiment
- Hypothesized Results of Experiment
- Actual Results of the Experiment
- Experiment Conclusion
- Summary

Introduction to the C4.5 Algorithm

- An upgrade
- Basic idea is to ask questions
- Choose splitting attributes

Introduction to the C4.5 Algorithm cont.

- Entropy
  - Given probabilities $p_1, p_2, \ldots, p_s \quad where \sum_{i=1}^{s} p_i = 1,$

Entropy is defined as

$$H(p_1, p_2, \ldots, p_s) = \sum_{i=1}^{s} \left(p_i \log\left(\frac{1}{p_i} \right) \right)$$

Introduction to the C4.5 Algorithm cont.

- C4.5 improves ID3 in the following ways:
  - Missing Data
  - Continuous Data
  - Pruning
    - Subtree Replacement
    - Subtree Raising

Introduction to the C4.5 Algorithm cont.

- C4.5 improves ID3 in the following ways cont.
  - Rules
  - Splitting
    - GainRatio

$$GainRatio\ (D,S) = \frac{Gain(D,S)}{H\left(\frac{|D_1|}{|D|},\ldots,\frac{|D_s|}{|D|}\right)}$$

Introduction to the K-Means Clustering Algorithm

- Cluster objects
- Determine the K-Means
- Objects attributes form a vector space

Introduction to the K-Means Clustering Algorithm cont.

- The objective K-Means tries to achieve is to minimize total intra-cluster variance, or the function ….

$$V = \sum_{i=1}^{K} \sum_{j \in S_i} \left| x_j - \mu_i \right|^2$$

where there are k clusters $S_i,\ i = 1,2,...,K \ \ and \ \ \mu_i$ is the mean of all points $x_j \in S_i$

Introduction to the K-Means Clustering Algorithm cont.

- The K-Means Clustering Algorithm can be broken down into the following steps
  1. Place k points into the space represented by the objects that are being clustered.
  2. Assign each object to the group that has the closest mean.
  3. When all objects have been assigned, recalculate the positions of the k means.
  4. Repeat steps 2 and 3 until the means no longer move.

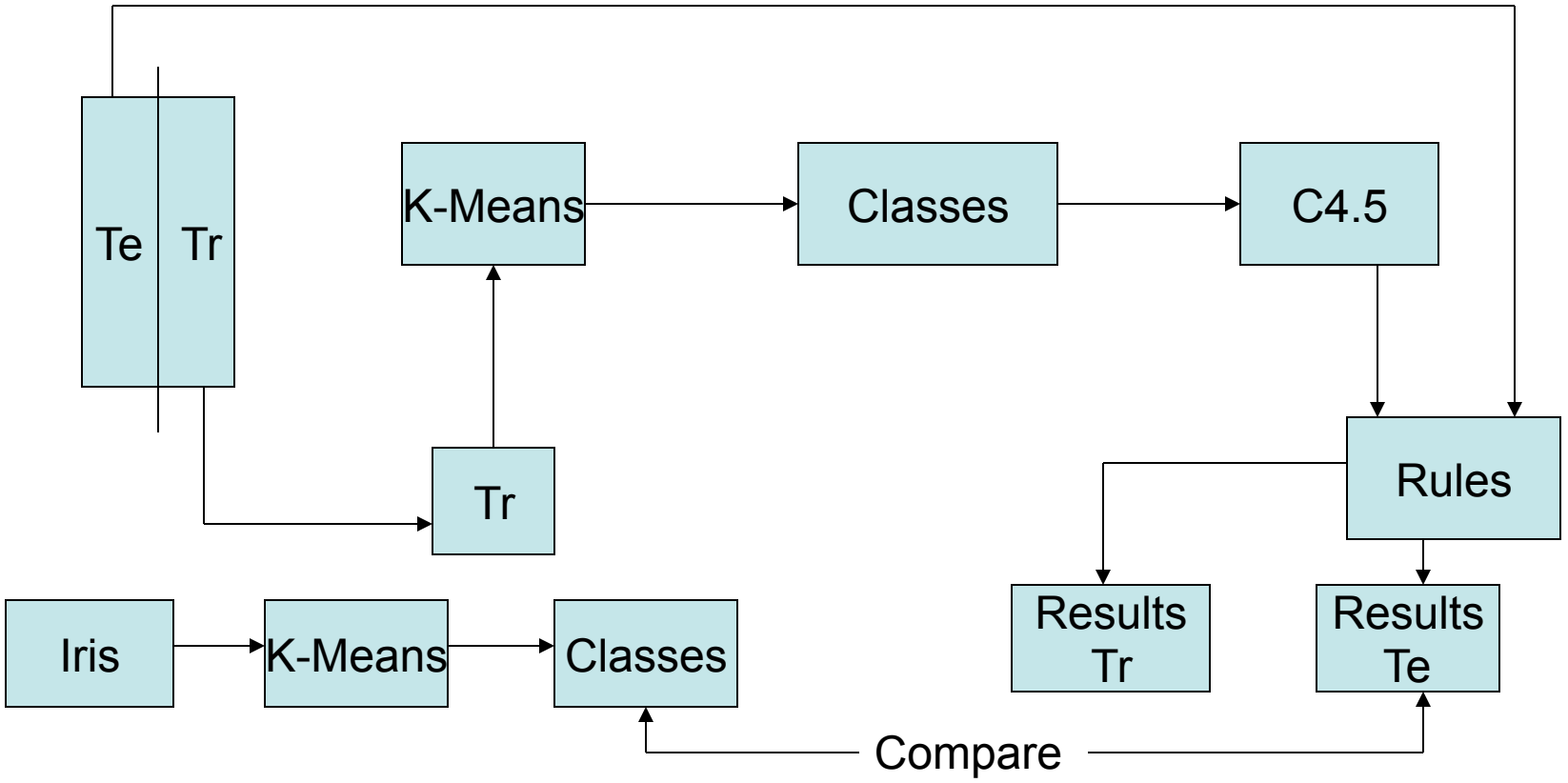
Dataset Overview

- Iris.xls dataset
- 3 Classes
  - Setosa
  - Versicolor
  - Virginica
- 4 Attributes
  - Sepal Length
  - Sepal Width
  - Pedal Length
  - Pedal Width
- 150 Items
  - 50 of each class

Description of Experiment

- K-Means
- C4.5
- C4.5 Rules
- K-Means
- Compare
- Classification

Graph of the Experiment



Hypothesized Results

- Very accurate
- Close to 100% classification rate

Results of the Experiment

- Setosa
- Versicolor
- Virginica
- Classification of data

Experiment Conclusion

- C4.5
- K-Means
- Classification

Summary

- C4.5 Algorithm
- K-Means Clustering Algorithm
- Dataset
- Experiment