Data Mining Lab Mini Talk

- Preprocessing
  - Discretization
  - Feature Selection

- Credits to Stefan Kramer for slide material
Discretization

- Dealing with numeric attributes:
  - cannot be handled by the learning scheme
  - performance is improved => overfitting
  - the range of the feature is divided into a set of intervals

- Supervised vs. Unsupervised:
  - Supervised consider the relation of the attribute values to the class values
  - Unsupervised: only look at the distribution of values of the attribute
Unsupervised Discretization

1. Domain-dependent
   - Age: “baby” if in (0,3], “child” if in (3,6], “school child” if in (6,10], “teenager” if in (10,18]

2. Equal-width
   - divide value range into a number of intervals of equal width

3. Equal-frequency
   - divide value range into a number of intervals so that (approximately) the same number of data points are in each interval

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Supervised Discretization

1. Entropy Split (Fayyad & Irani, 1993)
   - splitting (top-down): starts with single interval and successively splits the interval into sub-intervals
   - stops when a given number of intervals is reached or intervals becoming too small
   - entropy as splitting criterion

2. ChiMerge (Kerber, 1992)
   - merging (bottom-up): merging of adjacent intervals
   - use $X^2$–statistics to determine pair of interval to be merged
Feature Selection

- Many features may be:
  - irrelevant
  - redundant
- Removing them can:
  - increase efficiency
  - improve accuracy
  - prevent overfitting
- Feature (subset) selection techniques try to determine appropriate features automatically
Unsupervised Feature Selection

- Using domain knowledge:
  some features may be known to be irrelevant or redundant, common sense

- Random sampling:
  - select a random sample from the features
  - may be appropriate in case of many weakly relevant features or in connected with so-called ensemble methods
Supervised Feature Selection

• Filter approaches: using some evaluation measure of attribute with respect to class

• Wrapper approaches: using learning algorithm as plug-in to evaluate feature set(s)
Feature Measures for Filters

- **Gini-Index**: describes how a given attribute supports the partition of a set of instances into two subsets with respect to the class label (0 no class separation at all, 1 perfectly separated classes)

- **Information Gain**: calculates the entropy reduction for the split in a given attribute

- **Relief**: determines attribute weights for best separation by distance to near Hit and nearMiss instance

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Wrappers

- Search through the space of possible feature subsets
- Each subset encountered in search is tried with a learning algorithm
- Error rate in cross-validation as evaluation function
- Improve it by modifying the feature subset based on the result

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Pro’s / Con’s

• Disadvantage:
  
  • very inefficient for certain learning schemes: many cycles necessary
  
  • higher risk of overfitting

• Advantage:
  
  • feature subset is tailor to the learning algorithm
  
  • can consider combination of features
  
  • can eliminate redundant features
Strategies

- **Forward Selection:**
  - start with trying a single feature
  - select and add feature with the best performance
  - new iteration to get the next best feature
  - terminates upon fixed number of features or plateau

- **Backward Selection:**
  - Starts with full feature set
  - search for attribute with the least loss of performance
  - new iteration to get next elimination candidate

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Thank you for your attention