Class Binarization

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Synonyms

Error-correcting output codes (ECOC); One-against-all training; One-against-one training; Pairwise classification

Abstract

Many learning algorithms are only designed to separate two classes from each other. For example, concept-learning algorithms assume positive examples and negative examples (counterexamples) for the concept to learn, and many statistical learning techniques, such as neural networks or support vector machines, can only find a single separating decision surface. One way to apply these algorithms to multi-class problem is to transform the original multi-class problem into multiple binary problems.

Methods

The best-known techniques are:

- **One against all**: one concept-learning problem is defined for each class, i.e., each class is in turn used as the positive class, and all other classes form the negative class.
- **Pairwise (One against one)**: one concept is learned for each pair of classes (Fürnkranz 2002). This may be viewed as a special case of preference learning.
- **Error-correcting output codes**: ECOC allow arbitrary subsets of the classes to form the positive and negative classes of the binary problems. In the original formulation (Dietterich and Bakiri 1995), all classes have to be used for each problem, a later generalization (Allwein et al. 2000) allows arbitrary combinations. Clearly, one against all and one against one are special cases of ECOC.

The predictions of the binary classifiers must then be combined into an overall prediction. Commonly used techniques include voting and finding the nearest neighbor in the ECOC decoding matrix (Allwein et al. 2000).

Cross-References

- Preference Learning
- Rule Learning
**Recommended Reading**

