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Consensus Feature Ranking in Human Brain Image Database System (Datasets with Missing Values)

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Background & Objective: Discovering which medical tests have higher diagnostic value than the others is valuable knowledge. It is also known that the prediction accuracy of practical machine learning and data mining methods degrades when faced with many features that are not necessary for predicting the desired output. Therefore, development of a feature ranking method based upon the discriminative power of features and unbiased towards classifiers is of interest. In medical dataset, missing values and an unbalanced distribution of data must be taken into consideration in the ranking and evaluation of the medial attributes in order to legitimately apply an attribute ranking method. We have studied a consensus feature ranking method, based on multiple classifiers, and have shown its superiority to well known statistical ranking methods. In a comparison study, a Performance Index (PI) is proposed that takes into account both the number of features and the number of samples involved in the classification.

Experimental Approaches: In our method, each feature that could be a medical test result, presence of a symptom or any other biological indicator, is individually assessed with a single classifier and scored based on its classification performance. In order to avoid fabrication of data instances, prior to applying a classifier on the data, the instances that had a missing value in the considered feature are eliminated from the dataset. The scores from several sources are combined into a single consensus score. The features are then sorted and ranked based on this consensus scoring. At the evaluation phase, feature subsets are formed by selecting portion of the top-ranking features. The subsets are evaluated based on their classification accuracy using 10-fold cross validation with multiple classifiers and their performance index is calculated based on the results. This approach is compared with well-known information gain and chi-square feature raking methods.

Results: Consensus feature ranking method prioritized the more informative features appropriately. In both the PI and accuracy charts, the current method provided more reliable results on subsets with small numbers of features. As a feature subset became more populated, classification accuracy remained at a level approximating that generated by other methods, indicating exclusion of completely irrelevant features in the studied portion.

Conclusions: When evaluating the importance of features in medical databases, ensemble of classifiers could generate more accurate results comparing to the traditional statistical ranking methods, without having classifier bias.

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