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Machine Learning based Feature Selection Approaches for Early Prediction of Autism Spectrum Disorder - Review

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ABSTRACT

Feature selection is the task of selecting a small subset of the original features that can achieve maximum classification accuracy. This subset of features has some very important benefits: This makes feature selection an essential task for classification tasks.

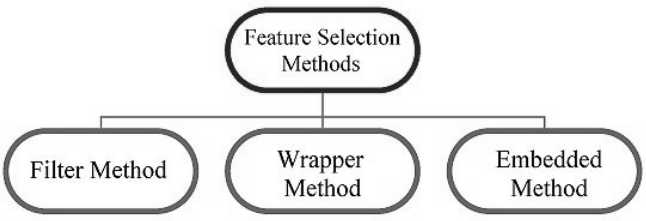
Keywords: Machine Learning, Feature Selection, Autism Spectrum Disorder

I. INTRODUCTION

Supervised methods can be classified into her three main categories depending on their reliance on classifiers: filter methods, wrapper methods and embedding methods. Filtering methods improve classification performance by examining only the inherent properties of the data to assess feature relevance without receiving feedback from the classifier. Estimate. The wrapper method relies on the classifier. These methods assess the 'goodness' of a selected feature subset directly from classifier feedback in terms of classification accuracy. In the embedding method, searching for the best subset of features is built into the construction of the classifier and can be viewed as searching in the combined space of feature subsets and hypotheses. Embedding methods are also specific to a particular classifier, but are cheaper than wrapper methods. According to the results reported in the literature, the performance of the filtering method alone is lower than that of the wrapper method, which, due to its numerical and computationally intensive nature, is not suitable for large datasets. may not be possible. Functional.

II. Feature Selection Methods

Machine Learning based Supervised methods can be classified into her three main categories depending on their reliance on classifiers: filter methods, wrapper methods and embedding methods.



Filter method

Filtering methods improve classification performance by examining only the inherent properties of the data to assess feature relevance without receiving feedback from the classifier. Estimate.. It's a faster and usually better approach if the number of features is huge. Avoids overfitting, but may not select the best features.

• Information gain – defined as the amount of information provided by a function that measures the decrease in entropy value given the target value. The information gain for each attribute is calculated considering the target value for feature selection.

• Chi-Square Test – The Chi-Square (X2) method is commonly used to test relationships between categorical variables. Compare the observed values of various attributes of the dataset to the expected values.

Chi-square Formula

$$X^2 = \sum \frac{(Observed\ value - Expected\ value)^2}{Expected\ value}$$

1. Fisher's Score –
2. Correlation Coefficient –
3. Variance Threshold –.
4. Mean Absolute Difference (MAD) –
5. Dispersion Ratio –
6. Mutual Dependence –
7. Relief

Fisher's **score** – Fisher's score selects each feature **separately from the** score based on Fisher's criteria, which produces many non-optimal features. The higher the Fisher score, the better the selected trait.

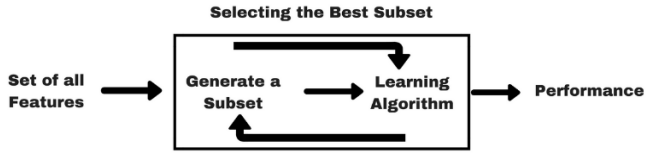
Correlation Coefficient – Pearson's correlation coefficient is a measure that quantifies the association and direction of the relationship between two continuous variables with values ranging from -1 to 1.

Variance Threshold – By default, this method removes features with zero variance. This method assumes that features with higher variance are more likely to contain more information.

Mean Absolute Difference (MAD) – Mean Absolute Difference (MAD) – This method is similar to the Threshold Variance method except that the MAP is not squared. This method calculates the mean absolute difference from the mean.
Volatility – Volatility is defined as the ratio of the arithmetic mean (AM) to the geometric mean (GM) for a given characteristic. Values range from +1 to ∞ because AM ≥ GM for a particular property. A higher variance ratio means more relevant features

Wrapper method

The wrapper method relies on the classifier. These methods assess the 'goodness' of a selected feature subset directly from classifier feedback in terms of classification accuracy.



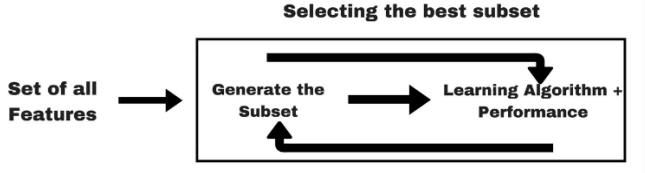
- Forward Selection — This method is an iterative approach that starts with an empty feature set and adds features to optimize the model at each iteration. The stopping criterion is until adding

new variables no longer improves the model's performance.

- Backward Elimination – This method is also an iterative approach, starting with all features first and removing less important features after each iteration. The stopping criterion is until no improvement in model performance is observed after removing features.
- Bidirectional Elimination – This method uses forward selection and backward elimination techniques simultaneously to arrive at a single solution.
- Exhaustive Selection - This technique is considered a brute-force approach to evaluating a subset of features. Create all possible subsets, create a learning algorithm for each subset, and select the subset that gives the best model performance.
- Recursive elimination – This greedy optimization technique selects features by recursively considering a smaller set of features. The estimator is trained on the first set of features and its importance is determined using the feature's feature importance attribute. Then less important features are removed from the current feature set until the required number of features remains.

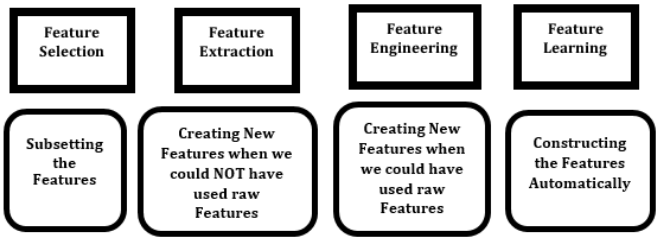
Embedded method

In the embedding method, searching for the best subset of features is built into the construction of the classifier and can be viewed as searching in the combined space of feature subsets and hypotheses. Embedding methods are also specific to a particular classifier, but are cheaper than wrapper methods.



Regularization - This method adds penalties to various parameters of the machine learning model to avoid overfitting the model. This feature selection approach uses lasso (L1 regularization) and elastic mesh (L1 and L2 regularization). A penalty is applied to the coefficients, making some coefficients zero. Features with zero coefficients can be removed from the data set.

Tree-based methods – methods such as random forests, gradient boosting. To select features, specify the feature importance. Feature importance indicates which feature is more important in influencing the target feature. Figure depicts the feature selection methods.



Feature Selection Methods

III. Conclusion

The more features, the faster and more convenient the filter method
In addition to the methods described above, there are many other ways to select features. Using a hybrid technique for feature selection can reduce the shortcomings of the algorithm by choosing advantages over other techniques.

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