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Performance Classification of College Teacher based on Semi-Supervised Model

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Abstract: In this paper we proposed a semi-supervised model to classify the performance of college teacher. Firstly, considering the label information and structure information, we defined the objective function which can reduce the dimension of the index information. Then, we classify the performance of college teacher based on the support vector machine model, which can describe the complex relationships between index and categories. Experimental results show that the proposed method have good classification effect for the performance of college teacher.

Keywords: College teacher, supervised learning method, feature reduction, support vector machine model, information preserving.

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1. INTRODUCTION

At present, many colleges have carry out the system of appointment for teachers. All these work requires a fair and objective performance evaluation of teachers. So the performance evaluation of teacher is more important than any period of time [1, 2]. However, the existing effective performance evaluation of teachers is not satisfactory, and there are many problems need to be solved urgently. Among them, the most criticized is the performance evaluation process, so there are too many subjective factors. For example, the traditional analytic hierarchy process needs to determine the weights manually, which cannot guarantee the objectivity of performance evaluation.

Many researchers have pay attention to this problem [3-5]. In order to improve the effectiveness of performance evaluation for college's teacher, many scholar have proposed to establish a standardized index system [6]. And then they have put forward to use principal component and improved entropy method to evaluate college teachers, which can make every teacher to objectively and correctly recognize their own advantages and disadvantages. The computation of evaluation have become complex because the indicator weight, computation

methods and its quantization indicator. So it is the key that a just and reasonable evaluation result is given based on these complex data [7].

In this paper, we presented a semi-supervised model to classify the performance of college teacher. First, we use a semi-supervised model to reduce the dimension of the index information, in which we take full advantage of the label information and structure information. Then, we use a support vector machine model to classify the performance of college teacher. Experimental results show that the proposed method have good classification effect for the performance of college teacher.

2. SEMI-SUPERVISED MODEL

In order to get an accurate description for original data, people have proposed many methods to reduce the dimensionality of high dimensional data, and try to preserve the intrinsic characteristics of the original data [8]. Depending on whether the label is available, the existing dimensionality reduction methods can be divided into unsupervised and supervised methods. These methods include principal component analysis, linear discriminate analysis [9], and local linear embedding [10]. When there is enough label samples, the linear discriminate analysis method have more effective than principal component analysis method.

With the discovery of low dimensional nonlinear structures of high-dimensional data, the locality preserving projections have proposed, which try to preserve the local neighbor structure information of samples [11]. Locality preserving projections methods have the remark advantage that this projection is linear and easily computable, and have higher recognition than others.

Although the supervised dimensionality reduction algorithm has achieved good results in many applications, but it is very expensive to do a lot of calibration for unlabeled data. In fact, the unlabeled data is easy to obtain relatively, so in this paper we use both the labeled and unlabeled data to reduce the dimensionality, then on this basis, we use support vector machine model to classify the performance of college teacher.

2.1 Relation work.

Data dimensionality reduction can obtain the low-dimensional representation of high-dimensional data samples, while preserving the low-dimensional representation of high-dimensional data samples and the intrinsic nature of most of the raw data. Given a set of points $X = \{x_1, x_2, ..., x_n\}$ in a high dimensional space R^D, we try to find a transformation matrix A to map these n points to another set of points $Y = \{y_1, y_2, ..., y_n\}$ in a low dimensional space $R^d (d << D)$, such that y_i represents x_i, where $y_i = A^T x_i$. Thus, any new high dimensional data points can be easily represented by a low dimensional data points. The objective function of locality preserving projections method is as follows:

$$\min_A \sum_{i,j=1}^{n} \left\| y_i - y_j \right\|^2 S_{ij} \tag{1}$$

Where the matrix S is a weight matrix. The matrix S is constructed through the nearest neighbor samples as following:

$$S_{ij}=\begin{cases}1 & if\ x_i\ is\ among\ K\ nearest\ neighbors\ of\ x_j\\ 0 & otherwise\end{cases} \tag{2}$$

The objective function of S_{ij} is a heavy penalty if neighboring points x_i and x_j are mapped far apart. Therefore, minimizing it is an attempt to ensure that if x_i and x_j is close then y_i and y_j are close as well.

Suppose A is an optimal projection matrix that is $y_i=A^Tx_i$. By simple formulation, the objective function of locality preserving projections can be reduced to:

$$\begin{aligned}&\frac{1}{2}\sum_{ij}(y_i-y_j)^2S_{ij}=\frac{1}{2}\sum_{ij}(A^Tx_i-A^Tx_j)^2S_{ij}\\&=\sum_{ij}A^Tx_iD_{ii}x_i^TA-\sum_{ij}A^Tx_jD_{jj}x_j^TA\\&=A^TX(D-S)X^TA\\&=A^TXLX^TA\end{aligned} \tag{3}$$

Where $X=[x_1,x_2,...,x_d]$, D is a diagonal matrix, $D_{ij}=\sum_j W_{ij}$, $L=D-S$.

2.2 Semi-supervised model.

A good dimensionality reduction method not only retains the same class of labeled samples, but also retains the structures separation of all samples, in which the degree of structures includes the local structure and overall structure of all samples [12]. In order to realize the above target, we consider the labeled and structure information of samples as following:

With prior class label information, we defined W using a supervised approach. In fact, each entry of the weight matrix W can be regarded as the similarity metric of a pair of samples. So we defined the weight matrix W as follows:

$$W_{ij}=\begin{cases}1 & if\ both\ x_i\ and\ x_j\ belong\ the\ same\ class\\ 0 & otherwise\end{cases} \tag{4}$$

In which W means that the same class information is emphases.

Similarly, we can set the similarity between two samples, if they belong to different classes.

$$B_{ij}=\begin{cases}1 & if\ both\ x_i\ and\ x_j\ belong\ the\ diffent\ class\\ 0 & otherwise\end{cases} \tag{5}$$

In order to maintain the overall structure of the data, and to prevent similar samples from being tagged Separate, we define the matrix $w_{ij}^{'}$ as follows:

$$w_{ij}^{'}=\begin{cases}1 & if\ both\ x_i\ and\ x_j\ belong\ the\ same\ class\\ \dfrac{1}{2n} & otherwise\end{cases} \tag{6}$$

In order to maintain local geometry and prevent heterogeneous samples, we define the matrix S_{ij} as follows:

$$S_{ij}=\begin{cases}1 & \begin{array}{l}if\ both\ x_i\ and\ x_j\ belong\ the\ same\ class\\ and\ \ x_i\ and\ x_j\ belong\ nearest\ neighbors\end{array}\\ 0 & otherwise\end{cases} \tag{7}$$

So, we can define a criterion function of semi-supervised dimensionality reduction method as follows:

$$J(a)=\frac{(1-\alpha)\sum_{ij}(y_i-y_j)^2B_{ij}+\alpha\sum_{ij}(y_i-y_j)^2w_{ij}^{'}}{(1-\beta)\sum_{ij}(y_i-y_j)^2W_{ij}+\beta\sum_{ij}(y_i-y_j)^2S_{ij}} \tag{8}$$

Where α and β are adjusted factors. Then we defined S_{ij}^{sb} and S_{ij}^{sw} as follows:

$$\begin{cases} S_{ij}^{sb}=(1-\alpha)B_{ij}+\alpha w_{ij}^{'} \\ S_{ij}^{sw}=(1-\beta)W_{ij}+\alpha S_{ij} \end{cases} \tag{9}$$

Utilizing the relationship $y_i=A^Tx_i$, the above minimization problem can be converted as:

$$J(a)=\frac{A^TXL^{sb}X^TA}{A^TXL^{sw}X^TA} \tag{10}$$

Let the column vectors $a_1,a_2,...,a_r$ be the solutions of the above equation, ordered according to their eigenvalue $\lambda_1,\lambda_2,...,\lambda_r$, then the embedding y_i is computed by the formulation:

$$XL^{sb}X^TA=\lambda A^TXL^{sw}X^TA \tag{11}$$

3. EXPERIMENTAL RESULTS AND ANALYSIS

In order to verify the classification effectiveness for the performance of college teacher, we gather the index information for different teachers. Then we use the semi-supervised method to reduce to the dimension of teachers. Last, we classify the teacher into different grade using the classical support vector machine model. In this paper, the performance of college teacher includes such as professional ethics level module, educational teaching ability module, scientific research innovation ability module, personal development module etc. We set $\alpha=0.5$, $\beta=0.4$ in the semi-supervised model. In order to verify the effectiveness of the proposed method, we compare the semi-supervised method and unsupervised method to extract the essential information from the index information. The comparing results are shown in Figure 1.

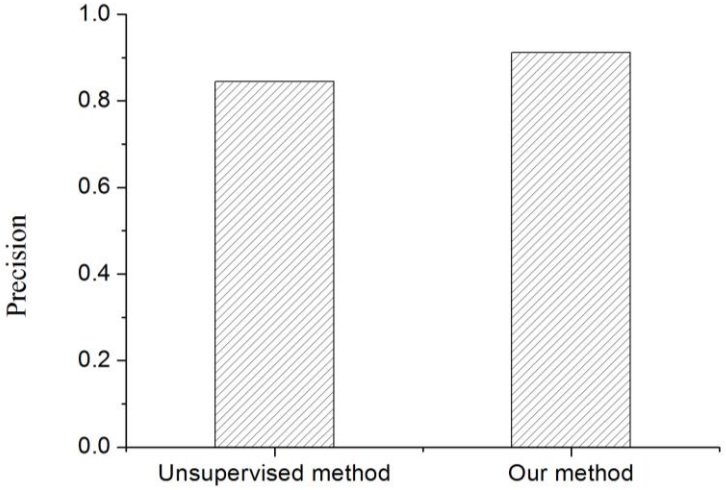

Fig 1. The recognition results of two methods

In the paper, the recognition effect comparison of the college teacher is shown in Figure 1. The two methods have good recognition effect. The proposed method has the recognition precision is higher to the unsupervised method. These results shows that the semi-supervised model is a good choose for the performance of college teacher, which is because that the proposed method is consider the label information and structure information. But the unsupervised method only

considers label information of samples, and ignores the local structure and overall structure of all samples.

4. CONCLUSION

This paper proposes a semi-supervised model to classify the performance of college teacher. We extract feature from the index information, and classify the teacher into different grade based on the support vector machine model. The between-class similarity and within-class similarity are defined to maximize the between-class and minimize the within-class. Meanwhile, the semi-supervised model preserves the global and local structure information for all samples. Experimental results the proposed model have good classification effect.

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