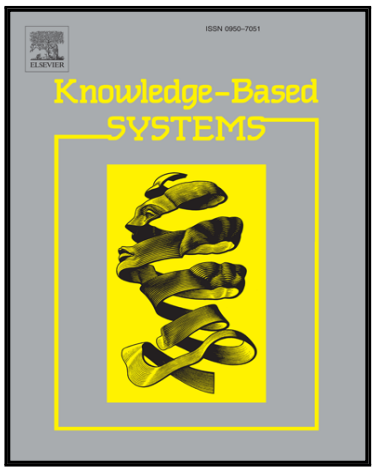

Self-weighted Multi-View Clustering with Soft Capped Norm

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Self-weighted Multi-View Clustering with Soft Capped Norm

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Abstract

Real-world data sets are often comprised of multiple representations or modalities which provide different and complementary aspects of information. Multi-view clustering plays an indispensable role in analyzing multi-view data. In multi-view learning, one key step is assigning a reasonable weight to each view according to the view importance. Most existing work learn the weights by introducing a hyperparameter, which is undesired in practice. In this paper, our proposed model learns an optimal weight for each view automatically without introducing an additive parameter as previous methods do. Furthermore, to deal with different level noises and outliers, we propose to use 'soft' capped norm, which caps the residual of outliers as a constant value and provides a probability for certain data point being an outlier. An efficient updating algorithm is designed to solve our model and its convergence is also guaranteed theoretically. Extensive experimental results on several real-world data sets show that our proposed model outperforms state-of-the-art multi-view clustering algorithms.

Keywords: Multi-view clustering, Soft capped norm, Self-weighted strategy, Nonnegative matrix factorization.

1. Introduction

Clustering is one of the most fundamental topic in machine learning and data mining. It aims to partition the data points into different groups such that the data points in the same group have high similarity to each other. A number of clustering methods have been proposed up to now, e.g., K-means [1, 2], spectral clustering [3, 4, 5], information-theoretic clustering [6], Bayesian matrix factorizaton [7, 8], etc. More recently, the Nonnegative Matrix Factorization (NMF) has been widely used as the relaxation technique for clustering with good performance [9, 10, 11, 12, 13, 14].

Nowadays, more and more data sets are with multiple modalities or represented by different views which capture different aspects of data and can be complementary to each other. This is due to the fact that data may be collected from different sources or be represented by different kind of features for different tasks [15, 16]. For example, in image analysis, images can be represented by different visual descriptors like GIST [17], CTM [18], LBP [19], SIFT [20], and HOG [21]; in text analysis, documents can be written in different languages [22]; and in web page categorization, web pages can be classified by page content or linkage [23]; in neural science, patients can be described by both genetic variations and MRI images [24]. Therefore, it is critical for learning algorithms to integrate these heterogeneous features to improve their accuracy and robustness. Multi-view clustering provides a natural formulation for clustering with such data in the unsupervised setting. Instead of relying on a single view, multi-view clustering aims to integrate compatible and complementary information provided by the multiple views such that a better performance can be obtained [25, 26, 27].

In recent years, a number of approaches have been designed to tackle the multi-view clustering problem. Roughly speaking, these approaches can be categorized into subspace approaches and graph-based approaches. The subspace approaches generally try to uncover the common latent subspace shared by multiple views [28, 29, 30, 31, 32], while the graph-based approaches were derived from traditional spectral clustering with the help of some similarity measures [16, 33, 34]. Although several multi-view clustering methods were reported with good performance [35, 36, 37, 38, 39], they still suffer from several drawbacks. For one thing, traditional multi-view clustering methods are usually sensitive to noises and outliers, especially the extreme data outliers, which may lead to suboptimal clustering results. For another, those methods combine different views by assigning a weight for each view. Consequently, they often have additional weight parameters to set, which is impractical and unsatisfactory especially in unsupervised clustering task. Furthermore, existing multi-view clustering methods, e.g., graph-based methods, are of high computational complexity due to the kernel/affinity matrix construction as well as the singular value decomposition.

In this paper, we propose a novel *S*elf-weighted *M*ulti-*V*iew *C*lustering model with 'Soft' *Ca*pped Norm (SCaMVC). By introducing a self-conducted weight technique, the pro-

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