A novel image clustering method based on coupled convolutional and graph convolutional network

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Abstract

Image clustering is a key and challenging task in the field of machine learning and computer vision. Technically, image clustering is the process of grouping images without the use of any supervisory information in order to retain similar images within the same cluster. This paper proposes a novel image clustering method based on coupled convolutional and graph convolutional network. It solves the problem that the deep clustering method usually only focuses on the useful features extracted from the sample itself, and seldom considers the structural information behind the sample. Experimental results show that the proposed algorithm can effectively extract more discriminative deep features, and the model achieves good clustering effect due to the combination of attribute information and structure information of samples in GCN.

Keywords: machine learning, image clustering, coupled convolutional, graph convolutional network.

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1. Introduction

Image clustering is very important in computer vision. In order to make full use of these unlabeled data and study the correlation between them, many clustering algorithms have been proposed and successfully applied in various practical applications, such as image segmentation [1-2], target detection [3] and image classification [4,5]. Among them, traditional clustering methods, such as K-means clustering algorithm [6], spectral clustering (SC) algorithm [7] and non-negative matrix factorization clustering (NMF) algorithm [8], capture similarity based on the concept of distance in the original data space, so they are considered as shallow models. Although the shallow models have been successfully applied in a variety of scenarios, calculating distance-based measures in raw data space is only suitable for describing local relationships in the data space and is limited in expressing potential dependencies between inputs, which is insufficient to discover semantic similarity.

With the booming development of deep learning, many researchers have shifted their attention to deep unsupervised feature learning and clustering [9-12]. Thus, a new clustering strategy, called deep clustering, emerged. When dealing with large, high-semantic and high-dimensional data, the multi-layer architecture based on deep neural network unsupervised representation learning has become the natural choice. In addition, deep clustering combines prior knowledge with clustering to obtain the optimal embedded subspace for clustering. Compared with traditional clustering methods, deep clustering method can effectively simulate the input distribution and capture the nonlinear characteristics of the input. Therefore, it can well solve the limitations of