Classify Data Clouds: Hierarchical Gaussianization for Image Classification

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Abstract

Image classification, such as object and scene classification, face and age recognition, and video event analysis, is an important topic in computer vision. A key step in image classification is how to represent an image by a feature vector, which can be used for latter classification analysis. It is known that global image descriptors, such as concatenates of gray intensities at each pixel, are sensitive to misalignment and image occlusions. Recently, the patch-based (a.k.a., bag-of-features) approach has drawn considerable attention in this field. Instead of describing features of the whole image, the patch-based approach first divides each image into order-less patches and then describes features (such as color, texture, and gradient) on each patch. So each image does not correspond to a point in a high-dimensional space, but to multiple points, i.e., a data cloud. In this talk, we present a model-based representation for image features. We propose to model each data cloud by a hierarchical Gaussian mixture model (GMM). The parameters for each GMM are learned in a Bayesian framework to allow information sharing across different images and to bridge the universal and individual information retrievals. The new feature vector consists of characteristics of each image-specific GMM, such as the means and weights, which capture the appearance information, and posterior probabilities at each patch, which capture the spatial information. It can be shown that some popular representations are special cases of ours. We compare our new representation with other approaches on several real data sets, and our performance ranks among the top in all the tasks.

This talk is based on joint work with Xi Zhou, Na Cui, and Thomas Huang.