Lecture 7.1 (09:30-09:55)

Exploring the relation between the geometry of a fixed embedding space and the underlying cluster structure of image data using the Merge and Expand framework

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Standard self-supervised clustering algorithms transform the input data through embedding models which are trained to fit the data and then cluster the embedded vectors. Despite its flexibility, a data driven embedding model may not be applicable when the raw data are unavailable for privacy and security concerns, and fails to fit the increasingly common scheme of transfer learning. We proposed an Merge & Expand (ME) framework to cluster images with a fixed embedding and a deep learning neural network classification model. We conducted a series of experimental analysis to explore the relation between the geometry of a fixed embedding space and the underlying cluster structure. We first demonstrated that the clustering outcomes were robust against varying numbers of initial clusters termed regions, and then assessed heterogeneity of predicted labels in each region and demonstrated it was a strong indicator about the quality of its clustering outcomes. We further exploited the heterogeneity information and modified ME to improve clustering accuracy by introducing the second embedding. Moreover, we gave intuitive explanations about the source of confusion in merging seed regions. Comparison with numerous clustering methods on three datasets indicates ME yielded competitive performance despite using a fixed embedding, a simple CNN architecture and a common loss function. To sum up, ME enables users to better understand the relation between geometry of the embedding space and the underlying cluster structure.