Multi-Modal Curriculum Learning for Semi-Supervised Image Classification.

Semi-supervised image classification aims to classify a large quantity of unlabeled images by typically harnessing scarce labeled images. Existing semi-supervised methods often suffer from inadequate classification accuracy when encountering difficult yet critical images, such as outliers, because they treat all unlabeled images equally and conduct classifications in an imperfectly ordered sequence. In this paper, we employ the curriculum learning methodology by investigating the difficulty of classifying every unlabeled image. The reliability and the discriminability of these unlabeled images are particularly investigated for evaluating their difficulty. As a result, an optimized image sequence is generated during the iterative propagations, and the unlabeled images are logically classified from simple to difficult. Furthermore, since images are usually characterized by multiple visual feature descriptors, we associate each kind of features with a teacher, and design a multi-modal curriculum learning (MMCL) strategy to integrate the information from different feature modalities. In each propagation, each teacher analyzes the difficulties of the currently unlabeled images from its own modality viewpoint. A consensus is subsequently reached among all the teachers, determining the currently simplest images (i.e., a curriculum), which are to be reliably classified by the multi-modal learner. This well-organized propagation process leveraging multiple teachers and one learner enables our MMCL to outperform five state-of-the-art methods on eight popular image data sets.