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学 位 論 文 内 容 の 要 旨

博士の専攻分野の名称　博士（情報科学）　氏名　段 磊

学 位 論 文 題 名

A Study on Crowdsourcing for Multi-Label Affect Annotation
（複数ラベル感情アノテーションのためのクラウドソーシングに関する研究）

The issue of learning from multi-label data is an emerging and promising research topic and has attracted significant attention from a lot of researchers. In this dissertation, we especially focus on a typical referent in multi-label learning: affect. Generally, an enormous amount of multi-label affect annotations is needed to form a multi-label affective learning technique. Moreover, the quality of the annotations directly affects the performance of the technique. Although high-quality affect annotations can be obtained from both experts and large crowds, the process is both expensive and time-consuming in practice. One way to obtain affect annotations is to use online crowdsourcing services, which are being used more frequently in the labeling community. We thus investigated ways to obtain at low cost reliable multi-affect datasets from variable-quality crowdsourced annotations for use with affect-related techniques.

Although multi-label affect annotations can be obtained from a crowdsourcing service at very low cost, in most cases, crowdsourcing annotators are rarely trained and generally do not have the abilities needed to accurately perform the offered tasks. Therefore, ensuring the quality of the results is one of the biggest challenges in crowdsourcing. A promising approach to improving the quality of crowdsourced annotations is to introduce redundancy by aggregating annotations provided by several annotators to produce one reliable annotation. Generally, the more the number of annotators is, the more reliable the aggregated annotation can be. However, hiring more annotators needs higher cost. Moreover, in subjective multi-label annotation tasks, a larger number of annotators are necessary to obtain the reliable annotation than those in objective or single-label annotation tasks. Given that the categories of “affects” are different from those of other kinds of labels, we incorporated the characteristics of affect annotation into estimation process. The purpose of the study is to ensure the quality of the aggregated multi-label affect annotation for each instance, from annotations provided by a limited number of annotators, to reduce the cost of data collection. Experimental results on real-world crowdsourcing data showed that by processing crowdsourced annotations using the proposed methods, the obtained multi-label affect datasets are with quality approaching that of ones obtained from the general consensus of large crowds or from human experts. Our work provided a promising way to reduce the cost creating high-quality multi-affect datasets, with minimal degradation in the quality of the results. We envision that by leveraging proper statistical quality control strategies, a crowdsourcing setting could be a good candidate to the problem of insufficient annotation data in affective learning techniques.

In Chapter 1 the background of this study, including the evolving research area of multi-label affective learning and crowdsourcing, is introduced. Then the challenge of collecting high-quality multi-affect datasets from crowdsourced annotations is discussed. After that, the purpose and the threefold contribution of this study are presented.

Chapter 2 presents the fundamentals necessary for the remaining chapters, including the characterization of affect, techniques in multi-label learning, and challenges of human computation and crowdsourcing. Then it is followed by the description of employed datasets and related work.

In multi-label affective learning, candidate labels are interrelated. In Chapter 3, we investigated estimation of multiple affect labels from crowdsourced annotations, with flexible incorporation of label dependency into the label-generation process.

In view of that emotive expressions are inevitably restricted by "consistency" and "context", in Chapter 4 we propose incorporating information of *emotional consistency* and *contextual cues* among instances into the label-generation process. This is based on the multi-affect estimation proposed in Chapter 3.

Different affect taxonomies are commonly used in the affective learning domain, which results in complications. Given that different affect taxonomies are generally founded on the same latent semantic space, where each possible label set in a taxonomy denotes a single semantic concept, in Chapter 5, we proposed a novel approach for establishing a semantic matching function of label sets in two taxonomies in a crowdsourcing setting.

In Chapter 6, the methods proposed in this dissertation are summarized and some future work are discussed.