Public Abstract
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Recent breakthroughs in deep learning have made possible the learning of deep layered hierarchical representations of sensory input. Since then machines could learn useful features on their own from raw data, to replace the labor-intensive and time-consuming feature design process by human experts.

However, Existing deep learning methods involve a large number of meta-parameters but existing applications usually do not explain why the decisions were made and how changes would affect performance. In addition, most of the existing works are done on simple and clean datasets and assume a fixed set of labeled data, which is not necessarily true for real-world applications.

This dissertation has three main parts. Firstly, it investigates the optimal meta-parameters of deep learning networks as well as the effects of various data pre-processing techniques on the benchmark MNIST digit recognition image dataset and a sleep-stage-recognition sensor dataset. Secondly, it proposes a new active labeling framework for cost-effective selection of labeled data for two deep learning algorithms based on three metrics: least confidence, margin sampling, and entropy. On the MINIST dataset, the methods outperform random labeling consistently by a significant margin. Thirdly, it applies deep learning to a real-world application – emotion prediction via physiological sensor data, based on real-world, complex, noisy, and heterogeneous sensor data. The classification accuracy is comparable with existing methods based on expert designed features.