Learning and Transferring Representations with Data from Multiple Domains (PI: Dr. Chung Fu Kai Korris; 2014/15)

Representation learning, which concerns with learning representations to extract and organize discriminative information from the available data, is a recently developed and rapidly growing field in machine learning and computational intelligence. It is tightly coupled with deep learning methods which hierarchically organize multiple nonlinear transformations with the goal of yielding more abstract and ultimately more useful representations. Transfer learning, also advocated recently, deals with the scenarios that the test and training sets have similar but pretty distinct distributions. Its main challenges are “what to transfer, how to transfer, and when to transfer”. The purpose of this research is to study how these two new learning paradigms should be put together. In fact, deep representation learning is supposed to be well suited for transfer learning, due to its objective of abstract representation of the source data variations and its advantage of using layered network architecture to model out-of-distribution training examples. Thus, the challenges are (i) how to carry out transfer learning between deep layered networks and (ii) how to enhance or enrich deep learning of hierarchical representation by leveraging the knowledge from the other domains. In this project, we propose to develop methods for more effective transfer learning and/or deep representation learning, and to exploit new approaches to and benefits of combining these two learning paradigms. The problem of learning and transferring

representations with data from multiple domains will be studied in the context of multi-task learning, domain adaptation learning and co-clustering. While we will formulate and devise deep representation transfer learning algorithms for these three application scenarios, attempts will be made to advance the development of these two learning paradigms. These include: (i) adding a cognitive aspect to the learning process by addressing the question of at what abstraction level (realized by deep representation learning networks) transfer learning should be carried out; and (ii) studying the theoretical problem of distance between domains/distributions. The success of this research will lead to the impact of (i) opening a new problem in transfer learning, i.e., why to transfer; and (ii) strengthening the foundation and effectiveness of both deep representation learning and transfer learning.