



Language
Technologies
Institute

Thesis Defense

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Proactive Transfer Learning

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Abstract

Humans learn from heterogeneous knowledge sources and modalities - through various books, lectures, communications, textual or visual - and yet given a novel task we are able to leverage the combined knowledge base to make comprehensive inferences for solutions. When necessary, we also actively mine and query diverse sources of information to acquire knowledge we want. Hence, learning is combinatorial across heterogeneous sources, and proactive in novel knowledge acquisition.

In this thesis, we exploit the proactive transfer learning framework which follows this metaphor and provides a unique solution for learning a novel low-resource task by (1) leveraging multiple existing heterogeneous knowledge sets, as well as by (2) querying an optimized subset of target samples to produce additional maximally-useful annotations. Specifically, we study a completely heterogeneous transfer learning (CHTL) task where source and target datasets differ in both feature and label spaces (e.g. text corpora in different languages, describing different topics). For the unique challenges of CHTL, we formulate a common latent subspace learning problem in which an optimal subset of source and target data are projected through shared network pathways, subsequently reducing the joint supervised and unsupervised loss. To ground heterogeneous labels into common space, we utilize embeddings obtained from an external knowledge graph or a language model. In addition, we describe a novel dynamic proactive learning (DPAL) task where we optimize queries with regards to multiple selection strategies ("learn to active-learn"), given multiple annotators with varying expertise. Lastly, by combining these two lines of work, we present the proactive transfer learning (PTL) framework which exploits unlabeled target samples while progressively improving transferability between source and target domains, thereby maximizing information gain from both transfer learning and conventional active learning approaches. We demonstrate the efficacy of the proposed framework via various low-resource multimodal transfer learning tasks, such as hetero-lingual text classifications, image-aided named entity disambiguation for social media posts, etc.

https://s3.amazonaws.com/shanemoon/papers/thesis_draft.pdf

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