**Project Proposal:- Optimizing Transfer Learning in Sentiment Analysis**

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We plan to evaluate and develop techniques for transfer learning from source domains to target domains. Having sufficient data is a prerequisite for machine learning techniques, and labeled data is often expensive and may not be always available. Hence ways to transfer learning from one domain with labeled data to another with only unlabeled data can be very powerful.

We will examine the application of transfer learning to the field of sentiment analysis specifically in the task of predicting ratings from reviews.

**Dataset:**

We will use Amazon review data, which is available at<http://jmcauley.ucsd.edu/data/amazon/links.html>

Data Description: Several million reviews with ratings from Amazon are available, in 24 categories. As an illustration, we’ve included a subset of the categories with counts in the table below. We will pick a few of the available categories (domains) for our project. Usage of this data requires citation of Ref 4,5.

|  |  |  |  |
| --- | --- | --- | --- |
| Books | (22,507,155 reviews) | (2,370,585 products) |  |
| Electronics | (7,824,482 reviews) | (498,196 products) |  |
| Movies and TV | (4,607,047 reviews) | (208,321 products) |  |
| CDs and Vinyl | (3,749,004 reviews) | (492,799 products) |  |
| Kindle Store | (3,205,467 reviews) | (434,702 products) |  |
| Apps for Android | (2,638,173 reviews) | (61,551 products) |  |
| Automotive | (1,373,768 reviews) | (331,090 products) |  |
| Baby | (915,446 reviews) | (71,317 products) |  |
| Digital Music | (836,006 reviews) | (279,899 products) |  |
| Amazon Instant Video | (583,933 reviews) | (30,648 products) |  |
|  |  |  |  |

**Project Details:**

We want to divide the project into 3 parts, the 3rd is a stretch goal. depending on time and challenge of the tasks.

**Part 1 :** How well do different machine learning models transfer across domains ? We will evaluate 2-3 machine learning techniques (Naïve Bayes, SVM, and Neural Networks) and determine which transfers the best. We will start with pretrained GLOVE embeddings and explore the performance with or without training it further. (Our objective is not to find the best model on the source / target domain by itself, but rather the model that lends best to transferability from source to target).

Measure: Comparative Accuracy of predicting rating from reviews when using one domain versus another.This will define the baseline for transfer learning for part 2.

**Part 2:** Main part of the project. We will examine and develop techniques to improve transfer learning from one domain to another.

Examples include:

a. Using domain similarity (source, target domain) to pick the source domain for transfer learning. (Ref: 2)

b. Using similarity to pick instances from source domain for transfer learning to target domain. (Ref: 2)

c. Variation of b above, with multiple source domains to pick instances for developing the source model to transfer. (Ref: 2)

d. Evaluate whether adding a small number of labeled target instances can help us get to desired accuracy in target domain.

1st Metric: Nts/Nt where

Nts = # labeled instances from target domain needed when starting from a model built on a source domain, to get to similar accuracy as a model built entirely on the target domain.

Nt = ~ minimum number of labeled instances from target domain to reach maximum possible accuracy when building a model directly on the target domain only.

2nd Metric: - Tts/Tt where

Tts = Epochs needed to get to similar accuracy when starting with a model trained on source domain

Tt = Minimum Epochs needed to reach maximum accuracy with a model trained on the target domain only.

e. Try to determine which examples from target domain would be most helpful in improving accuracy of the model (eg those most different from the source domain)

Metric: Same as in 2d, and vs the result in 2d.

f. Stretch goal: If time permits, and we develop sufficient expertise to write the algorithms, we will attempt using Attention based neural networks (Ref: 11), or Auto-Encoders (Ref : 8) to see if they help improve accuracy of transfer learning, and how much fewer training instances are needed with those models.

**Part 3: Stretch goal**

If time permits, we would like to also examine the effectiveness of transfer learning with different tasks within sentiment analysis. Specifically, we would like to see how transfer learning works in Aspect Based Sentiment Analysis. For this, we would be using the data from SemEval 2016, and a CNN / RNN to predict the aspects and associated sentiments.

Data: Labeled data for fine grained sentiment analysis in two categories in English : restaurants, and laptops. Paper describing the data(Ref 3). Sample analysis paper (Ref 6)

**References :**

1. Book : Sentiment Analysis and Opinion Mining, Bing Liu.

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8. Domain Adaptation for Large-Scale Sentiment Classification: A Deep Learning Approach<http://www.icml-2011.org/papers/342_icmlpaper.pdf>

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