

Learning to Rank

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1 Introduction

In this tutorial I will introduce ‘learning to rank’, a machine learning technology on constructing a model for ranking objects using training data. I will first explain the problem formulation of learning to rank, and relations between learning to rank and the other learning tasks. I will then describe learning to rank methods developed in recent years, including pointwise, pairwise, and listwise approaches. I will then give an introduction to the theoretical work on learning to rank and the applications of learning to rank. Finally, I will show some future directions of research on learning to rank. The goal of this tutorial is to give the audience a comprehensive survey to the technology and stimulate more research on the technology and application of the technology to natural language processing.

Learning to rank has been successfully applied to information retrieval and is potentially useful for natural language processing as well. In fact many NLP tasks can be formalized as ranking problems and NLP technologies may be significantly improved by using learning to rank techniques. These include question answering, summarization, and machine translation. For example, in machine translation, given a sentence in the source language, we are to translate it to a sentence in the target language. Usually there are multiple possible translations and it would be better to sort the possible translations in descending order of their likelihood and output the sorted results. Learning to rank can be employed in the task.

2 Outline

1. Introduction
2. Learning to Rank Problem
 - (a) Problem Formulation
 - (b) Evaluation

3. Learning to Rank Methods

- (a) Pointwise Approach
 - i. McRank
- (b) Pairwise Approach
 - i. Ranking SVM
 - ii. RankBoost
 - iii. RankNet
 - iv. IR SVM
- (c) Listwise Approach
 - i. ListNet
 - ii. ListMLE
 - iii. AdaRank
 - iv. SVM Map
 - v. PermuRank
 - vi. SoftRank
- (d) Other Methods

4. Learning to Rank Theory

- (a) Pairwise Approach
 - i. Generalization Analysis
- (b) Listwise Approach
 - i. Generalization Analysis
 - ii. Consistency Analysis

5. Learning to Rank Applications

- (a) Search Ranking
- (b) Collaborative Filtering
- (c) Key Phrase Extraction
- (d) Potential Applications in Natural Language Processing

6. Future Directions for Learning to Rank Research

7. Conclusion