Scrutinizing Opinions during Solitary Go: A Direct Cooperative Subject Representation Path

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Abstract— In this work, we focus on modeling user-generated review and overall rating pairs, and aim to identify semantic aspects and aspect-level sentiments from review data as well as to predict overall sentiments of reviews. We propose a novel probabilistic supervised joint aspect and sentiment model (SJASM) to deal with the problems in one go under a unified framework. SJASM represents each review document in the form of opinion pairs and can simultaneously model aspect terms and corresponding opinion words of the review for hidden aspect and sentiment detection. It also leverages sentimental overall ratings, which often comes with online reviews, as supervision data, and can infer the semantic aspects and aspect-level sentiments that are not only meaningful but also predictive of overall sentiments of reviews. Moreover, we also develop efficient inference method for parameter estimation of SJASM based on collapsed Gibbs sampling. We evaluate SJASM extensively on real-world review data, and experimental results demonstrate that the proposed model outperforms seven well-established baseline methods for sentiment analysis tasks.

1. INTRODUCTION

Online user-generated reviews are of great practical use, because: 1) They have become an inevitable part of decision making process of consumers on product purchases, hotel bookings, etc. 2) They collectively form a low-cost and efficient feedback channel, which helps businesses to keep track of their reputations and to improve the quality of their products and services. As a matter of fact, online reviews are constantly growing in quantity, while varying largely in content quality. To support users in digesting the huge amount of raw review data, many sentiment analysis techniques have been developed for past years. Generally, sentiments and opinions can be

analyzed at different levels of granularity. We call the sentiment expressed in a whole piece of text, e.g., review document or sentence, overall sentiment. The task of analyzing overall sentiments of texts is typically formulated as classification problem, e.g., classifying a review document into positive or negative sentiment. Then, a variety of machine learning methods trained using different types of indicators (features) have been employed for overall sentiment analysis. However, analyzing the overall sentiment expressed in a whole piece of text alone (e.g., review document), does not discover what specifically people like or dislike in the text. In reality, the fine-grained sentiments may very well tip the balance in purchase decisions. For example, savvy consumers nowadays are no longer satisfied with just overall sentiment/rating given to a product in a review; they are often eager to see why it receives that rating, which positive or negative attributes (aspects) contribute to the particular rating of the product. Recently, there has been a growing interest in analyzing aspect-level sentiment, where an aspect means a unique semantic facet of an entity commented on in text documents, and is typically represented as a high-level hidden cluster of semantically related keywords (e.g., aspect terms). Aspect-based sentiment analysis generally consists of two major tasks, one is to detect hidden semantic aspect from given texts, the other is to identify fine-grained sentiments expressed towards the aspects. Probabilistic topic models, which are typically built on a basic latent Dirichlet allocation (LDA) model have been used for aspect-based sentiment analysis where the semantic aspect can be naturally formulated as one type of latent topics (latent variables).

2. RELATEDWORK

Examining the Role of Linguistic Knowledge Sources in the Automatic Identification and Classification of Reviews

This paper examines two problems in document-level sentiment analysis: (1) determining whether a given document is a review or not, and (2) classifying the polarity of a review as positive or negative. We first demonstrate that review identification can be performed with high accuracy using only unigrams as features. We then examine the role of four types of simple linguistic knowledge sources in a polarity classification system.

We have examined two problems in document level sentiment analysis, namely, review identification and polarity

classification. We first found that review identification can be achieved with very high accuracies (97-99%) simply by training an SVM classifier using unigrams as features. We then examined the role of several linguistic knowledge sources in polarity classification. Our results suggested that bigrams and trigrams selected according to the weighted log-likelihood ratio as well as manually tagged term polarity information are very useful features for the task. On the other hand, no further performance gains are obtained by incorporating dependency-based information or filtering objective materials from the reviews using our proposed method. Nevertheless, the resulting polarity classifier compares favorably to state-of-the-art sentiment classification systems.

Adding Redundant Features for CRFs-based Sentence Sentiment Classification

In this paper, we present a novel method based on CRFs in response to the two special characteristics of "contextual dependency" and "label redundancy" in sentence sentiment classification. We try to capture the contextual constraints on sentence sentiment using CRFs. Through introducing redundant labels into the original sentimental label set and organizing all labels into a hierarchy, our method can add redundant features into training for capturing the label redundancy. The experimental results prove that our method outperforms the traditional methods like NB, SVM, MaxEnt and standard chain CRFs. In comparison with the cascaded model, our method can effectively alleviate the error propagation among different layers and obtain better performance in each layer.

In the paper, we propose a novel method for sentiment classification based on CRFs in response to the two special characteristics of "contextual dependency" and "label redundancy" in sentence sentiment classification. We try to capture the contextual constraints on the sentence sentiment using CRFs. For capturing the label redundancy among sentiment classes, we generate a hierarchical framework through introducing redundant labels, under which redundant features can be introduced. The experimental results prove that our method outperforms the traditional methods (like NB, SVM, ME and standard chain CRFs). In comparison with cascaded CRFs, our method can effectively alleviate error propagation among different layers and obtain better performance in each layer. For our future work, we will explore other hierarchical models for sentimental strength

rating because the experiments presented in this paper prove this hierarchical frame is effective for ordinal regression. We would expand the idea in this paper into other models, such as Semi-CRFs and Hierarchical-CRFs.

3. FRAMEWORK

We introduce a new supervised learning layer via normal linear model to jointly model the overall rating data. Thus, we propose a novel supervised joint aspect and sentiment model (SJASM), which can cope with the overall and aspect based sentiment analysis problems in one go under a unified framework.

We make the following assumptions about our proposed SJASM model:

• The generation for aspect-specific sentiments depends on the aspects. This means that we first generate latent aspects, on which we subsequently generate corresponding sentiment orientations.

• The generation for aspect terms depends on the aspects, while the generation for opinion words relies on the sentiment orientations and semantic aspects. The formulation is intuitive, for example, to generate an opinion word “beautiful”, we need to know its sentiment orientation positive and related semantic aspect appearance.

• The generation for overall ratings of reviews depends on the semantic aspect-level sentiments in the reviews.

The graphical representation of the proposed SJASM model is shown in Figure 1.

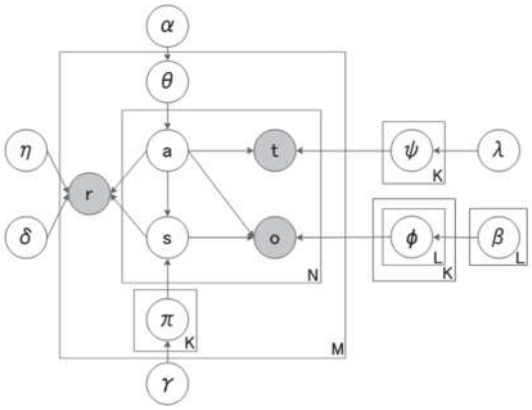

Fig.1: Graphical representation of SJASM. The boxes refer to plates that indicate replicates. The outer plate refers to review documents, while the inner plate refers to the repeated selection of latent aspects and sentiment orientations as well as aspect terms and opinion words within each review document.

Based on the model assumptions, to generate a review document and its overall rating, we first draw hidden semantic

aspects conditioned on document-specific aspect distribution; We then draw the sentiment orientations on the aspects conditioned on the per document aspect-specific sentiment distribution; Next, we draw each opinion pair, which contains an aspect term and corresponding opinion word, conditioned on aspect and sentiment specific word distributions; We lastly draw the overall rating response based on the generated aspect and sentiment assignments in the review document.

4. EXPERIMENTAL RESULTS

We evaluated our proposed SJASM model using publicly available user-generated review data from three categories, i.e., game (video game), CD (audio CD), and hotel. The game and CD reviews[2] were collected from Amazon[3], and the hotel reviews[4] was collected from TripAdvisor[5]. Table shows some statistics of the review data sets.

Category	Game	CD	Hotel
# of reviews in corpus	2,599	1,632	1,367
# of words in corpus	554,496	292,060	696,327
Vocabulary size	23,809	13,886	21,785
Average # of words/review	213	178	509

TABLE 1: Statistics of Review Data Sets

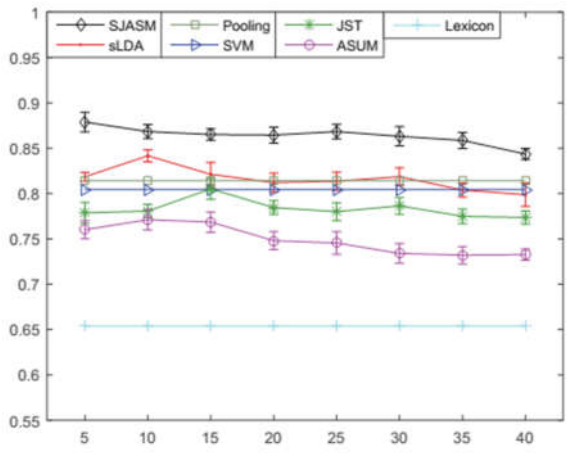

Fig.2: Overall sentiment prediction accuracy versus aspect number on the game data set.

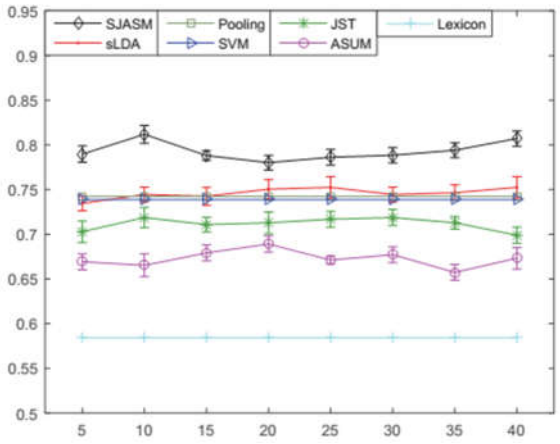

Fig.3: Overall sentiment prediction accuracy versus aspect number on the hotel data set.

5. CONCLUSION

In this work, we focus on modeling online user-generated review data, and aim to identify hidden semantic aspects and sentiments on the aspects, as well as to predict overall ratings/sentiments of reviews. We have developed a novel

supervised joint aspect and sentiment model (SJASM) to deal with the problems in one goes under a unified framework. SJASM treats review documents in the form of opinion pairs, and can simultaneously model aspect terms and their corresponding opinion words of the reviews for semantic aspect and sentiment detection. Moreover, SJASM also leverages overall ratings of reviews as supervision and constraint data, and can jointly infer hidden aspects and sentiments that are not only meaningful but also predictive of overall sentiments of the review documents. We conducted experiments using publicly available real-world review data, and extensively compared SJASM with seven well-established representative baseline methods. For semantic aspect detection and aspect-level sentiment identification problems, SJASM outperforms all the generative benchmark models, sLDA, JST, ASUM, and LARA. As for overall sentiment prediction, SJASM again outperforms the six benchmark methods sLDA, Pooling, SVM, JST, ASUM, and Lexicon.

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