A Model of Structured Opinion Format

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Abstract— Sentiment Analysis deals with identifying the sentiment or opinions expressed by the users in the review. Reviews of a product from users play an important role for decision-making process. This information is not only useful for users or customers, but it is also be used for evaluating the product. Since there are many of reviews are accumulated and expressed in both formal and informal written languages, it takes time for concluding the evaluation. When purchasing a product for the first time as usually needs to choose between several products with similar characteristics. The best way to choose the almost suitable product is to rely upon the opinions of others. We propose a new definition of opinion and its usefulness in this paper and describes how to convert unstructured opinion to structured format.

Keywords— Sentiment Analysis, Opinion Mining, POS Tagging,Tokenization,Review,Opinion.

1. INTRODUCTION

The development of World Wide Web and the social media led more and more users to share their views about products and services everyone use on the web. Web information can be classified into two categoriesed- Facts and Opinion. Opinions are increasingly available in form of reviews and feedback at websites, blogs, and micro-blogs that influence future customers. Product review by another customer plays an important role in our decision-making process. Consider a student who wants to buy a book,(s)he first looks for comments and reviews about the book on the web. The person, who has read the book, comments about the book and his experience on the web. The author gets feedback from the customers through these reviews to improve their books and their market.

Sentiment analysis or opinion mining is a new area of Natural Language Processing. It is also a field of computational linguistics and text mining. It determines the polarity of text whether it belongs to positive or negative polarity. Recognizing polarity in text requires Sentiment words are good, bad, excellent, great etc. These Sentiment words are key indicators for creating machine learning model for sentiment classification.

Extraction of sentiment from a review is based on two techniques (i) Supervised approach and (ii) Unsupervised approach. For supervised approach a large set of review is used to trained machine learning algorithm. A sentiment can be classified into three different categories-positive, negative and neutral. This method treated sentiment analysis is a text classification problem. So any supervised learning method as naïve-base classifier or support vector machine can be used. Another kind of rating is also possible like a 1 to 5 scale . 4 or 5 means opinion is positive and 1 or 2 means opinion is negative. so the problem becomes regression.

2. PREVIOUS WORK

[1],they focus on topic models owing to their advantage of performing both aspect extraction and clustering simultaneously. Some knowledge-based topic models have been proposed, that allow the user to input some prior domain knowledge to generate coherent aspects. In [3],they propose a three phase approach. Phase 1: Corpora Acquisition Learning Phase. Phase 2: Adjective Extraction Phase. Phase 3: Classification. Phase 1,automatically extract positive or negative document from web for a specific domain. Phase 2 detect positive and negative adjectives. Phase 3 classify new document with a previous set of adjectives. In [4], they examine the problem of automatic sentiment analysis at sentence level. They compile a set of conjunction rules to determine relevant phrases for sentiment analysis. Finally use support vector machines to conclude that linguistic analysis plays a significant role in sentiment determination.

In [5], they propose an unsupervised learning algorithm for classifying reviews as *recommended* (thumbs up) or *not recommended* (thumbs down). The semantic orientation of a phrase is calculated as the mutual information among the given phrase and the word "excellent" minus the mutual information among the given phrase and the word "poor".

In [6], they calculate sentiment of a overall document . They experimented with three standard algorithms: Naive Bayes classification, maximum entropy classification, and support vector machines. The results produced by machine learning methods are better in comparison to the human generated baselines. In terms of relative performance, SVM tends to do the best and Naïve Bayes tends to do the worst, although the differences are not significant.

3. NATURAL LANGUAGE PROCESSING

Natural Language Processing is a component of Artificial Intelligence. It is the ability of computer program to detect the human spoken language. Several Machine Learning algorithms are developed for this purpose. Many NLP techniques like Tokenization, Parts-Of-Speech tagging, Word sense disambiguation are used in sentiment analysis also.

4. TOKENIZATION OF TEXTS

Tokenization is the process of splitting a sentence into a list of words called tokens. We will start by splitting a complete review, like a paragraph, into a stream of tokens. Then Parts-of-speech tagger is used for this purpose. It is a process of converting a sentence, in the form of list of words, into a list of tuples, where each tuple is of the form (word, tag). The tag signifies the word is noun, verb, or adjective etc.

5. DEFINITION OF OPINION[2][8]

Our new definition for book review states that Opinion is a Hextuple (e , a , s, r, t ,b) where 'e' is the entity that has a unique name in the review; 'a' is the particular aspect that is a feature of the entity 'e'. It may be classified into two different types- a) explicit b) implicit. 's' is the sentiment of review. Sentiments can be classified into three different types positive, negative and neutral, clearly neutral sentiment shall not be helpful Sentiment lexicon also called the opinion word is used to identify the actual sentiment from the review. Some words that are used as positive sentiment – Award, Beautiful, Deluxe, Easy, Exceptional, Famous, Finest, Glowing, Outstanding, Perfect, Smooth, ultimate, Clear, Delightful, Excellent etc. Some phases also used to write down positive sentiment like- -Get up and glow, A shining example, Star in its own right, Make dreams come true, Run for my money, Just like that, Easy as ABC. etc. Some expressions also used to detect positive sentiment like-OMG, Mmmm, Sshhhh, Wow,A1 etc. Some words that are used as negative sentiment *Bad*, *Poor*, *Terrible*, Unhappy, Distress, Hard, Nonsense etc.   ; 'r' is the actual reviewer; 't' is the time of review and 'b' is the background of the reviewer expertise. Without knowing the background of reviewer expertise, it is impossible to detect the review is helpful or not. All the example consider in the case studies are collected from **http://www.flipkart.com**

6. CASE STUDIES

CASE STUDY 1

Consider the following review
(collected from Flipkart)
Deepak Puthraya
03 June 12

- **The book is awesome. The authors tell you everything in the book about C, every minute detail of the language in just 270 pages! But the book is not for beginners as the book doesn't go into explaining stuff in very detail as the other books do, like giving examples telling you exceptions and things like that. The authors expect you to figure them out on your own, by coding in C. They will touch upon, or I would say familiarize you with every thing the language offers to us.**

First we Tokenize the text and use Parts-Of-Speech tagger. POS Tagger is useful to detect noun, adverb and adjective from review. POS Tagger generally used abbreviation name to detect this.
('The', 'DT'), ('book', 'NN'), ('is', 'VBZ'), ('awesome.', 'NNP'), ('The', 'DT'), ('authors', 'NNS'), ('tell', 'VBP'), ('you', 'PRP'), ('every', 'DT'), ('thing', 'NN'), ('in', 'IN'), ('the', 'DT'), ('book', 'NN'), ('about', 'IN'), ('C', 'NNP'), (',', ','), ('every', 'DT'), ('minute', 'NN'), ('detail', 'NN'), ('of', 'IN'), ('the', 'DT'), ('language', 'NN'), ('in', 'IN'), ('just', 'RB'), ('270', 'CD'), ('pages', 'NNS'), ('!', '.'), ('But', 'CC'), ('the', 'DT'), ('book', 'NN'), ('is', 'VBZ'), ('not', 'RB'), ('for', 'IN'), ('beginners', 'NNS'), ('as', 'IN'), ('the', 'DT'), ('book', 'NN'), ('does', 'VBZ'), ("n't", 'RB'), ('go', 'VB'), ('into', 'IN'), ('explaining', 'NN'), ('stuff', 'NN'), ('in', 'IN'), ('very', 'RB'), ('detail', 'JJ'), ('as', 'IN'), ('the', 'DT'), ('other', 'JJ'), ('books', 'NNS'), ('do', 'VBP'), (',', ','), ('like', 'IN'), ('giving', 'NN'), ('examples', 'NNS'), ('telling', 'VBG'), ('you', 'PRP'), ('exceptions', 'NNS'), ('and', 'CC'), ('things', 'NNS'), ('like', 'IN'), ('that.', 'NNP'), ('The', 'NNP'), ('authors', 'NNS'), ('expect', 'VBP'), ('you', 'PRP'), ('to', 'TO'), ('figure', 'VB'), ('them', 'PRP'), ('out', 'RP'), ('on', 'IN'), ('your', 'PRP$'), ('own', 'JJ'), (',', ','), ('by', 'IN'), ('coding', 'NN'), ('in', 'IN'), ('C.They', 'JJ'), ('will', 'NN'), ('touch', 'NN'), ('upon', 'IN'), (',', ','), ('or', 'CC'), ('I', 'PRP'), ('would', 'MD'), ('say', 'VB'), ('familiarize', 'NN'), ('you', 'PRP'), ('with', 'IN'), ('every', 'DT'), ('thing', 'NN'), ('the', 'DT'), ('language', 'NN'), ('offers', 'VBZ'), ('to', 'TO'), ('us', 'PRP'), ('.', '.')

DETECT ENTITY FROM REVIEW
'e' is the entity that has a unique name in the review . First noun detected after parts of speech tagging is treated as entity. In this example "book" is the entity.

DETECT ASPECT OF ENTITY
'a' is the particular aspect that is a feature of the entity 'e'. Here C Programming is the particular aspect of the entity.

DETECT SENTIMENT LEXICON
 's' is the sentiment of review.
In our example first line indicate "   The book is awesome". We get a positive sentiment word from this review. We also get another sentence " the book doesn't go into explaining stuff in very detail as the other books". This indicates negative sentiment.

NAME OF THE REVIEWER
'r' is the actual reviewer. Here Deepak Puthraya is the actual reviewer

TIME OF REVIEW
Generally it indicates date of review. Here date of review is 03 June 12

BACKGROUND OF REVIWER EXPERTISE

We already get two types of sentiments from same review. "But the book is not for beginners" indicates that if value of 'b' tuple is 0, then the opinion will be negative and if 1 then opinion will be the positive.

CASE STUDY 2

chaitanya Kuri...
12 May 2014

- **Well this book doesnt require any review as such, however any new person to programming, who wants to have a compact book which contains all information about C... this is the one.**

After Tokenize the text and use Parts-Of-Speech tagger

[('Well', 'NNP'), ('this', 'DT'), ('book', 'NN'), ('doesnt', 'NN'), ('require', 'NN'), ('any', 'DT'), ('review', 'NN'), ('as', 'IN'), ('such', 'JJ'), (',', ','), ('however', 'RB'), ('any', 'DT'), ('new', 'JJ'), ('person', 'NN'), ('to', 'TO'), ('programming', 'NN'), (',', ','), ('who', 'WP'), ('wants', 'NNS'), ('to', 'TO'), ('have', 'VB'), ('a', 'DT'), ('compact', 'NN'), ('book', 'NN'), ('which', 'WDT'), ('contains', 'VBZ'), ('all', 'DT'), ('information', 'NN'), ('about', 'IN'), ('C', 'NNP'), ('...', ':'), ('this', 'DT'), ('is', 'VBZ'), ('the', 'DT'), ('one', 'CD'), ('.', '.')]

DETECT ENTITY FROM REVIEW
'e' is the entity that has a unique name in the review . First noun detected after parts of speech tagging is treated as entity. In this example "book" is the entity.
DETECT ASPECT OF ENTITY
'a' is the particular aspect that is a feature of the entity 'e'. Here Programming is the particular aspect of the entity.
DETECT SENTIMENT LEXICON
's' is the sentiment of review.
In this example, no direct sentiment is indicated. But overall review sentiment is positive.
NAME OF THE REVIEWER
'r' is the actual reviewer. Here chaitanya Kuri... is the actual reviewer.
TIME OF REVIEW
Generally it indicates date of review. Here date of review is 12 May 2014
BACKGROUND OF REVIWER EXPERTISE
"any new person to programming, who wants to have a compact book which contains all information about C... this is the one." indicates that if value of 'b' tuple is 0 or 1 whatever, then the opinion will be positive.

CASE STUDY 3

salim
16 Jan 2014

- **nice book of c programming with a nice coverage in short.if u know a basic of c u can read it to improve ur knowledge**

After Tokenize the text and use Parts-Of-Speech tagger

[('nice', 'NN'), ('book', 'VBD'), ('of', 'IN'), ('c', 'NN'), ('programming', 'NN'), ('with', 'IN'), ('a', 'DT'), ('nice', 'JJ'), ('coverage', 'NN'), ('in', 'IN'), ('shortif', 'NN'), ('u', 'NN'), ('know', 'VB'), ('a', 'DT'), ('basic', 'JJ'), ('of', 'IN'), ('c', 'NN'), ('u', 'NN'), ('can', 'MD'), ('read', 'VB'), ('it', 'PRP'), ('to', 'TO'), ('improve', 'VB'), ('ur', 'NN'), ('knowledge', 'NN')]

DETECT ENTITY FROM REVIEW
'e' is the entity that has a unique name in the review . First noun detected after parts of speech tagging is treated as entity. In this example "book" is the entity.
DETECT ASPECT OF ENTITY
'a' is the particular aspect that is a feature of the entity 'e'. Here C Programming is the particular aspect of the entity.
DETECT SENTIMENT LEXICON
's' is the sentiment of review.
In our example first line indicate nice book of c programming……..". We get a positive sentiment word from this review. We also get another sentence " if u know a basic of c u can read it to improve ur knowledge". This indicates negative sentiment if the naïve user is begineer.
NAME OF THE REVIEWER
'r' is the actual reviewer. Here salim is the actual reviewer.
TIME OF REVIEW
Generally it indicates date of review. Here date of review is 16 Jan 2014
BACKGROUND OF REVIWER EXPERTISE We already get two types of sentiments from same review. "if u know a basic of c u can read it to improve ur knowledge" indicates that if value of 'b' tuple is 0, then the opinion will be negative and if 1 then opinion will be the positive.

CASE STUDY 4

jisan cool
12 Apr 2013

- **the book is good for depth knowledge , i don't think it's relevant for beginner. some chapter i like very much, like garbage collection .runtime environments , and code generation . last chapters are more useful to me then 1st chapters . it gave me good understanding . but lack coding examples and pictorial illustrations which is very important . i think it will be harder for a novice understanding the 'syntax analysis' and 'lexical analysis' . in my opinion to understand it very good read any easy book 1st- like "Compiler Design 1st Edition (Paperback) by A. A. Puntambekar" or any others or you can read online articles . it can be good reference book no doubt for depth understanding.**

After Tokenize the text and use Parts-Of-Speech tagger

[('the', 'DT'), ('book', 'NN'), ('is', 'VBZ'), ('good', 'JJ'), ('for', 'IN'), ('depth', 'NN'), ('knowledge', 'NN'), (',', ','), ('i', 'PRP'), ('do', 'VBP'), ("n't", 'RB'), ('think', 'VB'), ('it', 'PRP'), ("'s", 'VBZ'), ('relevant', 'JJ'), ('for', 'IN'), ('beginner.', 'NNP'), ('some', 'DT'), ('chapter', 'NN'), ('i', 'PRP'), ('like', 'VBP'), ('very', 'RB'), ('much', 'RB'), (',', ','), ('like', 'IN'), ('garbage', 'NN'), ('collection', 'NN'), ('.runtime', 'JJ'), ('environments', 'NNS'), (',', ','), ('and', 'CC'), ('code', 'NN'), ('generation', 'NN'), ('.', '.'), ('last', 'JJ'), ('chapters', 'NNS'), ('are', 'VBP'), ('more', 'RBR'), ('useful', 'JJ'), ('to', 'TO'), ('me', 'PRP'), ('then', 'RB'), ('1st', 'CD'), ('chapters', 'NNS'), ('.', '.'), ('it', 'PRP'), ('gave', 'VBD'), ('me', 'PRP'), ('good', 'JJ'), ('understanding', 'NN'), ('.', '.'), ('but', 'CC'), ('lack', 'NN'), ('coding', 'VBG'), ('examples', 'NNS'), ('and', 'CC'), ('pictorial', 'JJ'), ('illustrations', 'NNS'), ('which', 'WDT'), ('is', 'VBZ'), ('very', 'RB'), ('important', 'JJ'), ('.', '.'), ('i', 'PRP'), ('think', 'VBP'), ('it', 'PRP'), ('will', 'MD'), ('be', 'VB'), ('harder', 'JJR'), ('for', 'IN'), ('a', 'DT'), ('novice', 'NN'), ('understanding', 'NN'), ('the', 'DT'), ("'syntax", 'JJ'), ('analysis', 'NN'), ("'", "'"), ('and', 'CC'), ("'lexical", 'JJ'), ('analysis', 'NN'), ("'", "'"), ('.', '.'), ('in', 'IN'), ('my', 'PRP$'), ('opinion', 'NN'), ('to', 'TO'), ('understand', 'VB'), ('it', 'PRP'), ('very', 'RB'), ('good', 'JJ'), ('read', 'NN'), ('any', 'DT'), ('easy', 'JJ'), ('book', 'NN'), ('1st-', 'CD'), ('like', 'IN'), ('Compiler', 'NNP'), ('Design', 'NNP'), ('1st', 'CD'), ('Edition', 'NNP'), ('(', 'NNP'), ('Paperback', 'NNP'), (')', 'NNP'), ('by', 'IN'), ('A.', 'NNP'), ('A.', 'NNP'), ('Puntambekar', 'NNP'), ('or', 'CC'), ('any', 'DT'), ('others', 'NNS'), ('or', 'CC'), ('you', 'PRP'), ('can', 'MD'), ('read', 'VB'), ('online', 'NN'), ('articles', 'NNS'), ('.', '.'), ('it', 'PRP'), ('can', 'MD'), ('be', 'VB'), ('good', 'JJ'), ('reference', 'NN'), ('book', 'NN'), ('no', 'DT'), ('doubt', 'NN'), ('for', 'IN'), ('depth', 'NN'), ('understanding', 'VBG')]

DETECT ENTITY FROM REVIEW
'e' is the entity that has a unique name in the review . First noun detected after parts of speech tagging is treated as entity. In this example "book" is the entity.

DETECT ASPECT OF ENTITY
No direct aspect definition is mentioned here. It is a comparative review.

DETECT SENTIMENT LEXICON
's' is the sentiment of review.
In our example first line indicate **good for depth knowledge** ……..". We get a positive sentiment word from this review. We also get another sentence " **i don't think it's relevant for beginner**". This indicates negative sentiment if the naïve user is begineer.

NAME OF THE REVIEWER
'r' is the actual reviewer. Here jisan cool   is the actual reviewer.

TIME OF REVIEW
Generally it indicates date of review. Here date of review is 12 Apr 2013

BACKGROUND OF REVIWER EXPERTISE We already get two types of sentiments from same review. "**i don't think it's relevant for beginner**" indicates that if value of 'b' tuple is 0, then the opinion will be negative and if 1 then opinion will be the positive.

CASE STUDY 5
Akshaya Dayal
10   nov 2013

- **This is definitely not a book for those taking a freshmen course in Algorithms. One of the biggest tragedies is that the author fails to convey the simplicity and "niceness" of algorithms.I almost hated this book while studying Prims. I would go for Cormen anyday over this. Also ,the MIT courseware helps for the DIY enthusiasts.**

After Tokenize the text and use Parts-Of-Speech tagger

[('This', 'DT'), ('is', 'VBZ'), ('definitely', 'RB'), ('not', 'RB'), ('a', 'DT'), ('book', 'NN'), ('for', 'IN'), ('those', 'DT'), ('taking', 'VBG'), ('a', 'DT'), ('freshmen', 'NN'), ('course', 'NN'), ('in', 'IN'), ('Algorithms.', 'NNP'), ('One', 'CD'), ('of', 'IN'), ('the', 'DT'), ('biggest', 'JJS'), ('tragedies', 'NNS'), ('is', 'VBZ'), ('that', 'IN'), ('the', 'DT'), ('author', 'NN'), ('fails', 'VBZ'), ('to', 'TO'), ('convey', 'NN'), ('the', 'DT'), ('simplicity', 'NN'), ('and', 'CC'), ('niceness', 'NN'), ('of', 'IN'), ('algorithms.I', 'NNP'), ('almost', 'RB'), ('hated', 'VBD'), ('this', 'DT'), ('book', 'NN'), ('while', 'IN'), ('studying', 'VBG'), ('Prims.', 'NNP'), ('I', 'NNP'), ('would', 'MD'), ('go', 'VB'), ('for', 'IN'), ('Cormen', 'NNP'), ('anyday', 'NN'), ('over', 'IN'), ('this.', 'NNP'), ('Also', 'NNP'), (',', ','), ('the', 'DT'), ('MIT', 'NNP'), ('courseware', 'NN'), ('helps', 'NNS'), ('for', 'IN'), ('the', 'DT'), ('DIY', 'NNP'), ('enthusiasts', 'VBZ'), ('.', '.')]

DETECT ENTITY FROM REVIEW

'e' is the entity that has a unique name in the review . First noun detected after parts of speech tagging is treated as entity. In this example "book" is the entity.

DETECT ASPECT OF ENTITY

'a' is the particular aspect that is a feature of the entity 'e'. Here **Algorithms** is the particular aspect of the entity.

DETECT SENTIMENT LEXICON

's' is the sentiment of review.

No direct sentiment lexicon adjective is found. But in first sentence "definitely not" indicate review is negative.

NAME OF THE REVIEWER

'r' is the actual reviewer. Here Akshaya Dayal is the actual reviewer.

TIME OF REVIEW

Generally it indicates date of review. Here date of review is 10 nov 2013

BACKGROUND OF REVIWER EXPERTISE

 "**This is definitely not a book for those taking a freshmen course in Algorithms**" indicates that if value of 'b' tuple is 0, then the opinion will be negative and if 1 then opinion will be the positive.

7. ACKNOWLEDGMENT

Natural Language Toolkit with Python 2.7 are used to get tokenized tag set in this paper. We consider www.flipkart.com is the main source of opinion.

8. CONCLUSION AND FUTURE WORK

In this paper, we propose a new definition of opinion for book review purpose and describe how to convert an unstructured opinion to a structured format (six tuples format). To detect sentiment from review or calculate the actual polarity of the opinion based on various scheme, 'r' (means name of actual reviewer) and 't' (means time of the review) need not be helpful. In future, we will try to calculate sentiment polarity and try to detect sarcastic review.

REFERENCES

[1] Zhiyuan Chen, Arjun Mukherjee, Bing Liu, Meichun Hsu, Malu Castellanos, and Riddhiman Ghosh. *Exploiting Domain Knowledge in Aspect Extraction*. To appear in *Proceedings of Conference on Empirical Methods in Natural Language Processing (EMNLP-2013)*, October 18-21, 2013, Seattle, USA.

[2] Bing Liu. *Sentiment Analysis and Opinion Mining*. Morgan & Claypool Publishers, May 2012M. Wegmuller, J. P. von der Weid, P. Oberson, and N. Gisin, "High resolution fiber distributed measurements with coherent OFDR," in *Proc. ECOC'00*, 2000, paper 11.3.4, p. 109.

[3] Ali Harb, Michel Plantié, Gerard Dray, Mathieu Roche, François Trousset, Pascal.Poncelet *Web Opinion Mining: How to extract opinions from blogs?* published in "CSTST'08: International Conference on Soft Computing as Transdisciplinary Science and Technology,.

[4] Ritesh Agarwal, T. V. Prabhakar, Sugato Chakrabarty. *"I Know What You Feel":Analyzing the Role of Conjunctions in Automatic Sentiment Analysis*,6th International Conference, GoTAL 2008 Gothenburg, Sweden, August 25-27, 2008 Proceedings pp 28-39

[5] Turney, P.D.: *Thumbs Up or Thumbs Down? Semantic Orientation Applied to Unsupervised Classification of Reviews*. In: Proceedings of the 40th Annual Meeting of the Association for Computational Linguistics ACL, pp. 417–434. Philadelphia (2002)

[6] Pang, Bo, Lillian Lee, and Shivakumar Vaithyanathan. "Thumbs up?: sentiment classification using machine learning techniques." *Proceedings of the ACL-02 conference on Empirical methods in natural language processing-Volume 10*. Association for Computational Linguistics, 2002.

[7] Songbo Tan, Xueqi Cheng, Yuefen Wang, Hongbo Xu *"Adapting Naive Bayes to Domain Adaptation for Sentiment Analysis"* ;31th European Conference on IR Research, ECIR 2009, Toulouse, France, April 6-9, 2009. Proceedings; pp 337-349

[8] Santanu Modak, Abhoy Chand Mondal *"A New Definition Of Opinion in Opinion Mining"* in the souvenir of NSRAMA 2014

[9] Bird, Steven, Edward Loper and Ewan Klein (2009), *Natural Language Processing with Python*. O'Reilly Media Inc.

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