

## **Sentiment Analysis and Education**

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### **Abstract**

This paper describes the detailed approach on how to classify and analyze the polarity or opinion (e.g. positive, negative, or neutral) of a given document, text-span or sentence. The experiments with various methods showed that the best performance can be achieved with the combination of both baseline and feature-based model. In addition, we have shown the potential application of this work in diverse fields.

**Keywords:** Sentiment Analysis, Education, Opinion Mining

## **Introduction**

The sentiment is the attitude, opinion or feeling toward something, such as a person, product, organization or location. Sentiment analysis is a tool to identify and extract subjective information the given source. Sentiment analysis task, also known as opinion mining often use natural language processing, text analysis and computational linguistics. One will like to know others opinions about movies, books, products, etc. These opinions and reviews can be found in social networking sites, personal web-blogs, discussion forums and so on. These opinions can also be used by companies to improve their product sales and services.

## **Problem Statement**

The problem of sentiment analysis is classifying the polarity of a given text at the sentence, document or feature or aspect level. Whether the expressed opinion in a document, a sentence or an entity feature/aspect is objective (also known as neutral) or subjective (also known as positive or negative).

## **Motivation**

With the proliferation of web 2.0, a user-generated online content or increase in popularity of online review websites and personal blogs, it is difficult for a user to crawl through all the data. Therefore, sentiment analysis is a tool capable of extracting the information most important to the user from the plain text data. This led to an increase in research in areas of opinion mining and sentiment analysis, with the thought of producing methodologies that can automatically analyze text spans or user reviews and extract information most relevant to the user. As a result, we thought of narrowing this tool for the field of education.

## **Related work**

Even though the area of opinion mining has recently emerged as a new research topic, a considerable amount of research activity has been done. We will discuss some of the related works that motivated and helped us throughout this work will be explained in this section.

In (Pang, & Lee, 2008) gave the strong emphasis on why this area of the opinion mining and sentiment analysis is much of a research problem. This paper also discusses some of the general challenges such as contrast with standard fact-based textual analysis. It also lists of some of the factors that make opinion mining difficult. This helped us to work on this problem of sentiment analysis.

In (Wilson, et al., 2005) the authors tells how to detect contextual polarity in phrase-level. The authors gave a decent approach to extract sentiment at phrase-level or sentence-level. Moreover, this work stresses on contextual polarity. It says that contextual polarity of the phrase may be different from word's prior polarity. This work also describes the intensity of negation and its effect on the polarity of the phrase. So we conducted our experiments at phrase-level also.

In (Pak, & Paroubek, 2010) the work is mainly on microblogging site such as twitter, taking the tweets data as the corpus of the work. This paper presents a method on how to collect a corpus of both positive and negative sentiments and also objective texts with no human effort. They performed statistical linguistic analysis of collected corpus. This paper motivated us to think of different possibilities of collecting corpus.

In (Godbole, & Srinivasaiah, 2007) says how to perform large-scale sentiment analysis for news and blogs.

In (Kouloumpis, et al., 2011) this paper is presented with data preprocessing. We have adopted this approach of data preprocessing into our work.

## Methodology

In this section we have used different machine learning methods, viz.,  
 Baseline method,  
 Naive Bayes (NB) and  
 Maximum Entropy (MaxEnt).

We first take the text-span and then tokenize it in the tokenization step. We take the tokens and then pre-process the tokens, which removes punctuations etc. Then we detect the features and extract them. These features are predicted the polarity with the help of the various methods mentioned above.

### Baseline

This model makes use of “bag of words” which relays more on the words, or sometimes a string of words. This model usually has a large list, it would be better if we consider it as a dictionary which is considered to be words that carry sentiment, i.e., a list of positive and negative words. For each text-span, we consider the number of positive and negative keywords that appear. This classifier returns the polarity with a higher count. In the case of a tie, the polarity of the majority class is returned.

### Naive Bayes (NB)

Naive Bayes is a simple model which works effectively on text categorization. We used a multinomial Naive Bayes model. Here class  $c^*$  is assigned to a text-span  $d$ , where

$$c^* = \underset{c \in C}{\text{argmax}} \left( \frac{P(c) \prod_{i=1}^n P(w_i | c)}{P(d)} \right)$$

$$P(c | d) := \frac{P(c) \sum_{i=1}^n P(w_i | c)}{P(d)}$$

### Maximum Entropy (MaxEnt)

Maximum entropy classifiers are commonly used as substitutes to Naive Bayes classifiers as they do not assume statistical independence of random variables that serve as predictors. Random variables are usually known as features. However, learning in such a model is generally slower than for a Naive Bayes classifier, and thus may not be applicable given a very large number of classes or features to learn. Learning in Naive Bayes classifier is a fundamental way of counting the number of co-occurrences (combined occurrences) of features and classes, while in a MaxEnt classifier the weights, which are typically maximized using maximum a posteriori (MAP) estimation, must be learned using an iterative procedure.

## Approach

The approach and work-flow is shown in the following figure.

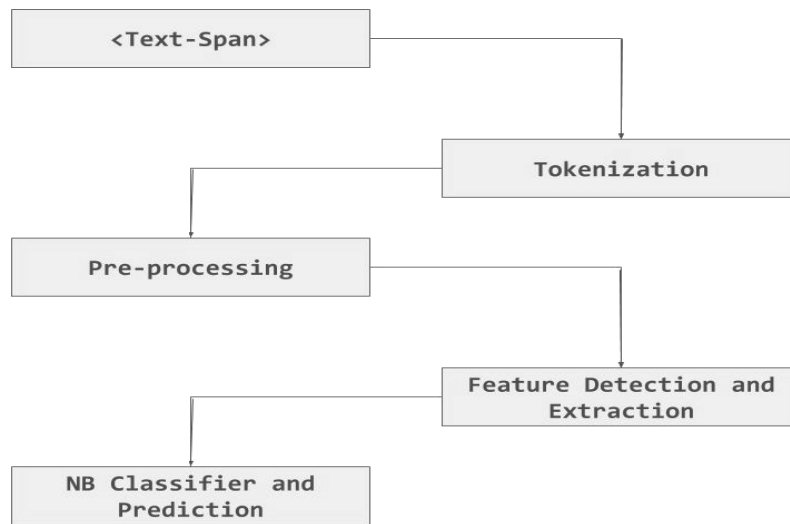


Figure 1: Work-flow of implementation of the methodology used

## Results

The results were obtained with baseline model on taking the unigrams, bigrams and trigrams and contrast it with the feature based model for two subtasks, i.e., document-level and sentence-level. Following are accuracy and F1 score with the corresponding subtasks at different levels.

### Accuracy

The corresponding table shows results of accuracy at two different levels for various approaches out of which the combination of first two approaches gives the better results of accuracy at both the levels.

Subtask	Baseline Model	Feature-based Model	Baseline + Feature-based Model
Document-Level	65.32%	78.93%	80.49%
Sentence-Level	54.76%	59.84%	61.27%

### F1 score

The corresponding table shows results of the F1 score at two different levels for various approaches out of which the combination of first two approaches gives the better results of the F1 score at both the levels.

Subtask	Baseline Model	Feature-based Model	Baseline + Feature-based Model
Document-Level	78.53	77.29	77.81
Sentence-Level	58.67	61.08	63.42

## **Potential Applications**

### **Feedback during the semester**

The course feedback from students at the end of the semester was taken; however, this has the drawback of not being helpful for students who have already taken the course (after completion of the course). Feedback should be taken in real time and analyzed in real time to assist and help the current students. This would allow students and teachers to address teaching and learning issues in the most favorable way for students.

The analysis of feedback using sentiment analysis approach can identify students' positive or negative feelings or even more refined emotions that the students are feeling to the present way or style of teaching. Feedback and comments can be collected in many ways using student response systems such as remote controls, mobile phones and sms. Responses can be gathered or acquired via social media such as twitter. In this way, using sentiment analysis on educational data can help in enhancing the teaching methodology. Opinions can be positive or negative. Different emotions can also be equated with these opinions. Moreover, emotions can be as bored, confusing and irritated. Responses such as confidece and enthusiasim might be considered as positive emotions. When a student feedback does not reflect either positive or negative feedback we may consider it as neutral feedback.

### **MOOC Discussion Forums**

MOOC Discussion forums can use collective sentiment analysis to study students' attitudes towards the course and course tools based on forum posts (course-level sentiment analysis). Use survival analysis (time up to which a student is interested) and later the active participation may decrease, sometimes lead to drop out of the course.

### **Book Reviews**

Reviews from different book-selling sites will be collected and analyzed with our tool sentiment analysis. Analysis based on author, content and genre will be collected. The author may be renowned, but the book he published may not be up to the mark. These all can be analyzed using our tool. This helps the buyers come to a conclusion and wish to buy or not. This also helps authors to analyze where he went wrong and rectify his mistake in his/her book. She/he will also get to know the taste or the essence of the readers. Book publishers also now see how and what exactly the readers looking for and then choose whether to publish or not for his next publication(s).

## **Conclusion**

This paper presented a family of Naive Bayes classifiers for the prediction of polarity. The experiments have shown that the best performance is achieved by using the binary classifier, trained to detect just two categories: Positive and Negative. In order to detect polarity, this work needs a strategy based on searching for polarity elements within the text span.

## **Future Work**

We would like to extend this work to different domains and finally make it domain independent. We would also like to work on more fine-grained aspects and make a tool for aspect-based sentiment analysis.

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