Analyzing ELeaming platform reviews using Sentimental Evaluation with SVM Classifier

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Abstract. In today’s scenario, the participation of eLearning courses is rapidly increasing among users, especially during post-pandemic situation. Due to a hike in the need of eLearning, there is a sharp increase in emerging of online courses. Not only the academic people (students and teachers), but others also interested in the online courses, irrespective of their ages. Since numerous eLearning platforms are mushrooming, it is mandatory to follow various standard techniques to evaluate the quality of these courses. It would be more adaptable, if the evaluation techniques are made based on the Course users feedback. These feedback of the users contain more valuable information which helps in constructive decision making. The satisfactions and criticisms of the courses are shared through opinion of the registered user. Due to enormous amount of web reviews available for a course, it is extremely time-consuming and difficult to manually analyze the review and come to a conclusive decision. Reviews contain course feature specific factual information along with the opinion statements which may be positive or negative. The text reviews obtained from most of the webpages of the online courses feedback or comments section, are found to be unstructured and inconclusive. Analyzing and extracting the actual opinion throughout the reviews manually is very difficult. So, an automated technique is needed to evaluate the course based on the features of the courses, which results in attaining a decision. The Aspect based opinion mining is such a methodology which describes the important aspects of each opinion and classify them on their polarity.

1. Introduction
Mining valuable information from these online Course reviews not only provides some necessary subject information for the potential candidate but also helps course organizers to track the feedbacks of users on time. The feedback information contributes course organizer to maintain the content of the course and improve the delivery, resources and finally make them gain competitiveness in the near future. However, the huge number of network comments also makes mining useful information to be a new challenge. It is hard and unrealistic for human to tackle all the reviews and classify them to positive or negative manually. Under this situation, automatic sentiment analysis technology has significant meaning. Via this approach, we can automatically extract the opinion which the author expressed on the course or its features. Document-level
and sentence-level [2] based sentiment analysis are usually used to judge the overall evaluations of the course. In order to obtain much finer grained and detailed course information, feature-level sentiment analysis is essential [3]. There are two major topics involved in feature-level sentiment analysis [4]: Extracting the course features which the user concerned. For example, in the sentence “The delivery and the content of the course are good”, (tone quality) is the course feature. Analyzing the sentiment orientation of the course features. That is, classifying the author’s evaluations expressed on the course feature into positive emotion, negative emotion or neutral. In the above sentence, the evaluation on the feature “content” is positive.

2. Literature Survey

2.1 Opinion Mining Approaches

Sentiment can be extracted through either by Machine learning approach or by Lexicon-based approach or Semantic approach or Statistical approach or Rule based approach [2]. Machine learning techniques can be categorized [4] as supervised and unsupervised learning whereas lexicon-based approach techniques can be categorized into corpus-based approach and dictionary-based approach. Support Vector Machine (SVM) outperform Naïve Bayes classifier.

2.2 Aspect Based Opinion Mining

Aspect based opinion mining is preferred in this work. The core tasks in aspect based opinion mining is aspect identification, aspect based opinion word identification and its orientation detection. In [1] SentiWordNet, two word phrases and linguistic rules together for opinion orientation detection, with automatic acquisition of aspects. In this work only explicit aspects are considered and word sense disambiguation is ignored.

In [3] Deep learning approach to improve aspect based Mining is introduced. CNN is comprised of one or more convolutional layers which are responsible for major breakthroughs in image classification. More recently, CNN is also applied to problems in Natural Language Processing like information retrieval and relation classification, sentiment analysis spam detection or topic categorization [12]. Sentences or documents that are the input of most NLP tasks can be represented as a matrix where each row represents one token. A token may be a word or a character. The convolutional layers can be represented as the weighted sum of the word vectors with respect to the shared weight matrix.

The dependency parsing [1], which reveals the syntactic structure by analyzing the dependency relationship between different components of a sentence. That is, the dependency parsing labels grammatical constituents such as “subject-verb”, “verb-object” and analyzes the relations between them. Topic models [5] are most popularly used aspect extraction methods as, web documents have reviews with a mixture of topics whereas each topic is a probability distribution of words[11]. Topic models are adapted and extended by probabilistic Latent Semantic Analysis (LSA) and Latent Dirichlet Allocation (LDA) models. Topic modelling [6] or clustering is only able to find some general or rough features, it is difficult to extract finer-grained or precise features.

In [7] Sentiscore algorithm is proposed. The classification process is done by KNN algorithm. The naïve bayes is perfect for the small amount of data to be processed but when the amount of data getting increased the accuracy getting low. So, finally the KNN algorithm will suite for the large volume of data [10]. By hybrid they both algorithms can get better accuracy but complexity increases.

2.3 Summarization and Rating Prediction

In [8] five steps to generate the summarization is discussed:
1) obtain the review text;
2) extracts adjective-noun word pairs;
3) counts each word pair’s occurrences;
4) performs a sentiment analysis of each word pair; and
5) displays the word pairs. TF and TF-IDF scoring methods are introduced but tend to contain word pairs which users would find rather irrelevant or uninformative.

Unlike previous works that used only Multinomial Naïve Bayes model, this work [9] employed Bigram and Bigram- Trigram Multinomial model. Bigram Trigram Multinomial model reported on the par best accuracy given by Random Forest while showing 12 times faster performance. Thus, Bigram-Trigram model is efficient model in text classification when dealing with huge dataset.

3. Proposed Methodology
In the proposed model, we use the machine learning algorithm (linear SVC) to classify the feature of the course. In which each feature of the course are trained, which makes the model more accurate and specific for the course. In preprocessing of data, the multiclass sentence is separated to improve the efficiency of the model. In addition, Opinion summarization of each individual feature is done by the dependency parser. The rating for the review are computed by the random forest algorithm and the feature for the model is extracted by the bag of word. Fig 1 illustrates the proposed methodology.

![Proposed method](image)

**Figure 1.** Proposed method.

3.1 Web Scraping
Web Scraping (also termed Screen Scraping, Web Data Extraction Web Harvesting etc.) is a technique employed to extract large amounts of data from websites whereby the data is extracted and saved to a local file in your computer or to a database in table (spreadsheet) format. In Fig 2, the web scrapping can be depicted.

![Web Scrapping](image)

**Figure 2.** Web Scrapping.
3.2 Preprocess Scrapped Data

Most often sentiment analysis is fed from natural language sentences. While generating the content using natural language, there may be incomplete texts and malformed sentences are included. Therefore, in order to do sentiment analysis, the sentences in the natural form, need to be pre-processed.

Pre-processing the review data is the exercise of cleaning and removing the noise from the sentences. Since online texts are customer feedback, there are lots of noise such as smiles and emoticons. So, keeping those unnecessary words in the review database makes more difficult, as each word in the text is treated as an input to the system. So, it is important to reduce the noise in the text. As a result, the performance of the classifier and the speed of the classification process will be increased. Reviews from the web contains more noisy data like ‘\n’ and non-opinion sentences. These sentence are identified and removed by the regex parser in the NLTK. The Multiclass(features) sentence are separated by finding the connecting sentence (CC) and the DT using the pos-tag to increase the performance of the model.

3.3 Aspect Extraction

Aspects are the important features mentioned by the customers in the online review. They give their feedback based on these aspects. However, these features are hidden within the sentences. Generally, customers do not clearly mention that a sentence is based on a particular aspect in the online review.

Approaches in Aspect Extraction are 1. Frequency based approach, 2. Relation based approach 3. Model based approach. Here the Frequency based approach and Relation based approach are used to identify the feature. The frequency based approach is used to find the features needed for the machine learning algorithm to predict the labels and the Relation based approach is used for dependency parser.

3.3.1 Frequency based Approach

This approach identifies the frequent aspects of a course on which many people have expressed their opinion. If, the occurrence of aspect related terms is more than that of the pre-defined threshold value, then that term is considered to be frequent aspect. In information retrieval, tf–idf or TFIDF, short for term frequency–inverse document frequency, is a numerical statistic that is intended to reflect how important a word is to a document in a collection or corpus.

TFIDF score for term I in document j=TF(i,j)*IDF(i) where IDF=Inverse Document Frequency
TF=Term Frequency
TF(i,j) = Term I frequency in document j
Total words in document j

Total Documents

\[ \text{IDF(i)} = \frac{\text{Total Documents}}{\text{documents with term i}} \]

and t=term
j=document

3.3.2 Relation based approach

In this domain, aspects are the important features of the course. Aspect can be a word or a phrase. For example, “course duration”, “delivery quality”, “comprehensibility” are the main aspects of the course domain. Using a POS tagger, preprocessed review files were tokenized. For that, POS tagger was given to each word of the review file.
For example, the review “very good content” is tokenized as “very/jj good/jj content/nn” where jj and nn represents adjective and noun respectively. When author reads reviews manually in most situations, nouns and noun phrases are identified as aspects. In order to extract aspects from the sentences in all reviews, observing for nouns and noun phrases are needed. After tokenizing the review texts using a POS tagger, it extracts NN (noun, singular), NNS (noun, plural), NNP (proper noun, singular) and NNPS (proper noun, plural) tagged words from the review file as aspects dependency parser is used to extract the Aspect from the sentence and their corresponding opinion word by using the synaptic dependency.

3.3.3 Dependency Parser
Opinion words express the opinion towards the aspects. So, during this phase, aspect related opinion words should be identified. Opinion words can be used as adjectives, adverbs and verb combinations. For the opinion word extraction process the dependency parser is used. Spacy provide a representation of grammatical relations between words in a sentence. These dependencies are triplets: Name of the relation, governor and dependent. For example, consider the review; “The content quality is great and I enjoy it”. According to the Spacy, the parsed output for this review is as follows:

the det quality NOUN []
content quality NOUN [] quality nsubj is AUX [the, content]
is ROOT is AUX [quality, great, and, enjoy] impressive acomp is AUX []
and cc is AUX []
i nsubj love VERB [] love conj is AUX [i, it] it dobj love VERB []

Here the content quality and its opinion great is indirectly connected. The children of the root connects the quality with great (The great is the acomp and the quality is the nsubj which is in compound with the content). Thus the summarized text is “content Quality - impressive”. An Example of Review Summarization can be found in Table 1.

### Table 1. Review Summarization

| Review                                                                 | Summarization       |
|------------------------------------------------------------------------|---------------------|
| “I have completed this course a month ago the content of the course is good and delivery of the course was great and comprehensible” | Content - good, Delivery - great |
| “Course duration is too long and it is difficult to follow the instructions”          | duration - long instructions - difficult |

3.3.4 Aspect and polarity based opinion classification
The Preprocessed data enters the trained Model which separates the opinion Based on the Aspect of the course for example if we process the course data the aspects may be ‘Duration’, ‘Content’, ‘Duration’, ‘Resource’ and each aspects carries their own polarity whether the opinions on the aspects are positive or negative (‘+’, ‘-’) SVM is used to train the model which gives better accuracy than other classification algorithm. In Table 2 Aspect and Polarity Prediction can be illustrated.
Table 2. Aspect and Polarity Prediction

| Reviews                      | feature    | Polarity |
|------------------------------|------------|----------|
| Content is good              | Content    | Pos      |
| Duration is too long         | Duration   | Neg      |
| Resources is good            | Resource   | pos      |
| Great course in the Range    | Value for money | pos   |
| Content quality is poor      | Content    | neg      |
| Assessment is good           | Assessment | pos      |

3.3.5 Opinion based Course feature rating

The Aggregate score for each course features are computed which gives an overall view of the course feature opinion in the review. The Bag of words is use to extract the opinion features from the review sentence and the Random Forest algorithm is used to predict the output result rating of the review. The bag-of-words model is a simplifying representation used in natural language processing and information retrieval (IR). In this model, a text (such as a sentence or a document) is represented as the bag (multiset) of words, disregarding grammar and even word order but keeping multiplicity.

4 Evaluation and Result

In this experiment we have used the natural language processing to separate the multiclass sentence into the single class sentence which increases the accuracy and the efficiency of the SVM model.

|                     | precision | recall | f1-score | support |
|---------------------|-----------|--------|----------|---------|
| Content             | 0.89      | 0.89   | 0.89     | 83      |
| Resource Quality    | 0.77      | 0.85   | 0.80     | 39      |
| Delivery            | 0.93      | 0.79   | 0.86     | 34      |
| Comprehensibility   | 0.84      | 0.74   | 0.79     | 43      |
| Course Duration     | 0.85      | 1.00   | 0.92     | 33      |
| avg/total           | 0.86      | 0.86   | 0.86     | 232     |

Figure 3. Result of aspect prediction.

The result of the Aspect classification is shown in fig. 3. The main Aspects of the course data are the content, Resource Quality, Delivery, Comprehensibility, Course Duration. The SVM is used to predict the aspects of the course which shows an accuracy of 86%.
Figure 4. Result of polarity prediction.

In fig. 4 the results of the polarity prediction are tabulated. The SVM is used to predict the polarity of the reviews. It shows 94% of accuracy.

| pos  | 0.92 | 0.95 | 0.94 | 199 |
|------|------|------|------|-----|
| neg  | 0.96 | 0.93 | 0.95 | 233 |
| avg/total | 0.94 | 0.94 | 0.94 | 432 |

Figure 5. Result of rating prediction.

Figure 5 shows the error rate of the prediction is minimum. The random forest shows low level of error.

5 Conclusion and future work

The above results conclude that feature specific aspect mining of the online courses is conceivable. Extracting the frequency of aspects and classification of the aspects and its polarity could be done initially. The polarity is calculated for the aspects identified based only on user comments. Comparing with machine learning classification algorithm like Naïve Bayes and Decision tree algorithm, the SVM classification can be scaled to the 86% of the accuracy. The dependency parser identifies the dependency between review sentences and their relative opinions. Using Random Forest algorithm, the Scores can be provided for various courses features and recommendation is given the courses to users.

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