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# Aspect Based Sentiment Analysis

## Abstract

This report represents a research project in which we developed an ABSA system that receives and parses a set of text inputs such as restaurant reviews or messages from social media discussing a entity such as food or ambiance. The system attempts to detect the primary aspects (features) of the entity and to estimate the average sentiment of the texts per aspect term. (e.g. how positive or negative the opinions are on average for each aspect) by using POS tagging, tfidfvectorizer. The system implements different classifiers such as Naive Bayes, SVM, Random forest and compares the results. Performance was measured using precision, recall, F1 and overall accuracy. The best results achieved were using SVM classifier with average precision of 0.75, recall of 0.74, F1 score of 0.74 and overall accuracy of 75% for the first dataset and with Naïve Bayes classifier with precision of 0.73, recall of 0.66 and F1 score of 0.69 with 69% overall accuracy for second dataset.

## Introduction

Aspect-based sentiment analysis is the research problem that focuses on the recognition of all sentiment expressions within a given document and the aspects to which they refer. It analyzes people's opinions, sentiments, appraisals, attitudes and emotions towards entities or aspects such as products, services organizations etc. expressed in text. Aspect based sentiment analysis (ABSA) has spread to every possible domain, from health care to consumer products, social events to political campaigns and elections. Opinions are an integral part of human activities as they influence our behavior. Taking any decision, people want to know the opinions of others. The organizations and businesses need their users' opinions about their products and services to serve them better products, users want to know other people's opinions about a certain service or product to make an informed decision. In politics, the candidates have been known to take advantage of this technology advancement available to appeal to a specific target audience. Past decade has seen a tremendous increase in people using internet as a platform to voice their opinions. The rise of social media in recent years has made it possible to collect huge amount of opinions data to be used for these real-world applications.

## Techniques

There are two approaches to Sentiment Analysis – the classifier-based approach, which treats Sentiment Analysis as a special case of text classification and uses standard Machine Learning techniques to solve the problem and the lexicon-based approach, which uses sentiment lexicons – dictionaries of words with labels specifying their sentiments – to identify the sentiment of text. Both approaches have their advantages and drawbacks. This report presents the former approach. The two datasets were given for aspect-based sentiment analysis. Python was used to implement the project as abundance of packages such as sklearn make it easy to implement classic machine learning algorithms. Pandas library was used to read the csv files.

### *Preprocessing*

A very essential part of this system is data preprocessing as the data given was noisy and a preprocessing step improves the quality of linguistic features, mainly text preprocessing to normalize the data into suitable input data format needed to feed the classifier model.
At first the 'text' column from the dataset was stored in a list to handle the data easier. Fully capitalized words were converted to lowercases. All the numbers from the text sentences were removed along with the punctuation marks and stop words. Vector space model which is also known as bag of words model was used in which a text (such as a sentence or a document) is represented as the bag (multiset) of its words, disregarding grammar and even word order but keeping multiplicity.
For the second phase each text entry was passed through a tokenizer and POS tagger to obtain the tokens and POS tags respectively that were necessary for the features. Each sentence, with its pseudo-tokens produced by the normalization step, is mapped into a sequence of POS tagged lemmas. TfidfVectorizer was used to transform text to feature vectors that can be used as input to estimator. It converts each token (word) to feature index in the matrix, each unique token gets a feature index.

### *Features*

Aspect term polarity - For a given set of aspect terms within a sentence, to determine the polarity of each aspect term: positive, negative, neutral or conflict (i.e., both positive and negative) Word N-grams, Polarity of neighboring adjectives, Neighboring POS tags and Parse dependencies and relations were used. All the classifiers performed operations on the same set of features. In the preprocessed texts a window of + or - 5 words around the aspect term was considered. This aspect term was extracted from the given data sets' 'aspect' column. Inside this window, number of positive emoticons and negative emoticons were considered for polarity detection.
Sentiment of aspect was computed by using sentiment value of each n-gram and distance between the n-gram and the aspect. Sentiment of aspect category is computed by calculating the distance between n-gram and the corresponding aspect. Aspect category polarity also been detected using just unigram and bigram features during the first phase. Better results were achieved with the former mentioned approach.

### *Classifiers*

Four classifiers were used to compare the results with both data sets. All the classifiers were fed the same features. Classifiers used were,

1. Naive Bayes
2. SVM
3. Random Forest
4. Decision Tree

## Evaluation

The performance of the various approaches for the subtasks of Aspect Based Sentiment Analysis has been evaluated. The performance can be evaluated through precision (P), recall (R) or F-score (F) depending on the subtask, which are defined as

$$\text{Precision} = \frac{tp}{tp + fp} \qquad \text{Recall} = \frac{tp}{tp + fn}$$

$$\text{F}_1 \text{ Score:} \quad 2\frac{PR}{P+R}$$

Where TP (True Positive), TN (True Negative), FP (False Positive) and FN (False Negative) are the cases correctly classified or incorrectly classified, and F-score is the some average of precision and recall metrics.

| Data 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SVM | | | Naive Bayes | | | Random Forest | | | Decision Tree | | |
| | 1 | -1 | Avg | 1 | -1 | Avg | 1 | -1 | Avg | 1 | -1 | Avg |
| Precision | 0.8 | 0.74 | 0.75 | 0.84 | 0.75 | 0.75 | 0.76 | 0.77 | 0.73 | 0.76 | 0.75 | 0.70 |
| Recall | 0.77 | 0.73 | 0.75 | 0.73 | 0.71 | 0.71 | 0.75 | 0.69 | 0.72 | 0.76 | 0.68 | 0.71 |
| F1 Score | 0.78 | 0.73 | 0.74 | 0.78 | 0.73 | 0.72 | 0.75 | 0.73 | 0.71 | 0.76 | 0.71 | 0.71 |
| Overall Accuracy | 0.75 | | | 0.73 | | | 0.72 | | | 0.71 | | |

| Data 2 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SVM | | | Naive Bayes | | | Random Forest | | | Decision Tree | | |
| | 1 | -1 | Avg | 1 | -1 | Avg | 1 | -1 | Avg | 1 | -1 | Avg |
| Precision | 0.79 | 0.54 | 0.64 | 0.88 | 0.41 | 0.73 | 0.87 | 0.28 | 0.73 | 0.86 | 0.30 | 0.72 |
| Recall | 0.76 | 0.57 | 0.63 | 0.73 | 0.53 | 0.66 | 0.68 | 0.48 | 0.62 | 0.67 | 0.45 | 0.61 |
| F1 Score | 0.78 | 0.55 | 0.63 | 0.80 | 0.47 | 0.69 | 0.76 | 0.35 | 0.66 | 0.76 | 0.36 | 0.65 |
| Overall Accuracy | 0.67 | | | 0.69 | | | 0.66 | | | 0.66 | | |

## Conclusions

To summarize, the report presents the findings of aspect-based sentiment analysis using different classifiers such as Naïve Bayes, SVM, Random Forest on datasets that of restaurant review and laptop review using steps such as POS tagging and use of tfidfVectorizer. The best results were achieved by the SVM classifier for the first dataset with 75% overall accuracy and Naïve Bayes classifier for the second dataset with 69% overall accuracy.

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