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# Mining sentiments in SMS texts for teaching evaluation

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ABSTRACT

This paper explores the potential application of sentiment mining for analyzing short message service (SMS) texts in teaching evaluation. Data preparation involves the reading, parsing and categorization of the SMS texts. Three models were developed: the base model, the "corrected" model which adjusts for spelling errors and the "sentiment" model which extends the "corrected" model by performing sentiment mining. An "interestingness" criterion selects the "sentiment" model from which the sentiments of the students towards the lecture are discerned. Two types of incomplete SMS texts are also identified and the implications of their removal for the analysis ascertained.



## 1. Introduction

In education, it is typical to have an end-of-course evaluation in which the students can express their opinions about the teachers or instructors as well as the content and delivery of the course. Such evaluation generally involves a Likert scale (Likert, 1932) in which the students will indicate their opinions on the course by checking how strongly they agree or disagree with carefully constructed statements about the teachers, the course content and the delivery of the course. Typically, there are five levels: strongly agree, agree, neutral, disagree and strongly disagree.

The proliferation of handphones and usage of short message service (SMS) among students offer an opportunity for such evaluation to be conducted immediately after a lesson. In this way, prompt feedback can be provided to the instructors and the necessary actions can be taken during the course.

Short message service (SMS) is a component of the Global System for Mobile Communications (GSM) series of standards in 1985. SMS is a means of sending short text messages not longer than 160 characters (including spaces) between mobile phone devices. SMS text messaging is the most ubiquitous data application in the world, with annual worldwide SMS volumes estimated to have increased from 2.6 trillion in 2007 to nearly 5.5 trillion SMS at end-2009 (Portio Research, 2010). The term SMS is often used as a synonym for all types of short text messaging, as well as the activity of creating SMS texts. In this paper, we use the term "SMS texts" to refer to the individual SMS text messages sent.

This paper examines the opportunities and challenges of obtaining teaching feedback from students via SMS texts. Specifically, it explores the potential applications of text mining on SMS texts used for teaching feedback. To the best of our knowledge, the present paper is the first to explore such applications in educational data mining.

In addition, the paper also contributes to the literature on text mining (Feldman & Sanger, 2007) and sentiment mining (Liu, 2010). Recent research on sentiment analysis or opinion mining (Liu, 2010) has focussed on the mining of massive volume of texts with opinions or sentiments. Unlike most texts, however, SMS messages are comparatively short and offer a number of challenges. Firstly, because of its nature, the responses given will be different for different users. So if there are 100 students in a class, no two students would give the same SMS feedback even when linguistic rules are observed and no spelling errors are committed. Secondly, SMS messages are pervaded by abbreviated shortcuts (e.g. *oic*), emoticons (e.g. *:)*). Thirdly, it is common for SMS texts to contain "noises" such as spelling and grammatical errors, incomplete sentences, false starts, repetitions and pause filling words such as *um* and *uh*. The challenge, in this case, is to extract insights from an analysis of such noisy and unstructured data in SMS texts. In exploring these challenges, the paper paves the way for further research by proposing a systematic approach to analyze such SMS texts for education purposes.

This paper is organized as follows. Section 2 provides some background on the project for using SMS texts for teaching evaluation. Section 3 discusses some of the data pre-processing steps required before modeling can be performed on the SMS texts. Modeling and model evaluation are also explored. In Section 4, the results of the sentiment analysis are presented and the implications

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of incomplete SMS texts are considered. Finally, Section 5 concludes and proposes possible directions for future research.

## 2. Background

The study makes use of SMS text messages generated from a SMS Response System (SMSRS), which is a platform independent web-application system[1] developed by one of the co-author (Wai Keong Mak). The system allows audience in a lecture, tutorial or seminar to send in their comments, responses and feedback via SMS. The response can be in the format of a response to a multiple-choice question, a poll or a simple text message using a mobile phone's SMS facility. For responses of the first two types which involve response of a single alphabet, the answers can be immediately tabulated, graphed and displayed to the class via a website. The focus of this study is on the third type involving a SMS message in the form of free text.

In this particular study, the setting is a physics lecture given by a lecturer in a junior college, the equivalent of high school. The physics lecturer delivered his lecture, after which the students were asked to submit their feedback on the lecture via SMS texts.

The lecturer was interested in finding out how the students felt about the lecture. The feedback provided by the students would allow him to moderate his delivery of subsequent lectures.

## 3. SMS texts: text mining and sentiment mining

### 3.1. Data preparation

Analysis of SMS texts can be difficult because of the incompleteness of the data. Firstly, the default limitation on the maximum number of characters which can stored for each SMS text results in only a limited amount of text which can be analyzed. Secondly, many of these SMS texts are incomplete. In this section, we detail the data preparation process and also deal with the issue of incomplete SMS texts.

The data preparation process of SMS texts is made up of 3 phases, as shown in Fig. 1. They are:

1. Reading the SMS corpus or collection of SMS texts.
2. Parsing of the SMS texts;
   - **Part of speech (POS) tagging**: Each term is tagged with a POS tag. In this analysis, POS tagging is an intermediate step that is carried out to identify concepts. Table 1 gives a description of the different POS tags used in this analysis.
   - **Stemming**: Inflection refers to the change in form in words to mark gender, number or tense. For example, the root word prevent has the following inflections – *prevents*, *prevented* and *preventing*. Stemming is the process of mapping all the variants to its root word.
   - **Synonyms**: Certain terms or concepts may mean the same thing. For example, *cancer of the thyroid* and *thyroid cancer* refer to the same thing. These will need to be mapped to each other.
   - **Exclude list**: In this analysis, pronouns, particles and prepositions (except *of*) are not extracted during parsing since these POS are usually to be redundant in text mining. For additional concepts that are redundant, they are populated in the exclude list.
   - **Type/entity extraction**: For each concept extracted, a type or entity is also identified. A type is defined as a semantic grouping of concepts. Types include higher-level concepts, positive and negative words and qualifiers, contextual qualifiers, first names, places, organizations, amongst others. If the concept does not belong to any of the defined types, then it is typed as *Unknown*. Types help to group concepts in text link analysis to offer visualization of interesting relationships between concepts.
3. **Text categorization**: Based on the concepts defined for each category, each SMS text can either belong to no category, one category or several categories.

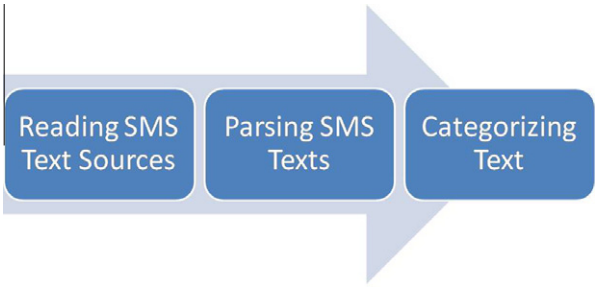


**Fig. 1.** SMS mining: data preparation.

In the data preparation process, however, it is noted that some of these SMS texts are incomplete. Two types of incomplete SMS texts can be discerned in the dataset. Type 1 incompleteness involves an incomplete message due to the limitations on the maximum number of characters which can be stored for each SMS text in the online feedback system. On the other hand, Type 2 incompleteness involves the respondent sending a single alphabetical letter instead of a complete message. This may or may not be a grade awarded to the lecturer. In the SMS corpus, there are 3 sets of SMS texts with Type 1 incompleteness and 4 sets of SMS texts with Type 2 incompleteness. Table 2 presents both types of incomplete SMS texts in this SMS corpus.

In addition to these incomplete types, smileys such as = *P* and single character word like *K* which is actually short form for *Ok* may provide more insights on how the students relate to the lecturer.

How serious is the issue of data incompleteness for the analysis? In our analysis, we propose modeling with and without these incomplete text removed and comparing the results. In this way, we can ascertain whether removing such incomplete SMS texts will result in additional insights. This will be discussed later in this paper.

### 3.2. Exploratory data analysis and visualization

Exploratory data analysis of the prepared SMS could be performed at either the concept or category level.

Exploratory data analysis at the concept level involves viewing a list of concepts extracted, the relevant statistics in terms of frequency and percentage of occurrence of the respective concepts as well as the number and percentage of documents in the corpus that contain the concepts.

Fig. 2 displays the exploratory analysis for the most frequently occurring concepts. There are a total of 118 concepts available for scoring. The corresponding percentage and frequency of the occurrence of the concept are shown in the third and fourth column while that for the occurrence in the number of documents are given in the fifth and sixth column. As shown in the diagram, the most frequently occurring concept is *lecture*: it occurs in 18.4% of the SMS corpus and 32.8% of the SMS texts in the corpus. This is followed by the concept *pace* and to a lesser extent, *fun*, *lesson* and *feedback*.

[1] URL: www.smsrs.com.