Sarcasm Detection Method to Improve Review Analysis

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Abstract: Currently, classifying sarcastic sentences into positive and negative sentiments has been a difficult problem and an important task. The sarcastic sentences could indicate negative meaning by using positive expressions, or positive meaning by using negative expressions.Sarcasm is a special kind of sentiment that comprise of words which mean the opposite of what you really want to say, especially in order to insult or wit someone, to show irritation, or to be funny.Therefore, determining sarcasm is an important task in order to correctly classify the sentence. In this paper, we propose an approach to detect sarcasm.First, we apply dependency parsing to amazon review data. After that, we classify phrases in the sentence into the proposed phrase based on the sequence of part-of-speech as proposed by Bharti et al. After being classified into either one of the phrase types, it is determined whether each phrase is positive or negative.If the emotions of the situation phrases and the sentiment phrases are different, the sentence is determined to be a “sarcasm”. Using the above method , the experimental result shows the effectiveness of our method as compared with the the existing research.

1 INTRODUCTION

With the spread of web services, everyone can post a review of a product on the Web and it is readable from anyone. The user review published on the web is a valuable information resource to which another user refers when she/he is making decision on a purchase. However, selecting the useful information manually to the user from the vast amount of review requires much effort. Therefore, the study of current reputation analysis to automate the analysis of the text have been conducted. In general, reputation analysis uses polarity detection techniques that classify statements into positive and negative ones. However, the current polarity detection techniques only consider the emotion of each word of the sentences. Thus it is difficult to correctly judge the polarity of expressions such as sarcastic sentences that does not directly express their intention. Sarcasm is a special type of sentiment which plays a role as an interfering factor that can flip the polarity of the given text. Given an example of tweet: “Nothing I love more than a crowded library with no seats #sarcasm”. Although this example uses a word “love” to express the positive sentiment, the tweet as a whole expresses negative sentiment toward the library. Figure 1 shows a typical procedure of current polarity detection techniques. In the left balloon of Figure 1, although the text should be classified as negative, it is mistakenly determined as positive by an existing polarity detector. Similarly, the detector would determine as negative by mistake the text that needs to be classified positively, as in the right balloon of the Figure 1. As mentioned above, sarcastic texts affect the classification accuracy of the polarity detector.

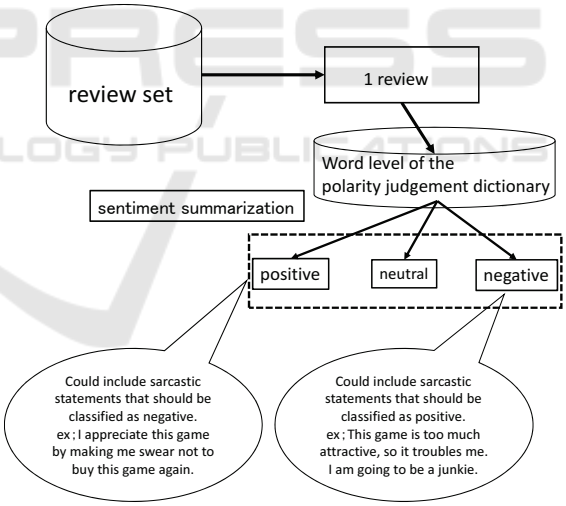

Figure 1: Typical procedure of current polarity detection.

In this paper, we propose a sarcasm-emotion detection method for improvement of accuracy of emotion determination intended for reviews. Our method is based on Bharti’s method and determines whether

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a review in Japanese is a sarcasm. Since in Japanese ambiguous expressions appear more frequently than in English, we propose a method that can cope with ambiguous expressions. Bharti et al. dealt with sarcasm detection using Twitter. Bharti et al. proposed phrases called situation phrases and sentiment phrases to detect sarcasm. In this paper, situation phrases and sentiment phrases are called proposed phrases in total. Using the phrase above, Bharti et al. proposed a PBLGA(a parsing-based lexical generation algorithm) method for determining the sarcasm. For more information about Bharti's method refer to 2.1. Bharti's method first parses the tweets. Then it analyzes the clauses to detect proposed phrases in them. If a phrase is detected as a situation phrase or a sentiment phrase, it phrases are stored the instance of positive/negative sentiment/situation phrases. If proposed phrases were determined a negative situation phrase and a positive sentiment phrase, or a positive situation phrase and a negative sentiment phrase, the tweet is determined as "sarcasm". In Bharti's method, the instances of positive/negative sentiment/situation phrases are stored in order to find sarcastic tweets in a new corpus by means of simple string match only. On the basis of the Bharti's method, we propose a sarcasm-emotion detection method based on polarities of words. We determine the emotion of the proposed phrases based on the number of words with the emotion included in the phrases just as the Bharti's method. From the results of counting, our approach determines the emotions of the proposed phrases. Further, if the numbers of P and N are the same, we will determine the emotion of the proposed phrases using the tf-idf scores. After judging the emotion of the phrase, we determine the sarcastic statement. Specifically, if the emotions of the proposed phrase are different, we determine "sarcasm". The main difference between this research and Santoth et al. research are shown in as follows.

- We propose sarcasm-emotional detection method based on emotion of phrase.
- In order to improve the determinetion accuracy of phrase emotion, feelings of phrases are selected manually.

We conducted the evaluation experiment in order to demonstrate the usefulness the proposed method. The proposed method is implemented to analyze review texts of computer games. When applied to 140 reviews of a game "MSG EXTREME VS-FORCE", the proposed method could determine sarcastic sentences with the precision of 0.79 and the recall of 0.56.

The structure of this paper is as follows. Section 2 surveys the existing research of sarcasm detection. In Section 3, as an assumption of our research, we discuss the concept of sarcastic sentence. Section 4 describes our proposed method. In Section 5, we evaluate how our proposed method can detect sarcasms in comparison with the existing sarcasm detection methods. Section 6 discusses the results of the proposed method and Section 7 concludes this paper.

2 RELATED WORK

In this section, we survey the existing research of sarcasm detection.

2.1 Study in English Text in SNS Sites

Bharti et al. determined sarcasm in Twitter based on two of their proposed method, namely, PBLGA and IWS algorithm. In order to determine sarcasm in Twitter data, PBLGA, or parsing based lexical generation algorithm, either one of the following combinations must present in a tweet: (a) contradiction of negative sentiment and positive situation (b) contradiction of positive sentiment and negative situation. Bharti's method first parses the tweets. Then it analyzes the clauses to detect proposed phrases in them. If a phrase is detected as a situation phrase or a sentiment phrase, its sentiment score is determined based on the number of positive and negative words in it. If the sentiment score is positive, the proposed phrase becomes positive, and if the sentiment score is negative, the proposed phrase becomes negative. If a tweet contains a negative situation phrase and a positive sentiment phrase, or a positive situation phrase and a negative sentiment phrase, the tweet is determined as sarcastic. In Bharti's method, the instances of positive/negative sentiment/situation phrases are stored in order to find sarcastic tweets in a new corpus by means of simple string match only. IWS algorithm is an algorithm to determine the sarcasm in view of the interjection representation. If interjection appears in the beginning of the tweet and intensifier appears other than in the beginning, than a tweet has high probability to classify as sarcastic.

As a preliminary of the experiment, dealing 50000 tweets with hash tags as training data in order to select a phrase that becomes the emotion of the proposed phrase. They constructed proposed phrases using the training data. The test experiment was applying the two algorithms perform two kinds experiment without hash tag and hash tags into two types of data sets. The result of applying the IWS approach with respect to sarcasm tweets with the hash tag called #sarcasm representing the sarcasm, obtained 96%of accuracy, superiority of Bharti et al. Also, when they compared

the two algorithms, IWS algorithm is a superiority compared to PBLGA algorithm. Examples of each emotion phrase data Bharti et al. have been used is as shown in Table 1.

Table 1: Phrases used by Bharti et al.

positive sentiment phrase: Great, lucky, cute, good, glad, delicious, best, Awesome, Perfect, joy, strong, hilarious, better, goreous, honest, innocent, talented, nice, happy, Pretty, proud, excellent
negative sentiment phrase: terrible, little, bit, little, expensive, half, cold, food, tight jeans, rude, wrong, dramatic, abusive, unhealthy, crap, ugly, excuse, dirty, troubled, least, hard, bad, bad, a few days
positive situation phrase: no regret, love, love discovering, just love, effectively making, absolutely Love, feel so loved, wanna be loved, falling, honesty tell, will fly, love seeing, winning, now enjoying managing
negative situation phrase: Clarifying, are pumped, released, are arriving, babysitting, only run, kicking, crashing, destroyed, attacking, criticizing, is lying, confused, dividing, exhausted, keep arguing, will be, gets stuck, is losing, biting, shouting

2.2 Sarcasm Extraction Method based on Patterns of Evaluation Expressions

Hiai et al.(Hiai et al.(2016)) propose a extraction method of sarcastic sentences in prodect review. First, they analyze sarcastic sentences in prodect reviews and classify the sentences into 8 classes by focusing on evaluation expressions. Next, they generate classification rules for each class and use them to extract sarcastic sentences. Their method consists of three stage; judgement processes based on reles for 8 classes, boosting rules and rejection rules. In the experiment, they compare their method with a baseline based on a simple rule. The experimental result shows the effectiveness of their method. However, they did not compare with other sarcasm determination method.

2.3 Automatic Detection of Sarcasm in BBS Posts

Isono et al. (Isono et al.2013) propose two detection systems that determine sarcasm and slander in posts on bullentim board system(BBS). They made a corpus of sarcasm in BBS, and classified sarcasm instances into eight classes: interrogative, guess, give-up, unbalance, exaggeration, shock, metaphor, and constract. For each sarcasm class, they constracted syntactic patterns for detection of sarcasm that include sentence structures and polarity conditions of the target sentence, the previous sentence and the next sentence. Their first system detects sarcasm using a database of the syntactic patterns. They made a corpus of slander using Support Vector Machine(SVM), where as features, they use frequencies of words in the list, and positive expressions and negative expressions in the target sentence, the previous sentence and the next sentence. In the experiment, the proposed systems can achieve superior F-measures compared with baseline systems. But, the accuracy of the system for determining the sarcasm was low.

3 TASK SETTINGS

In this section, we describe the definition and examples of “sarcastic statement”. Around the definition of sarcasm, actively debate is carried out in psychology and a wide range of fields. However, it cannot obtain a clear answer what kind of linguistic phenomenon sarcasm is (Utsumi reference).

In this study, we focus on sarcastic sentences that cause errors in polarity determination. We define the sarcastic statement as follows.

Definition of sarcasm

“Negative expression that convey a positive meaning”or“Positive expression that convey a negative meaning”

An example of sarcastic sentence corresponding to “Negative expression that convey a positive meaning” is as follows.

Example 1

I bought a very tasty cake on the way home after I bought the game. I disposed of the game wrapped in wrapping paper of the cake! Thank you!

Example 1 includes more positive words (with single underlines) than negative words (with double underlines), while its overall meaning is negative. This Example 1 tends to be classified as positive though actually it expresses a negative feeling. Further, an example of sarcastic sentence corresponding to “Positive expression that convey a negative meaning” is as follows.

Example 2

This game is too much attractive, so it troubles me. I am going to be a junkie.

Example 2 includes more negative words(with single underlines) than positive words(with double underlines), while its overall sentiment is positive. This Example 2 tends to be classified as negative though actually it expresses a positive feeling. We identify the sarcastic statement that intention and expression are different. Based on the above definition, we determine the sarcasm in the next section.

4 PROPOSED METHOD

In this section, we describe in detail the proposed method. On the basis of the Bharti's method, we propose a sarcasm-emotion detection method based on polarities on words. It describes the method determining the sarcasm or emotion in the rest of the section.

4.1 Flow of Sarcasm Extraction Technique

We describe an overview of the proposed method Figure 2 shows an overview of the proposed method The following describes the detail of Figure 2.

As the first step, we carry out crawling from the review to collect evaluation data. As the second step, we parse the review and break down the whole sentence into phrases. As the third step, we judge whether the proposed phrase in the parsed ones are included. In this study, we propose situation phrase and sentiment phrase as our proposed phrase. In addition, we define the proposed phrase as follows.

Definition of proposed phases

We call sentiment phrases and situation phrases as proposed phrases in total.

For the parsed ones corresponding to the proposed phrase, we manually determine the emotion (positive or negative) in the parsed ones. When judging emotion of parsed ones, we create the dictionary manually. As a final step, we judge the sarcasm-emotion detection by using the proposed phrases. By counting the parsed ones to the positive or negative, we determine the feeling of the proposed phrases. We detect whether the review is sarcastic by using the feeling of the proposed phrases. Sarcasm-emotion detection is described in detail in 4.3. We applied the proposed method to the review of the online review site. In the rest, we describe in detail with respect to the proposed method. Preprocessing before sarcasm-emotion detection is described in 4.2. Section 4.3 describes sarcasm-emotion detection method to detect sarcasm.

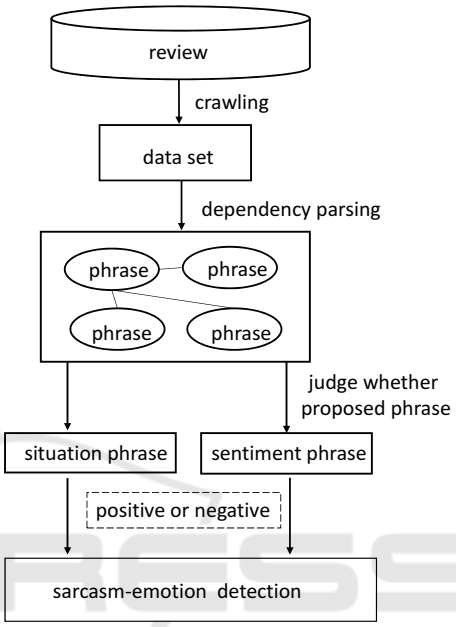

Figure 2: The proposed method.

4.2 Phrase Analysis

Here, we describe preprocessing for sarcasm-emotional detection. Specifically, it is judged and counted whether emotions are included in the parsed ones. After crawling the review, we apply the dependency parsing for a review. The dependency parsing is a technique to analyze the syntactic relationship, such as relationships between words to isolate the whole sentence to morpheme. In this research, we used Cabocha. CaboCha is a Japanese dependency analyzer based on support vector machines. Figure 3 shows an example which carry out the syntax analysis using Cabocha.

The following sentence is the input of the dependency parsing shown in Figure 3. "This game is very interesting. I threw it from the top floor of the momentum left over by Abenoharukasu. Thanks to alchemist who has drilling this kind of terrible game!!!. Thank you Bannam." From a result of the dependency parsing, we made a review the set of the parsed ones. Next, we disucuss the dependency relation. In Figure 3, ① corresponds to "threw", and ② corresponds to "from

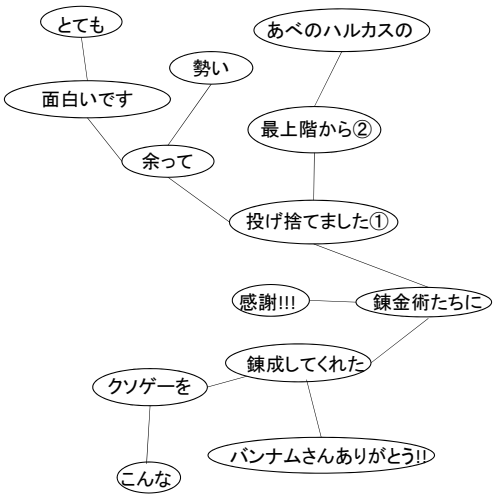

Figure 3: Dependency parsing.

the top floor". Considering the analysis result of Figure 3, it turns out that ② qualifies ①.

Using the syntax analysis, we determine whether the part of speech of the parsed ones can be included as the part of speech of the proposed phrases. As a proposed phrases, we propose a situation phrase and a sentiment phrase as the type of phrase. Situation phrase means to the "action" in the sentence, and sentiment phrase means to the "emotion" in the sentence. Proposed phrases is represented by a combination of parts of speech. Table 2 shows a part of speech corresponding to the proposed phrases.

Table 2: Correspondence table of the phrases.

sentiment phrase: adjective , noun , noun + verb ,adjective verb
situation phrase: verb , adverb + verb , verb + adverb, adjective + verb , verb + noun , verb + adverb + adjective , verb + adjective + noun , adverb + adjective + noun

We treat a parsed ones as a situation phrase or sentiment phrase according to which combination of the parts of speech given in Table 2 matches the target phrase. Table 3 shows the result of sorting those applicable to proposed phrase from the parsed ones in Figure 3. It should be noted that in this paper is the selection of the phrase to depend on parsing the results of Cabocha. Also, if it contains proper nouns in the phrase, the phrase is treated as noise representation.

Finally, we determine the phrase that can be determined include feelings to phrases correspond to the proposed phrase (including positive or negative). In this study, we determined whether positive or negative manually. Table 4 shows the result of emotional sorting those applicable to proposed phrases from the phrase in Figure 3. Incidentally, we deal with

Table 3: Results of phrase classification of the example.

sentiment phrase: interesting, the top floor, told me to drilling, alchemy, thanks
situation phrase: left over, threw, terrible

Table 4: Emotional phrase correspondence table.

Positive sentiment phrase : thanks, interesting
Negative sentiment phrase : None
Positive situation phrase : None
Negative situation phrase : threw

phrases that include proper names as noise representation. From the above procedure, we calculate whether contains a number of emotions subject to review. By using a number of emotions subject to review, we determine the feelings of phrase. In the next section, we describe the method of calculating the phrase of emotion and the sarcasm-emotion detection.

4.3 Sarcasm-Emotion Detection

Here, we describe a method sarcasm-emotion detection by using the emotion of the proposed phrases. In the previous section, we examined whether or not there is a phrase that can be judged as positive or negative for the phrase that corresponds to the proposed phrases. Here, we describe about the judges approach the feelings of the "proposed phrase". After determining the feeling of proposed phrases, we judge sarcasm-emotion detection method as a final evaluation.

4.3.1 Deciding Sentiment of a Proposed Phrase

As a prestage of sarcasm-emotion detection, we evaluated the feelings of the phrase. In order to assess the feeling of the "proposed phrases", we define the following formula.

$$PR = \frac{PWP}{TWP}$$
$$NR = \frac{NWP}{TWP}$$
$$SentimentScore = PR - NR$$

For the proposed phrases, PR is positive ratio, NR is negative ratio, TWP indicates the number of all of the

proposed phrase with respect to each reviews. In addition, PWP and NWP are the numbers of positive and negative proposed phrases respectively. Using the above equations, we describe technique for determining the emotion of the phrases below. Procedure for determining the emotion of the proposed phrases is as shown in Figure 4. Let us explain Figure 4.

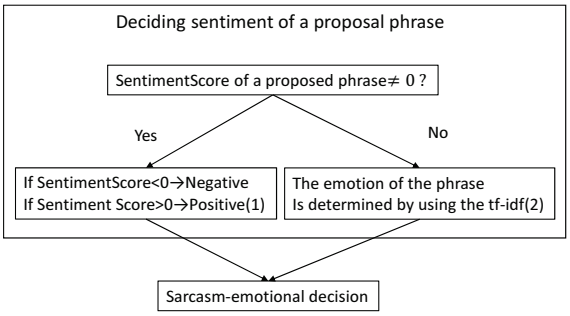

Figure 4: Emotion detection of proposed phrases.

If the SentimentScore of the proposed phrases is unequal to 0, as in (1) of the Figure 4, then the emotion of the phrase is determined based on the SentimentScore, namely, positive when SentimentScore $>$ 0 and negative otherwise. If the SentimentScore of the proposed phrases is equal to 0, as in (2) of the Figure 4, then the emotion of the phrase is determined using tf-idf. The tf-idf is a method of calculating the weight of a particular word in the document that by combining tf method and idf method. This technique has been utilized in the field of information retrieval and text mining and machine learning. It is shown below with respect to the meaning of tf method and idf method. tf (term frequency) represents term frequency, it represents the number of times a particular word is found at the text in. idf (inverse document frequency) represents the natural logarithm of the inverse of the number of documents that contain the words in the training data. A high frequency in the text it is seen that as much the word is important. Calculation formula for weighting is as formula.

$$w_{t,d} = t f_{t,d} \log \frac{N}{d f_t}$$

Here, N is the data for the entire review data. Further, $t f_{t,d}$ in the number of$t$ appears in a document d, $d f_t$ is the number of documents in which the word t appears in the N sentences. By using the above determination process, it was evaluated in the emotions of the situation phrase and sentiment phrase. Taking Table 4 as an example, the emotion of the sentiment phrase is determined to be positive, emotion of the situation phrase is determined to be negative. After determining the feelings of the proposed phrase, we will make a final sarcasm-emotion detection.

4.3.2 Deciding Sarcasm-Emotion Detection of Reviews

Next, we determine the sarcasm or emotion by using the emotion of the proposed phrase. Figure 5 shows sarcasm-emotion detection method.

	Situation Phrase (P,N,Neither)			
Sentiment Phrase (P,N,Neither)		positive	Negative	Neither
	Positive	Positive	Sarcasm	Positive
	Negative	Sarcasm	Negative	Negative
	Neither	Positive	Negative	Neither

Figure 5: Sarcasm-emotion detection.

Based on the definition, it determines that the sarcastic statement in this study if the emotions of the proposed phrases are different. Taking Table 4 as an example, the emotion of sentiment phrase is judged to be a positive, the emotion of the situation phrase is determineded to be a negative, therefore this review is determined to be the sarcastic statement. Also, if both of the emotion of the situation phrase and sentiment phrase are the same, it is determined that the target sentence is non-sarcastic statement, the same emotion of the entire sentence. By using the sarcasm-emotion detection method described above, we determine the sarcasm.

5 SARCASM JUDGEMENT EVALUATION

In this section, we confirm the accuracy of the proposed method. At that time, we compared to the existing sarcasm detection method.

5.1 Experimental Set-up

We conduct an experiment using reviews of a product that are “flaming”, that is, including many negative reviews. We evaluate as a target star5 reviews of Mobile Suit Gundam EXTREME VS-FORCE of amazon products. The subject of the review has been “flaming” for game content is unpopular. Because there are many negative expressions in spite of high scores, we treate as experimental data in this experiment. We applied the proposed method to 140 reviews of star5 reviews. Before applying the approach, we labeled “sarcastic statement or non-sarcastic statement” and “positive or negative or neither”. Determination of

sarcasm is based on the definition given in section 3. Also, if you cannot determine whether positive or negative in the non-sarcastic statement, we treate as "neither". Examples of non-sarcasm statement "neither" are included those such as the following.

Example3

I want to say about this game only the following words: May the Force be with you.

As mentioned above, we dealt things not established as sentences as "neither". Table 5 and Table 6 show the result of labeling.

Table 5: Labeling result 1.

sarcastic statement	89
non-sarcastic statement	51

Table 6: Labeling result 2.

positive	33
negative	11
neither	7

Table 5 is a result of the labeling process to either the entire review "sarcastic statement" or "non-sarcastic statement". Table 6 is a result of the labeling process in three of emotion " is non-sarcastic statement". Result of labeling, 89 reviews from 140 reviews is determined to be sarcastic statement. Further, we can assume that "flaming reviews" are more likely to contain sarcastic in the star5 reviews. Using the above results, we perform each experiment.

5.2 Evaluation Method

Here, we describe the experimental results of the proposed method. To compare the results with existing research, three parameters are considered, namely, precision, recall and f-score. We describe below for each evaluation method. Table 7 shows evaluation method in this research.

Table 7: Evaluation method.

		fact	
		sarcasm	non-sarcasm
prediction	sarcasm	T_p	F_p
	@non-sarcasm	F_N	T_N

We write the following precision , recall , F-score by using the evaluation method in Table 7.

Precision: Among the predicted data, actually shows the proportion of what is positive. Formula becomes (1)

$$Precision = \frac{T_p}{T_p + F_p} \tag{1}$$

Recall: From what is positive, indicating the percentage is expected to be positive. Formula becomes (2)

$$Recall = \frac{T_p}{T_p + F_N} \tag{2}$$

F-score: Show the harmonic mean of precision and recall.Formula becomes(3)

$$F - score = \frac{2 \cdot Precision \cdot Recall}{Precision + Recall} \tag{3}$$

Using the above evaluation method, we evaluate the accuracy of the proposed method.

5.3 Evaluation Results

We compare with the existing sarcastic statement detection method and the proposed method in this data set. We apply to this data set the sarcasm detection method of Isono et al. (2013) and Hiai et al. (2016). Table 8 shows the existing sarcastic statement detection method and the proposed method comparison result.

The result of applying the proposed method to the data set, proposed method achieved 0.79, 0.56, and 0.63 precision, recall and f-score respectively in Amazon dataset. As the result of applying the existing sarcasm determination method in this data set, it found that the proposed method outperformed the existing method in terms of the accuracy to determine sarcastic statements. The reason of this result would be because the expressions specific to games did not match the syntactic patterns of the existing research. Therefore we make clear that the advantage of our proposed method is due to no use of syntactic patterns. From the above, determining the sarcastic statement by using the our proposed method is useful method in the online revies site.

Table 8: Experiment result 1.

	precision	recall	F score
proposed method	0.79	0.56	0.63
Hiai et al.	0.60	0.03	0.06
Isono et al.	0.63	0.07	0.13

6 DISCUSSIONS

From the experimental result, it shows the results of high accuracy of proposed method for sarcasm

of our definition. However, they also show the results in which our method sometimes determine SentimentScores that the reviews do not actually mean if the numbers of positive and negative phrases are much different. It will be discussed because our proposed method depends on the numbers of the proposed phrases. Therefore, we consider that it can not determine the sentences as “sarcasm” such as following.

Example 4

It is like a dream that I can use such a cool miniature aircraft so early by purchasing such a terrible game!

A result of the proposed method apply to the example 4, the proposed phrase determined “positive is” by containing many positive phrase. Thus our method determined that this review praised the product positively. This result shows that there are sarcastic sentences that cannot be correctly classified by counting the phrases in the reviews. In order to judge this review as sarcastic, we will need to consider combinations of phrases or interjections.

7 CONCLUSION

In this paper, we proposed a sarcastic statement determination for the classification accuracy improvement of emotional judgment in the online review sites. The result of the comparison of the existing research, we could confirm the usefulness of the proposed method. However, there are sarcastic reviews our method cannot judge as sarcastic may be because our method detect sarcasm on the basis of the numbers of positive and negative phrases. In order to determine the review such as described above, we will need to improve our method. We are going to improve our method to increase the accuracy of sarcasm and emotion detection by incorporating interjection words and considering combinations of phrases.

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