Sarcasm Detection

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Abstract: Sarcasm is a use of irony to mock or contempt i.e. the opposite of what is implied. Sarcasm detection is the task of predicting sarcasm in text. the crucial step in sentiment analysis due to ambiguous nature of sarcasm. because of this ambiguity, sarcasm detection has been a difficult task for humans . hence it's detection has gained importance in many Natural Language Processing applications. In this paper, we describe approaches, issues, challenges and future scopes in sarcasm detection.

INTRODUCTION

Sarcasm is a sophisticated form of sentiment expression where speaker expresses their opinions opposite of what they mean. Sarcasm is often characterized as ironic or satirical wit which is used to insult, mock, or amuse. Example: *"Nice perfume. You must marinate in it."* In this example, there is no negative word, yet it seems sarcastic with a particular victim as its target. Sometimes, sarcastic sentence comes with a hashtag which is labeled explicitly. For example: *"Oh how I love being ignored #sarcasm."* However, it is not necessary that speaker will always labeled #sarcasm hashtag in its message. Hence, recognition of sarcasm is important to avoid misunderstanding in everyday communication as well as for the development and refinement of Sentiment analysis.

Sarcasm is defined by various dictionaries according to their perspective. As defined in Macmillan English dictionary [11], sarcasm is "the activity of saying or writing the opposite of what you mean, or of speaking in a way intended to make someone else feel stupid or show them that you are angry". According to The Random House dictionary [12], sarcasm is "a harsh or bitter derision or irony" or "a sharply ironical taunt; sneering or cutting remark". The Collins English dictionary [13] defines it as "mocking, contemptuous, or ironic language intended to convey insults or scorn". Another definition of sarcasm, according to Merriam-Webster [14] is "a mode of satirical wit depending for its effect on bitter, caustic, and often ironic language that is usually directed against an individual".

Several online social networking services allow users to post and read messages to express their opinions related to products, politics, stock markets, entertainments etc. In addition, users usually post a lot of complex sentence structured messages, making it difficult to identify its sense for a machine as well as for humans. Therefore, Sentiment analysis as well as its application i.e. Sarcasm detection has become emerging trend in Data mining.

According to analysis of previous researches, it can be concluded that there are several features observed in the text which plays an important role in identifying the sarcasm viz. lexical, hyperbole, pragmatic etc [6], [10]. There are several approaches which are implemented to recognize sarcasm. In recent years, most researches implement supervised or semisupervised machine learning approaches for this purpose [8], [9], [20], [21]. Also Novel approaches [15], [16], Behavioural approaches [7], Bootstrapping approach [18], [19] are used for sarcasm detection. Sarcasm detection is performed on various types of datasets such as social media platforms like Twitter, Facebook, Instagram etc., Feedback systems like Student's feedback, Product reviews, Movie reviews etc.

In this paper, we explore an empirical study on the sarcasm detection in various platforms. The rest of the paper is organized as follows: In Section II, related work is presented. Types of sarcasm are given in Section III. Feature set analysis is discussed in Section IV. Various approaches for sarcasm detection are given in Section V. Issues related to sarcasm detection are given in Section VI. Challenges in sarcasm detection are discussed in Section VII. Finally, in Section VIII, we conclude with some final remarks and present some future works.

RELATED WORK

Many researchers have performed and investigated the use of different types of features in text dataset along with different methods for sarcasm detection. Generally sarcasm detection methods are categorized into two methods: supervised and semi-supervised. Also other methods are emerging for sarcasm detection such as Deep learning, Bootstrapping etc.

Davidov et al. implemented the semi-supervised sarcasm identification algorithm (SASI) to detect sarcasm in Twitter and Amazon product reviews [21]. This is the first robust algorithm used for sarcasm detection. They used pattern-based and punctuation-based features in reviews and tweets. Whereas Lukin and Walker implemented Bootstrapping method to identify sarcasm and nastiness in online dialogue using pattern-based features [19]. Bouazizi and Ohtsuki introduced a pattern-based approach using four set of features to detect sarcasm viz. sentiment-related, punctuation-related, patternrelated, syntactic and semantic [2]. González-Ibáñez et al. studied lexical and pragmatic features in tweets, extracted using unigrams and dictionary-based for classifying sarcastic, positive and negative tweets by employing two classifiers: Support vector machine (SVM) and Logistic regression

(LogR) [20]. Fersini et al. introduced an ensemble approach,

Bayesian Model Averaging (BMA) to detect sarcasm and irony in Microblogs, taking into account feature sets such as pragmatic particles and PoS tags [9].

Barbieri et al. examined the tweets whether they are sarcastic or not, by adding important group of features such as Frequency, Written-spoken, Intensity, Structure, Sentiments, Synonyms and Ambiguity [16]. They used Novel computational approach based on supervised machine learning techniques. Liu et al. also proposed Novel multi-strategy ensemble learning approach (MSELA) to detect sarcasm in both English and Chinese social media [15]. They extracted the various feature sets for both English and Chinese texts, where English sarcasm features consist of punctuation symbols, lexical and syntactic features and Chinese sarcasm features includes rhetorical, homophony, construction features. Riloff et al. worked on one of the most common form of sarcasm i.e. Sarcasm as contrast between a positive sentiment with negative situation [18]. They presented a novel bootstrapping algorithm along with SVM, which automatically devise lists of positive sentiment phrases and negative situation phrases from sarcastic tweets. Zafarani et al. constructed behavioral modeling framework to detect sarcasm using list of features depending on the different forms of sarcasm [7]. Parsing-based lexicon generation algorithm (PBLGA) was proposed by Bharti et al. in 2015 to recognize the sarcasm in tweets using hyperbole feature and NLP preprocessing technique: PoS tagging [4]. Bamman and Smith adopted binary logistic regression algorithm to classify tweets as sarcastic or not sarcastic [10]. But they added extralinguistic information (features) such as tweet features, author features, audience features, environment features to achieve high accuracy in detecting the sarcasm.

Sarcasm was detected from student's feedback in twitter by Cocea et al. using machine learning techniques and n-grams, unigrams features along with additional features such as emotion label, polarity label, number of hashtags etc. [8].

Sarcasm detection in Dutch tweets with a hashtag such as '#sarcasm', '#irony', '#cynicism' etc., was studied and examined using balanced winnow classifier by Kunneman et al. [6]. They verified the French tweets

also and observed that the hashtag signals a polarity switch in most cases.

Sarcasm detection task was reframed as a Literal/Sarcastic sense disambiguation (LSSD) by Ghosh et al. [5]. They investigated the twitter data using unsupervised methods and SVM classifier with a modified kernel using word embedding. A hadoop based framework, a big data approach was devised by Bharti et al. to detect sarcasm in real time, based on parsing and PoS tagging [1]. They also calculated the execution time for each algorithm with and without hadoop based framework and compared for the same.

Irony and sarcasm are seemed to be the same linguistic phenomena as they are both ways of saying one thing and meaning another, but actually they are different. Irony is a phenomenon which is used to mock or joke in a non-offensive manner, sometimes pointing to ourselves, whereas Sarcasm is a form and use of irony which is offensive and pointed to other person.

TABLE I

TYPES OF SARCASM.

T1	i) Contrast between positive sentiment and negative situation ii) Contrast between negative sentiment and positive situation iii) Contrasting connotations iv) Verity negation
	v) Temporal facts extraction
T2	i) Wit
	ii) Snivel
	iii) Prevaricatio
	iv) Rampant
T3	i) Prosodic variations
	ii) Structural variations
	iii) Lexical analysis
T4	i) Language expertise
	ii) Environment expertise
T5	i) Likes and dislikes prediction

In most of previous work, Precision, Recall, Accuracy and F-score for all Machine learning algorithms used in research were calculated along with their performances.

TYPES OF SARCASM

Many researchers defined several types of sarcasm according to their perspective based on feature and structure of text. We summarized the sarcasm into five types according to Zafarani et al. [7], Bharti et al. [4], Mondher Bouazizi and Tomoaki Ohtsuki [2], given in Table I.

The types of sarcasm given in table are explained in detail as follows:

A. Sarcasm as a Disparity of Sentiments

In this type of sarcasm, text sentiment conflict with text situation. This type of sarcasm can be further divided as follows:

1) Contrast Between Positive Sentiment and Negative Situation: It is a most common form of sarcasm, where sarcastic text consists of positive sentiments such as 'love', 'enjoy', etc. followed by an undesirable expression, state or activity. For example, "Oh how I love *being ignored.*" Or "Absolutely adore it when my*bus is late."* The sarcasm in these examples occurs due to the positive sentiment words (e.g. love, adore) with a negative activity or state (e.g. being ignored, bus is late).

2) Contrast Between Negative Sentiment and Positive Situation: In this type of sarcasm, sarcastic sentences include negative sentiments followed by positive state or activity. Example, "I hate Australia in cricket, because they *always win*". #sarcasm. This example indicates negative sentiment with word 'hate' but situation is positive as they 'always win'

T1- Sarcasm as a disparity of sentiments

T2- Sarcasm as means of conveying emotion

T3- Sarcasm as a form of written expression

T4- Sarcasm as a function of expertise

T5- Behaviour-based sarcasm

3) Contrasting Connotations: This type of sarcasm uses words having contrasting connotations within the same text. Example: *"I love getting spam emails!"* In this example, obviously spam has negative connotation, but love is positive word [7].

4) Contrasting Present With the Past: This type of Sarcasm occurs when users use sarcastic remark in present comment based on the contrasting context in previous comment. It is used to clarify the presence of sarcasm in a previous comment. For example,

User 1: You are doing great! Who could predict heavy travel between #Thanksgiving and #NewYearsEve. And bad cold weather in Dec! Crazy!

Major U.S Airline: We #love the kind words! Thanks so much.

User 1: Wow, just wow, I guess I should have #sarcasm. Considering above example, it is clearly seen that the User 1 actually expressing sarcasm in his/her first comment. But the Major U.S. Airline was unable to understand the intention behind it. So, the User 1 remarking his/her sarcasm in third comment based on previous comment of Major U.S. Airline.

5) Verity Negation: When text contradicts to fact or universal truth with negative expression, it is called verity negation sarcasm. Example: "They are so bickering couple. Opposite poles do not attract at all." We know that 'Opposite poles attracts' is a fact. But, the example is clearly sarcastic with negative expression.

6) Temporal Facts Extraction: Similar as Verity negation except text contradicts to facts about event. Example: "It was a FUN spending my birthday with you and your boyfriend." Here, the event is birthday. And the text contradicts to this event indicating sarcasm as the person seems not happy by spending the birthday with friend's boyfriend.

B. Sarcasm as Means of Conveying Emotion

Sarcasm is used to express the user's various mental situation depending on his/her mood. Following are the types.

1) Wit: In this type, sarcasm is used to express unnatural extreme happiness, wittiness, etc. For this user makes use of capital letter, question marks, emoticons, etc. Example: "What a FANTASTIC weather! I just LOVE rain!!" Clearly the person is expressing extreme happiness because of rain. But actually the person is irritating.

2) Snivel: This type of sarcasm is used to show the person's annoying or angry mood. It also comes under positive expression in negative situation sarcasm. For example: "I'm so pleased mom woke me up with vacuuming my room this morning. #sarcasm" This example clearly indicates the angriness of person with positive word 'pleased', as he/she had to wake up in the morning because of the sound of vacuum cleaner.

3) Prevarication: It refers to the type of sarcasm, when person avoids or ignores to give a clear answer by using

uncommon words, unusual expression, etc. Example: "Bob, you have to work hard." "Ohh ya, I am just crystal clear about what to do." Here, the word 'crystal' is very uncommon to use before the word 'clear', which indicates sarcasm. Here, the person is avoiding to tell that he can not complete the work.

4) Rampant: This sarcasm expresses violence nature of person and it heavily relies on hyperbolic text. For example: "Hey Bob, I'm going to need you to work overtime." "Oh, don't worry! I'll be there! Want me to shine your shoes while I'm at it?! Hell, I'll come to your house tonight and wash your goddamn Ferrari! Actually, you know what? Forget it. I'm just gonna go home and blow my brains out."

C. Sarcasm as a Form of Written Expression

High intensity of vocal with low pitch and slow tempo indicates the sarcasm in spoken dialogue. Based on this, many users are trying to express sarcasm in writing form. Therefore, to convey sarcasm through written text, users are using certain style of writing. Following are the types of sarcasm for written expression.

1) Prosodic Variations: Sometimes to emphasize the certain parts of the text, users repeat letters in word or repeat punctuations to indicate the opposite of what they mean. Example: *soooo, wooow, awesomeee, "!!!", etc.* Also sometimes to indicate the intensity of tone, users often capitalize the words. For example: "Oh WOOOW. What an AMAZING
food."

2) Structural Variations:: Sarcastic sentences sometimes follow certain structure in which opinion of user is expressed in the first few words, while in later part, description of particular scenario is given. Example: '*I love it when my friends ignore me*'. In this example, the first few words, '*I love it*', conveys user's view. But later part, *'when my friends ignore me'*, describe the situation in disappointing way.

3) Lexical Analysis: This type of sarcasm is purely based on the hashtag (e.g. #sarcasm, #irony, etc.) which is strong indicator of sarcasm. Example: "I just love to party alone.
#sarcasm".

D. Sarcasm as a Function of Expertise

1) Language Expertise: Language skills of user including vocabulary and grammar skills should be measured as it is expected from user to have a good command over the language if one is using form of language to express sarcasm. Example: "He is a good person. #sarcasm.", indicates the sarcasm with explicitly labeled hashtag. But "He is a very good person as evil", indicates sarcasm without hashtag. And it is achieved because the person having good language skills.

2) Environment Expertise: Being familiar to surrounding environment, users are able to express sarcasm better. For this usage familiarity is measured based on duration. Example: "I love it when I am called at 4 a.m. because my neighbour's kid can't sleep!" In this example, the person is well familiar with the surrounding situation.

E. E. Behaviour-Based Sarcasm

Behaviour of user's point of view is considered in this type of sarcasm.

TABLE II
TYPESOF FEATURE.

Types of feature	Examples
Lexical feature	Unigram, bigram, n-grams, etc.
Pragmatic feature	Emoticons, replies, emphatic, etc.
Hyperbole feature	Intensifiers, interjection, quotes, punctuation, etc.
Pattern-based feature	Frequency of appearances of word
Syntactic feature	Pos-grams and temporal imbalance etc.
Contextual feature	Annotators, etc.
Metaphoric feature	Extreme positive or negative nouns, extreme adjectives, proverbs, honorifics etc.

1) Likes and Dislikes Prediction: Users may express like or dislike approach towards various factors such as products, services, events, etc., which indicates sarcasm. Example: "I just love the food serving."

FEATURE SET ANALYSIS

Analysis of features is done on the basis of types of sarcasm occur in text for sarcasm detection [4], [7], [10]. Also the structure or pattern in text is responsible for feature extraction [1], [2], [15], [20]. We summarized the set of features in Table II.
According to table, generally features can be grouped into five set as follows:

A. Lexical Feature

This set of feature includes text properties such as unigram, bigram, n-grams, skip-grams, #hashtag, etc. They play an important role in sarcasm detection.

B. Pragmatic Feature

Symbolic and figurative texts such as emoticons, smileys, replies, emphatic and onomatopoeic expressions, etc. are considered as pragmatic features. Several authors have experimented this feature in their work as it is one of the powerful and key features for detecting sarcasm in textual data.

C. Hyperbole Feature

This feature plays a vital role in sarcasm detection. Hyperbole is the use of exaggeration as a figure of speech. Text properies such as intensifiers, interjection, quotes, punctuation, etc. is called hyperbole. By using this feature, several researchers have achieved good accuracy in their works.

D. Pattern-Based Feature

Pattern-based feature has high frequency words and content words on the basis of frequency of appearance in the text. Pattern followed in text may be very specific for some text or it may be very general.

E. Syntactic Feature

These features contain recurrent sequences of morphosyntactic pattern (Combination of morphology and synax). The features which are relevant to syntax are called morphosyntactic features. They are often composed of PoS-grams and temporal imbalance.

F. Contextual Feature

Contextual features are the features which use information beyond the text, targeted for sarcasm detection. Basically, context refers to any information or common knowledge beyond the text to be predicted. It can be incorporated using supplementary data or information from the source platform of data. For example: annotators. Additional context is requested by annotators in the form of reddit comments with sarcasm labels.

G. Metaphoric Feature

It includes extreme positive or negative nouns, extreme adjectives, proverbs, honorifics, etc. This feature contains important and valuable information about author's emotions.

ISSUES IN SARCASM DETECTION

The current approaches, types and features used for sarcasm detection also encounter issues that are handled in different ways. In this section we focus on several important issues such as issues with data, issues with features, issues with classification techniques.

A. Issues with Data

Although labeled sentences with hashtag provide clear revelation of data, the quality of dataset may become ambiguous and doubtful. For example: *'I love bland food. #not'*. Sarcasm is expressed through #not. If we remove #not and consider only 'I love bland food', then it may not have sarcastic interpretation.

B. Issues with Features

Sarcastic sentences deceive the sentiment classifier and hence accuracy to classify the text may be reduced. Sentiment can be used as feature for classifier and it requires ground polarity of sentence. Therefore, new features should be explored and used with the combination of existing features for better accuracy.

C. Issues with Classification Techniques

Sometimes researchers use small set of data, sometimes large. But it is not necessary that the dataset is fairly distributed for classification, which makes dataset balanced and imbalanced. So, the accurate classification technique should be applied on dataset for accurate classification of sentences into sarcastic and non-sarcastic.

CHALLENGES IN SARCASM DETECTION

Sarcasm detection is a very challenging task as it has ambiguous nature. Following are some of the challenges faced in sarcasm detection.

A. Difficulty in Sarcasm Detection from Text

In spoken interaction, sarcasm can be recognized using facial expression whereas in written communication, there is no facial expression in text. Therefore, detection of sarcasm from text is challenging and requires much deeper study.

B. Negative Sentiment Using Positive Words

Sarcastic sentences expresses a negative opinion using only positive words or intensified positive words. So, a simple bag-of-words cannot be used for Sentiment Analysis on such sentences. They require additional features such as features related to author, audience, semantic, etc.

C. Use of Short Text

The detection of sarcasm in short and noisy contextless text becomes very challenging as they do not provide more features.

D. Integration of World Knowledge

Integration of world knowledge is required in some cases and it is itself a big task. For example, *'Love the cover (book, amazon)'*. If we consider the expression *"do not judge a book by its cover"*, we realize that it is actually a sarcastic sentence.

E. Hyperbole

Sarcasm is often signaled by hyperbole, the use of exaggeration. For example, "Wow GPRS data speeds are blazing fast". In this example, "blazing" is the hyperbole. Hyperbole detection helps in sarcasm detection, but this itself is an NLP problem which requires further investigation.

F. Additional Features

Additional new features need to be explored for sarcasm detection, may involve going deeper into semantics, hyprbole, punctuation-based features.

APPROACHES FOR SARCASM DETECTION

We now discuss the approaches used for sarcasm detection based on our survey. In general, approaches for sarcasm detection can be classified as: rule-based, statistical, distributional, classification, deep learning. We describe these approaches in detail below.

A. Rule-Based Approaches

Rule-based approaches are used by several researchers to identify sarcasm through specific evidences that are captured in terms of rules. These rules heavily rely on sarcasm indicators. Hashtag is a key indicator of sarcasm, often used to highlight sarcasm. For example: "Wow, you are so brilliant. #not #sarcasm." Maynard et. al. [17] used this approach for detecting the sarcasm from tweets. They tokenized the hashtags in tweets followed by lexicon-based approach and compiled several rules for patterns of hashtag. According to their experiments, the hashtag tokenisation achieves 98% Precision, while the sarcasm detection achieved 91% Precision and polarity detection 80%. Bharti et. al [4] investigated the sarcasm using two rule-based classifiers viz. Parsing-based lexicon generation algorithm (PBLGA) that creates parse trees of sentences including sentiment and situation phrases and Interjection word start algorithm (IWS), which uses hyperbole feature. Advantage of this approach is that they can do error analysis corresponding to multiple rules.

B. Statistical Approaches

Sarcasm detection based on this approach varies according to features and learning algorithms.

Bag-of-word is used as a feature by most approaches which is a feature generation tool, represents a text as the bag (multiset) of its words, disregarding grammar and even word order but keeping multiplicity. But statistical approaches motivates us to use different types of feature and their combinations such as pragmatic, pattern-based, lexical, contextual etc., for sarcasm detection. We can experiment different types of classifiers such as SVM, Naïve Bayes, Logistic regression, etc. for this approaches.

Riloff et. al. [18] used SVM classifier with lexical features including unigram and bigram, which achieved 64% precision with 39% recall. While Dmitry et. al. [21] used patternbased features and punctuation-based features with k-nearest neighbours (KNN) classifier. Barbieri et. al. [16] presented novel computational model for sarcasm detection using various features such as frequency, sentiments, written-spoken, intensity, structure, synonyms and ambiguity.

This approach helps to overcome the issues with features and classification techniques as it improves the performance using the combination of different features and techniques.

C. Distributional Approaches

This approach consider Distributional Hypothesis which states that the words occur in the same contexts tend to have similar meaning. Therefore, the context vector derived from the data represents sense of a target word, as proxies for meaning purpose. To measure the

similarity in meaning, Geometric techniques like cosine similarity are applied to context vectors.

Ghosh et. al. [5] implemented this approach with the incorporation of classification approach and word embeddings. For this, they have used Distributional semantic models (DSMs) which follows Distributional Hypothesis and Cosine similarity as a Geometric technique. They observed that this approach achieved 7%–10% F1-score and overcomes the challenge of additional feature and issue of classification technique.

D. Classification Approaches

Classification approaches are commonly used method to identify the target word or sentence as sarcastic or literal. For this purpose, several machine learning classifiers such as SVM, Naive bayes, Maximum entropy, etc. are used.

Most work in sarcasm detection on any dataset relies on SVM [18], [20], [21]. Also Bamman et. al. [10] used binary logistic regression with various types of features.

E. Deep Learning Approaches

Deep learning-based techniques are emerging as popular for sarcasm detection which is part of a broader family of machine learning methods based on learning representations of data and uses high level abstractions in data by using a deep graph. For example: Deep neural network.

Rosanno et. al. [3] adapted a visual neural network for image dataset from Instagram and Tumblr. The multimodal fusion of textual and image data were experimented via Deep network adaption framework to detect sarcasm in the fusion. They observed thar this approach improves the sarcasm detection as image-related features are included.

CONCLUSION AND FUTURE WORKS

Research in sarcasm detection has grown significantly in the past few years. It is the emerging field in data mining which requires much deeper insight. Our paper gives detailed survey about types of sarcasm, approaches for sarcasm detection and discusses some issues and challenges.

On the basis of our survey, we formulate following possible future works:

• Coverage of various types of sarcasm • Exploring new feature sets and new datasets.

For our future work, we will try to implement the model for sarcasm detection using Classification approach and Natural language processing techniques on the dataset of Employee feedbacks, as till now no work has done on this dataset as per our knowledge. We will try to achieve the better performance of this model in terms of Accuracy, Precision, Recall and F-score. Also we will test our model by adding new feature Hyperbole, because this feature is now in trend and needs more attention.

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