



Different Approaches in Sarcasm Detection: A Survey

Rupali Amit Bagate^{1,2(✉)} and R. Suguna¹

¹ Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science
and Technology, Avadi, Chennai, India
rupali.bagate@gmail.com

² Army Institute of Technology, Dighi Hills, Pune, India
drsuguna@veltech.edu.in

Abstract. Sarcasm is an unwelcome impact or a linguistic circumstance to express histrionic and bitterly opinions. In sarcasm single word in a sentence can flip the polarity of positive or negative statement totally. Therefore sarcasm occurs when there is an imbalance between text and context. This paper surveys different approaches and datasets for sarcasm detection. Different approaches surveyed are statistical approach, rule based approach, classification approach and deep learning approach. It also gives insight to different methodologies used in past for sarcasm detection. After surveying we found deep learning is generating a good result as compare to other approaches.

Keywords: Sentiment analysis · Sarcasm detection · Machine learning · Deep learning

1 Introduction

Sentiment analysis is field of study to analyze and extract the sentiment or opinion of people toward product or topic mentioned in text, facial expression, speech or music. In natural language processing, big data mining and machine learning sentiment analysis is one of the research area. Researchers use opinion mining in place of sentiment analysis. Sentiment analysis (SA) identifies sentiments in text and analyzes its polarity as neutral, positive or negative. SA identifies a state of mind of a person from his emotions expressed in text [1]. This field focuses to obtain opinions, sentiments, emotions based on observations of one's actions that are involved in written text, music, speech, utterance etc.

As per the survey sentiment analysis can be carried out at four respects such as document, sentence, aspect, and lexicon level. Document level considers a full document for sentiment analysis for e.g. blog of specific topic. As name suggests sentence level takes sentence into consideration i.e. paragraph has many sentences. In sentence majority of the polarity decides the person's sentiment towards the topic. Aspect level and lexicon level consider a word from sentence for sentiment analysis. Figure 1 shows a visual taxonomy of sentiment analysis as described above. One step ahead challenge in sentiment analysis is detecting sarcasm. Therefore, sarcasm is one of the prominent

research areas of Sentiment analysis, which can be analyzed on all sentiment analysis (SA) levels.

As Defined in Cambridge Dictionary [2] Sarcasm is usage of words that clearly signify the converse of what someone utters to hurt someone's feelings or to censure something in an amusing way. As per Oxford Dictionary [3] to convey the mock or disrespect sarcastic words have been used. Sometimes Sarcasm has a positive implied surface sentiment with negative sentence (for example 'Visiting my project guide is much exciting!!!'). or negative entail sentiment (for example 'what a bad act, terrible anyway') or no surface sentiment (for Example 'I am feeling sick as dog!').

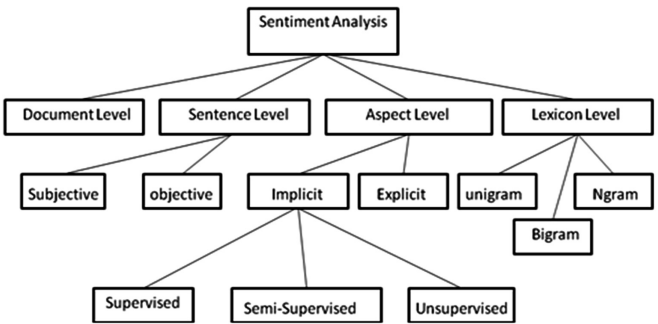


Fig. 1. Taxonomy of sentiment analysis

Sarcasm is a special kind of sentiment with negative, positive or no surface sentence [4]. Sarcasm often expressed with facial expression, textually, utterance while communicating etc. Sarcasm is a very salient aspect in Social media analysis. Data in Social Media is huge and unstructured. Also the absence of face to face contact or the context is very challenging to analyze, be it the mockery or satire in the sentences or words. In this paper we surveyed and compared different techniques to analyze sarcastic sentiments from given a text.

This article surveys state of art in sentiment analysis for sarcasm. Section 3 describes Linguistic presentation of sarcasm. In Sect. 4, various datasets are discussed. Different Approaches are discussed in Sect. 5. The article is concluded in Sect. 6.

2 State of Art

Many authors studied and summarized the different features and methods of text datasets for sarcasm detection. Generally, sentiments are classified into four categories as discussed in Sect. 1. Prominently this review is focusing on Sarcasm detection using lexicon level and implicit aspect level methods. Aspect level SA is categorized into two parts, explicit and implicit level. Implicit aspect extraction can be done in supervised, semi supervised and unsupervised way (refer Fig. 1). For sarcasm identification various mechanism used such as rule Based, deep learning, bootstrapping, statistical etc. [4, 5].

Table 1 shows the detailed survey of sarcasm detection. Tayal et al. [6] used Semi supervised approach to analyze the political sarcastic tweets and polarity detection for a given dataset. The author described process of sentence pre-processing, sentence detection, polarity detection and pos tagging. Filatova [7] used document level sarcasm detection. Sentence level (SA) is not producing accurate result compare to document level. They performed qualitative and quantitative analysis on text by considering document and text utterance [7]. Davidov [8] used semi- supervised approach to study sarcasm detection on text. They used single word feature, n-gram features, pattern features and punctuations features to analyze the text for sarcasm identification. They have used hash-tags utility to identify the sarcasm. Tunghamthiti et al. [9] suggested a novel method of sentiment analysis on concept level considering common sense knowledge with coherent identification of subject relevance. For this it uses machine learning classification. Lunando et al. [10] have considered a sentiment score in SentiWordNet for sentiment analysis for sarcasm identification. Bharti et al. [11] used parsing-based lexicon generation algorithm (PBLGA) to identify Sarcasm based on the interjection word that takes place in the sentence. The blend of two methods is also studied and differentiated with the technique/approach to detect sarcasm. Rajadesingan [12] developed a SCUBA model (sarcasm using behavioral modeling) to detect sarcasm by analyzing users past and current tweets. Riloff et al. [13] presented novel bootstrapping algorithm which automates learning and list out positive idioms and negative idioms from sarcastic tweets. Barbieri et al. [14] and Giachanou et al. [15] worked on short text like micro blogging. Instead of pattern of words as a feature, they worked on set of seven features comprises of frequency of words, written and spoken style, intensity of words, structure of sentences, sentiments, synonyms and ambiguity. Fersini et al. [16] proposed a Bayesian Model Averaging (BMA) combines multiple classifiers as per their fidelity and their minimal probability predictions to better classification of sarcastic and non sarcastic statements, as well as ironic and non ironic text. Roberto González-Ibáñez et al. [17] proposed sarcasm categorization by lexical and pragmatic facet which detects positive negative idioms expressed in Tweets. They compared a performance of automatic sarcasm detection & human classification technique using different studies. Authors have used unigram, dictionary based using support vector machine and logistic regression classifier to classify sarcasm. Bouazizi et al. [18] worked on a pattern based approach for sarcasm detection. They considered four set of features (Punctuation, pattern, syntactic & semantic) sarcasm. Authors classified tweets as a sarcastic and non-sarcastic and suggested method that achieves an accuracy of 83.1% along with precision as 91.1%. Lukin et al. [19] used bootstrapping method, which trains the classifier to distinguish subjective dialogues into sarcasm & nastiness. It uses pattern-based classifier build on syntactic structure which attains a high precision and recall. Davidov [8] used semi supervised sarcasm identification algorithm (SASI) technique on two different domains, Amazon and Twitter. They discussed the difference between two domains dataset. SASI algorithm uses structured dataset of amazon and sarcasm hashtag for twitter analysis. So, from above we can summarize different methods used for sarcasm detection by different authors. Next section explains the linguistic representation of sarcasm.

Table 1. Summary of different methods of sarcasm detection

Author/Year	Domain	Method	Features
Davidov et al. [8]	Twitter Amazon product Review	Semi supervised sarcasm identification algorithm (SASI)	Pattern based and punctuation based
Lukin and Walker [19]	Online dialogue	Bootstrapping Method	Pattern based
Bouazizi and Ohtsuki [18]	Twitter	Pos tagger and SVM	Punctuation based, pattern based, syntactic & semantic [5]
Gonzalez-Ibanez et al. [17]	Twitter	Unigram & Dictionary Based using SVM & logistic regression classifier [5]	Lexical & pragmatic Feature
Fersini et al. [16]	Microblog	Bayesian Model Averaging	Pragmatic piece & part of speech Tags
Barbieri et al. [14]	Twitter	Decision tree	Frequency of words, written and spoken style, intensity of words, structure, sentiments of context, synonyms, ambiguity
Liu et al. [20]	English & Chinese social Media	Multi-strategy ensemble learning approach [5, 20]	Punctuation symbol, lexical syntactic Feature (English) Rhetorical, homophony, construction feature (Chinese)
Riloff et al. [13]	Twitter	Bootstrapping Algorithm along with SVM	Context consideration from Syntactic Structure
Rajadesingan et al. [12]	Twitter	SCUBA framework	Identify user's past tweets, behavioral Modeling
Bharti et al. [11]	Twitter	Parsing-based lexicon generation algorithm (PBLGA) Multiple presence of the interjection words	Negative sentence and positive situation Sentence start with interjection
Lunando et al. [10]	Indonesian social media	Machine learning (Naïve bayes, Maximum Entropy, Support Vector Machine)	Negativity information and the number of interjection words
Tunghamthiti et al. [9]	Twitter	Support vector machine	Concept level & Common sense knowledge
Davidov et al. [21]	Twitter and amazon	Semi Supervised sarcasm identification	Hash tags, 1 gram feature, n-gram features, pattern features and punctuation features [8]
Filatova [7]	Amazon product reviews	Low star rating	Document and a text utterance
Tayal et al. [6]	Twitter	Supervised approach	Punctuation marks, adjective and verb

3 Linguistic Presentation of Sarcasm

Sarcasm means where literal meaning & interpretation of words are contrary to each other [22]. Sarcasm is a form of irony. Irony is a metaphor which is a discrepancy between what actually occurs and what is anticipated. Irony is a rhetorical device where

the words are intentionally used to show a meaning in spite of the desired one. Irony is often fallacious for sarcasm. Sarcasm is a form of lingual irony. Sarcasm is wilful insulator induce harm. When someone says, “Oh, great” your extraordinary food skills made my stomach full. In above sentence you don’t actually mean that the incident is positive. It induces a negative surface. Here, word ‘great’ ironically shows a higher negative entail, even after word is positive. Three types of ironies are there such as Verbal, Situational and Dramatic. Verbal irony is utilization of locution to convey something different what a person writes. The main attribute of verbal irony is, that is availed by a speaker or writer intentionally. It comes in text where a person sight to be understood as meaning something unlike to what his words actually mean. Situational irony is disparity between what is expected to happen and what actually happen. Statement states the situational irony, “The fire station burns down while the firemen are out on a call.” Dramatic irony occurs when the audience has already a perception of situation, what is happening than a character. “In a drama, the person walks into a scene and the audience already knows the suspect is in the house”.

Types of Sarcasm: There are four varieties of sarcasm [23]. Propositional, Embedded, Like-prefixed and Illocutionary. Propositional Sarcasm has implicit sentiments hidden inside a statement. Understanding a context of sentence is very important to interpret a sentiment of sentence. For e.g. “food was amazing!!!”. Here sentence can be interpreted as non-sarcastic if circumstances are not known. Embedded Sarcasm where inappropriate words are embedded in sentence for e.g.” Because he’s been such a fine friend, I’ve struck him off my list”. Word struck is embedded incongruity in sentence. Illocutionary sarcasm comprises of non textual clues in sentences. It contrast the sincere utterance of text. It comprises of writers attitude such as facial expression while uttering a sentence. For e.g. rolling one’s eye while saying “That’s how assignment should be done!”. Like-prefixed sarcasm is implicit refusal of argument being said. For e.g. “ you are like your friend”.

Tuple Representation: [4] sarcastic sentences are represented as collection of six tuples. $\langle S, H, C, u, P, P' \rangle$ where S is Speaker, H is listener, C is Context, u is utterance, P is Literal Proposition and P' is Intended Proposition. Above Tuple conveys Speaker S utters a context C in Literal Proposition p in such a way that Hearer H hears intended Proposition P'. For e.g. Customer says “your room service was fantastic!!!!”. Here manager knows that their service was worst, therefore sarcasm is understood. Below is the representation of six Tuple representations for above statement.

S: Customer **H:** Manager **u:** Your room service was fantastic **P:** Really room service was good **P':** Room service was horrible.

4 Datasets

This section explains different datasets considered for sarcasm detection. Datasets are split up into short, long and dialogues. Example of short text is tweets or reviews of products on Amazon. Long text can be a blog contents and dialogues are chat communication happens online for e.g. in telecom sector. Short text contains mostly one

sarcastic utterance, whereas long text contains sarcastic and non sarcastic sentences together in context. Table 2. shows a work done on different datasets by researchers.

Table 2. Summary of datasets used in various fields

Dataset type	Related work
Short text	[6, 8, 9, 11, 12, 14, 16–18]
Long text	[7, 10]
Dialogues	[19, 24, 25]

5 Approaches

This segment describes different methods for sarcasm detection in sentiment analysis. As per the literature survey and study Rule based, statistical based, classification technique [5], deep learning based [26] approached are described below.

Rule Based: Rule Based approach identifies sarcasm using certain evidence occurs in context in terms of rules. These rules are mostly consisting of hashtags # sarcasm #annoyed etc. For example: “Her performance was amazing!!!” #sarcastic. Rajadesingan et al. [12] used this method to identify the sarcasm in text. They have collected 40,000 tweets to with positive and negative sentiments. They filtered sentences with less than 10 frequencies using bigram and trigram features and calculated sentiment score for sentences.

Statistical Based: [20] Sarcasm detection using statistical Approach differs in various features and learning algorithm. They used pattern-based features which points out the existence of distinctive patterns taken out from a huge sarcasm dataset. Davidov et al. [8] considered precise match, partial overlap and no match techniques to classify the pattern base feature. Authors categorized words into HFWs (High Frequency Words) and CWs (Content Words) resulted from corpus frequency more or less than FH [21]. Liu et al. [20] Considers an english and Chinese sarcastic datasets. Authors have not used explicit feature to identify the sarcasm. They have not considered the imbalance between non-sarcastic and sarcastic samples. They have not considered explicit features to identify sarcasm and also ignores the imbalance between non-sarcastic and sarcastic samples in real world applications. They implemented a novel method MSELA to solve the imbalancing problem. They considered Rhetorical, homophony, construction feature (in Chinese) and Punctuation symbol, lexical syntactic Feature (in English) for sarcasm detection [20].

Classification Technique: Several classification techniques are classified as supervised, unsupervised and semi supervised. SVM, naïve bayes, maximum entropy uses supervised techniques. Tayal et al. [6] used supervised approach to detect sarcasm using different features such as punctuation marks, adjective and verb from context. Davidov et al. [8] used Semi supervised approach for sarcasm detection. They have considered pattern based and punctuation based features for SASI [5] algorithm. Turney [27] used unsupervised approach to identify semantic orientation. author used

collection of pattern of tags to identify semantic orientation using PMI (Point wise Mutual Information) information retrieval method.

Deep Learning: Deep Learning is becoming a promising area in natural language processing as well as sarcasm detection. [22] Identified subtle form of incongruity from the depth of sarcasm. They used four types of word embedding feature to collect the context disparity when sentiment words are missing. They experimented four kinds of word embedding: LSA, GloVe, Dependency-based and Word2Vec. Only current feature alone is not sufficient to calculate the performance. Inclusion of past feature improves the performance more. Ghosh et al. [28] and Joshi et al. [24] used a blend of a Convolution Neural Network and Recurrent Neural Network (Long Short-Term Memory) followed by a Deep Neural Network yielding F Score of 0.92%. They compared their techniques with recursive SVM. Which show an improvement for the deep learning architecture. [26] Identified sarcasm using pre-trained convolution neural network (CNN) by extracting sentiments(S), emotions (E), personality features (P) along with baseline features (B). Authors applied CNN and CNN-SVM method on three different datasets, balanced (dataset 1), imbalanced (dataset 2) and test dataset (dataset 3). Table 3 shows the summary of how deep learning generates better results as compared to other techniques.

Table 3. [26] Experimental results of 5 cross validation on datasets

B	S	E	P	Dataset1 F1 score %		Dataset2 F1 score %		Dataset3 F1 score %	
				CNN	CNN, SVM	CNN	CNN, SVM	CNN	CNN, SVM
+				95.04	97.60	89.32	92.32	88.00	92.20
	+	+	+		90.70		90.90		84.43
+	+	+	+	95.30	97.71	89.73	94.80	88.51	93.30

6 Conclusion

Sarcasm detection in social media, micro blogs, ecommerce or dialogues provides vital perception for current trends, discussions, views and real time happening on various domains. Sarcasm detection has emerged remarkably in recent years as upcoming research area. This paper surveys different approaches and datasets used for sarcasm detection. As observed, most of authors worked on explicit sentiments of given sentence. Very less work covers the implicit aspect detection from sentence for sentiment analysis for sarcasm. Most of authors used supervised and semi-supervised approach for sarcasm detection. Future direction to work in sarcasm is to work on implicit aspect from sentence taking previous and further context into consideration while doing sarcasm detection. As per survey, very few authors worked on drawing out of contextual Information for sarcasm detection. Deep Learning is one of the best method as per survey to achieve good results. Therefore we concluded Deep Learning is one of the interesting & promising area to work on sarcasm detection.

References

1. Abdi, A., Shamsuddin, S.M., Aliguliyev, R.M.: QMOS: query-based multi-documents opinion-oriented summarization. *Inf. Process. Manag.* **54**(2), 318–338 (2018)
2. <https://dictionary.cambridge.org>
3. <https://en.oxforddictionaries.com>
4. Bhattacharyya, P., Carman, M.J., Joshi, A.: Automatic sarcasm detection: a survey. *ACM Comput. Surv. (CSUR)* **50**(5), 22 (2017). Article No. 73
5. Chandankhede, C., Chaudhari, P.: Literature survey of sarcasm detection. In: 2017 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), 22 March 2017
6. Yadav, S., Gupta, K., Rajput, B., Kumari, K., Tayal, D.: Polarity detection of sarcastic political tweets (2014)
7. Filatova, E.: Irony and sarcasm: corpus generation and analysis using crowdsourcing (2012)
8. Tsur, O., Rappoport, A., Davidov, D.: Semi-supervised recognition of sarcastic sentences in Twitter and Amazon (2010)
9. Tunghamthiti, P., Kiyooki, S., Mohd, M.: Recognition of sarcasms in tweets based on concept level sentiment analysis and supervised learning approaches (2014)
10. Purwarianti, A., Lunando, E.: Indonesian social media sentiment analysis with sarcasm detection (2013)
11. Babu, K.S., Jena, S.K., Bharti, S.K.: Parsing-based sarcasm sentiment recognition in Twitter data (2015)
12. Zafarani, R., Liu, H., Rajadesingan, A.: Sarcasm detection on Twitter: a behavioral modeling approach (2015)
13. Riloff, E., Qadir, A., Surve, P., De Silva, L., Gilbert, N., Huang, R.: Sarcasm as contrast between a positive sentiment and negative situation (2013)
14. Barbieri, F., Saggion, H., Ronzano, F.: Modelling sarcasm in Twitter, a novel approach (2014)
15. Giachanou, A., Crestani, F.: Like it or not: a survey of Twitter sentiment analysis methods. *ACM Comput. Surv.* **49**(2), 28 (2016)
16. Pozzi, F.A., Messina, E., Fersini, E.: Detecting irony and sarcasm in microblogs: the role of expressive signals and ensemble classifiers (2015)
17. González-Ibáñez, R., Muresan, S., Wacholder, N.: Identifying sarcasm in Twitter: a closer look, vol. 2. Association for Computational Linguistics (2011)
18. Bouazizi, M., Ohtsuki, T.: A pattern-based approach for sarcasm detection on Twitter (2016)
19. Walker, M., Lukin, S.: Really? Well. Apparently bootstrapping improves the performance of sarcasm and nastiness classifiers for online dialogue (2013)
20. Liu, P., Chen, W., Ou, G., Wang, T., Yang, D., Lei, K.: Sarcasm detection in social media based on imbalanced classification. Springer, Cham (2014)
21. Rappoport, A., Davidov, D.: Efficient unsupervised discovery of word categories using symmetric patterns and high frequency words (2006)
22. Grice, H.P.: Logic and conversation. In: *Speech Acts*, vol. 3 (1975)
23. Camp, E.: Sarcasm, pretense, and the semantics/pragmatics distinction. *Noûs* **4**, 587–634 (2012)
24. Tripathi, V., Bhattacharyya, P., Carman, M., Joshi, A.: Harnessing sequence labeling for sarcasm detection in dialogue from TV series ‘Friends’ (2016)
25. Tepperman, J., Traum, D., Narayanan, S.: “Yeah Right”: sarcasm recognition for spoken dialogue systems (2006)

26. Cambria, E., Hazarika, D., Vij, P., Poria, S.: A deeper look into sarcastic tweets using deep convolutional neural networks, Osaka, Japan (2016)
27. Turney, P.D.: Thumbs up or thumbs down?: semantic orientation applied to unsupervised classification of reviews (2002)
28. Ghosh, A., Veale, T.: Fracking sarcasm using neural network (2016)