

## Impact of Emotion in Sentiment Analysis of opinions expressed on Product Reviews

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### Abstract

*The expression of opinions of a product or service is essential to promote the business further. The electronic commerce websites such as Amazon, Flipkart and others are providing opportunity to the buyers to express the opinion about the product that they purchased from online. The opinions shared in such a common platform. These are helpful to the public who are intended to purchase the same product either from the same seller or from different seller. The sentiment analysis is a technique to analyse the opinion shared by the buyers to classify it as either positive or negative or neutral. There are varieties of model in existence to analyse such sentiments from the shared opinions. The research gap here is that the opinions may have bias in the sense that the opinions are expressed in due weightage of the emotional mood of the buyer. Hence, this research focuses on analyzing the opinions shared by the buyers in terms of its emotions. In support of this, a publicly available dataset is analysed and the results are showing that there is a tremendous variation between the sentiment analysis and emotion analysis of reviews.*

**Keywords:** Sentiment Analysis, Opinion Mining, Emotion Analysis, Product Reviews, Social Networks

### 1. Introduction

Sentiment Analysis (SA) is the process of analyzing the reviews of products or services offered by the business entities. It is a field of affective computing. The term opinion mining is synonymously used with this. It is done by using statistical method, text processing and Natural Language Processing (NLP). The business organization can understand what the people says, how they said and how they feel about the product or service offered by them. The sentiments by the customers are available in the form of reviews, comments, and also in social networking platforms such as tweets in which the people expresses their opinion about the brand, product and / or service. The review data are available in different forms like text, video and audio. The reviews can be analysed by using various techniques including machine learning models. The said opinion needs to be classified by using such techniques. These models usually apply the NLP techniques over the reviews and then classify them in terms of its polarity such as positive, negative and neutral.

Mental state of the human can be expressed by emotions attached to feelings and thoughts. NLP techniques are popularly used for emotion recognition as it is entitled with natural language of humans. Emotional impact on opinions has attracted the researchers in the recent past due to the ability to analyse the opinions from the plethora of publicly available data on platforms.

Sentiments can be analysed in terms of the emotional attachment. It is also essential to identify the mood of the customer or buyer when he or she expressed the opinion in a publicly available platform such as blogs. The customer tends to express a good review when he or she is in happy mood. The opinion would not be appreciated when the customer would be in sad or angry mood. This places the requirement of analysing requirement in terms of the emotional mood of the customer. Emotional score attached to the sentiment reviews can be used to support for improved decision making process.

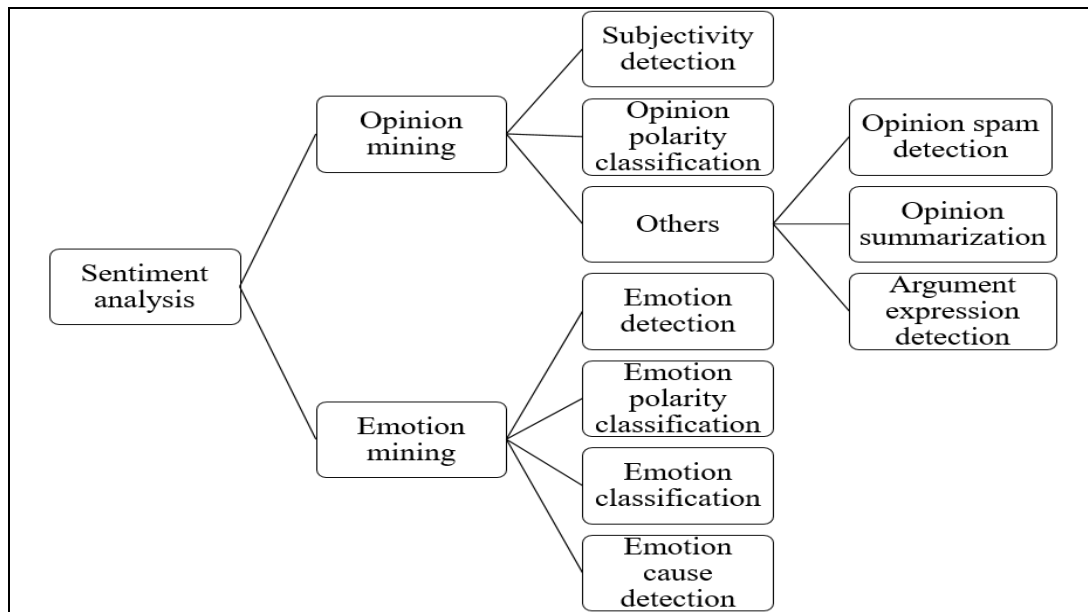


Figure 1. Glossary of sentiment analysis

## 2. Related Research

Emotion in human is started from the day of birth. There is no single and universally agreed definition of emotion, though it is more than trillion years old [1]. The understanding and explanation of human emotion started from 19th century. There are so many theories proposed by the researchers, sociologists, anthropologists and psychologists over a century. The existence of such theories and research are still unable to either prove or disprove the state of emotion with human in solidarity of evidence. The emotion recognition can be computationally identified by NLP techniques [2]. Online social networking environment such as Facebook, Twitter and many more provides a platform for sharing the human emotions without having any geographical barrier. Emotion-aware dialogues are generated from the user's emotions which are shared in any common and publicly available platforms.

Emotions are attached with the neurons of human brain. The human will act and react based on the commands issued by the brain. The emotions of human are expressed in different forms such as text, speech and facial expressions [3]. It is also considered as an important performance of HCI. The study conducted the research to find the correlation between the sentiment analysis and the emotion recognition.

Social media offers the buyers of products and services including mobiles, movies, automobile and electronic goods to express the opinions. It can again be categories both the product and service attracted the customers or not. Sentiment analysis is extracted from the opinions shared in the websites [4]. There are different methods proposed by the researchers to analyse the sentiments and find some insights about the same. Sentiment mining otherwise called as opinion mining uses the NLP and machine learning techniques used to determine the attitude of the person towards the product or service or in general cases. The topic of interest for the research can also be determined by emotion mining by using similar techniques [5]. Emotions are expressed in different forms such as voice or speech and text. The discovery of emotions from the text is still considered as a cumbersome problem, as a research domain. It has wide range of applications like mining from interesting teaching materials in e-learning platform, predicting mental health disorders. The communities of practice are used to represent the sentiments which are in understandable formats by the computing systems. Of course, the extraction and analysis of sentiments and opinion from the available sources are considered as an inter-disciplinary

domain of research [6]. Despite the different sources of data such as social media content, question and answering system would also provide a considerable amount of data in forms of voice and text. Such data can also be analysed in terms of understanding the human behavior that attended the interview or visited the museum. The sensing of emotions from text is a crucial element in a ubiquitous computing environment. Hate speech is also one such problem domain to mining emotions. The emotion mining can use electronic documents like electrocardiogram (ECG) along with speech and text [7]. The study conducted to assess the role of demographic location as part of human emotion, apart from speech and text.

While the sentiment analysis concentrates about the classification of words or opinions as either positive or negative depends on its polarity, the emotion recognition does it fit into different classes of emotions such as fear, anger, happy, trust and so on [8]. The combination of other techniques with NLP could be used to identify the emotion from the available data in an environment. In today's world, social network generates huge volume of data. The researchers from both academia and industry are concentrating on recognizing emotions from such big data. It can be coined as "Social Media Big Data" which attracted researchers to devise and develop useful patterns from social media [9]. Rather than simply using the NLP techniques, the word-net framework can be created to preserve the semantics and the emotions attached to it. This will harness the meaning of computing emotions from every sentence.

The availability of multimedia contents are rich in quantity and the same offers an opportunity for the researchers to identify the behaviors and the activities carried out by the people in terms of sentiments and opinions. The idea behind analyzing the multimedia content is it gives the platform to extract the sentiments and opinions from the visual content rather than the textual content [10]. The social media blogger – Twitter – is the widely used platform for the bloggers to share such multimedia content of sentiments. Unstructured data are one among the type of data available for the content extraction and analysis on particular topic of interest. The contents of such data are in different formats like audio, video, text and images [11]. The different modalities can be applied over such voluminous of big data for the analysis of sentiments and emotions. Twitter as an online social networking blogging site has attracted the users to share their feelings and emotions. The data hosted in the site has unprecedented growing. The blog post available on daily basis in the site is around billions in different topics, called hash tags [12]. These tags are used for the extraction of sentiments from the website using different techniques. Deep Learning has attracted the researchers for improving the accuracy of the research carried out in different domains. It is generally believed that it offers the improvement of accuracy. The emotion analysis is also used to identify the users' opinions about the events and products from the public opinions. Twitter has such public opinions in huge volume [13]. The lexical analysis and syntactic features are the widely used method to analyse the sentiments and emotions available in online social networking sites like Twitter. Social media has attracted the public at greater extent due to its availability and the speed of information sharing and broadcasting. These characteristics attracted the researchers to analyse the same for various applications including political campaign, viral marketing. Twitter is identified as it has emotion flow [14]. There is an availability of dynamism in the emotions presented in Tweets. Twitter is not only used to post the blog but also used to express the opinions and emotions of its users. The influence of the emotion analysis is also an interesting study about the Tweets available in the site [15]. It can also be used to study the user relationship from the available data.

The sentiment is categorized based on polarity. It can be used to analyse such sentiments for the digital marketing as well as viral marketing. The word to mouth model works out better to popularize a particular product or even a brand [16]. The analysis of a product from different brands by using Tweets can be done. The availability of methods such as lexicon based and NRC can be used to analyse the tweets. The analysed data can be used to promote the product using the digital marketing. Customer reviews or opinions are playing vital role in product promotion, familiarity of the product in horizontal and vertical market segment and also the product availability in the market. The usual strategy used to analyse the sentiments is based on the

available vocabulary or familiarly called as bag-of-words model [17]. The machine learning model such as unsupervised model can be a different thought of applying the same for sentiment analysis. Finding the polarity of sentences shared by the users in a shareable platform is so called sentiment analysis. The polarity of sentences falls into three classes namely positive, negative and neutral. The Instant Videos are used to share the emotions or opinions or sentiments by the users 'all of a sudden' [18]. This has the impact of expressing the opinion about the product, as review. This can be used as data to analyse the emotional sentiment about the product or service.

Sentiment classification based on the polarity has studied by the researchers in the recent years, as it is still considered as a live research domain. The electronic commerce service providers offer a large variety of products for online purchase. These websites are also offering the opportunity to the buyers to express their opinions about the product purchased from their websites [19]. The sentiment or opinions shared by the buyers can be used to analyse the polarity of the same. This will help the manufacturers and also the service providers to analyse the product demand and for improved decision making process. Mobile phones are changed the human lives and they became as part of human life. It also assists to carry out day-to-day activities of people. The convenience of the mobile phones is the applications (Familiarly called as Mobile Apps) can be used anywhere and everywhere [20]. There are number of such applications available for a same task or purpose. The users are provided the way to express the product review about such mobile applications. The interestingness of the study about such reviews is based on different features of the same app.

Social networks not only attracted the researchers but also the general public. Social network analysis is the set of measures used to analyse the impact of network [21]. The influential node in the network is an interesting phenomenon. When the message is shared in the network, a particular node would become an expert about the topic. This will classify the nodes in appropriate category based on the polarity. The social network measures are used to identify such polarity. Data Mining is the extraction of patterns, which can be used for useful knowledge generation. The preschool children emotions are attached with their mental health [22]. This study will help the administrators for improving the cognitive ability of the children based on their emotional attitude. The video shoots of the children expresses the current state of the emotion and cognition about the concentration on studies. Though the users of social media expresses their feelings and opinions in the common platform, by means of micro-text, videos and audios, including the instant messaging, the study carried out to understand the relationship that may exist between the writer and the reader. It would be achieved by discovering the communities that may exist in the entire network [23].

Emotion analysis is an attractive research. It can be done from different sources of data such as text, videos, audios, microblogging, instant messages [24]. There are wide varieties of methods and techniques were presented for efficient analysis of emotions from text, by the research community. The deep learning as an evolution of neural network is being applied for the extraction and analysis of emotions from textual data. Analysis of emotion from annotated-data is an interesting study. The opinions and emotions can be extracted from different sources of data like multimedia content, websites, e-commerce sites and social networking sites. The data available in such platforms are also plenty like voice, text, audio, speech. It is a challenging research to extract the opinions from such emotions from all these available formats and sources [25]. There are different models proposed by different researchers over a period of time and topic based model is one such model. This combines the proposed model with available machine learning model. The advent of Internet technologies provides the opportunity for information sharing and exploration by different means. The timely analysis of data by the authorities concerned will promote the corresponding domain for social harmony and to improve health issues [26]. The combination of methodologies for the effective analysis of emotions from the text data using machine learning with proper preprocessing would improve the efficiency of research.

### 3. Material and Method

Amazon Musical Instruments Reviews dataset [27] from kaggle is used to analyse the emotion. This has 10,261 sentiments shared by the buyers. The dataset has classified scores of overall sentiments which ranges between 1 and 5. It is also found that the sentiment analysis is given only with positive polarity (classification). There are no missing values found in the dataset. The emotion analysis is carried out by using syuzhet package under statistical package R. It works on the basis of OpenNLP of Apache. This package will extract the emotions based on the six different classes namely anger, anticipation, disgust, fear, joy, sadness, surprise and trust. It will also provide the final values of score under negative and positive. These are the accumulated score for all the corresponding emotions.

### 4. Results and Discussion

Some classical examples of sentiments along with its sentiment score and emotion score are given in Table-1. The sentiments in the table are shown that they are variable in length. It is also noted that there is a significant difference between the pre-assessed scores for the reviews by sentiment analysis and the scores by the emotion analysis. Though the sentiment analysis scores of the reviews are with positive polarity and with related scores, the emotion analysis shows that the scores are in existence in both positive and negative. It is also observed that for a review comment the scores of both positive and negative are zero. It means that it is a neutral statement, but for the same statement the sentiment score is given as 3 with positive polarity.

Similarly, the individual review comments were analysed based on the emotion and the final score with the polarity of positive or negative or both.

**Table 1. Sentiment analysis and emotion analysis scores of sample reviews**

Sl. No.	Review Comment	Sentiment analysis score	Emotion Analysis	
			Positive Score	Negative Score
1	The primary job of this device is to block the breath that would otherwise produce a popping sound, while allowing your voice to pass through with no noticeable reduction of volume or high frequencies. The double cloth filter blocks the pops and lets the voice through with no coloration. The metal clamp mount attaches to the mike stand secure enough to keep it attached. The goose neck needs a little coaxing to stay where you put it.	5	2	0
2	Not much to write about here, but it does exactly what it's supposed to. filters out the pop sounds. now my recordings are much more crisp. it is one of the lowest prices pop filters on amazon so might as well buy it, they honestly work the same despite their pricing	5	0	3
3	I now use this cable to run from the output of my pedal chain to the input of my Fender Amp. After I bought Monster Cable to hook up my pedal board I thought I would try another one and update my guitar. I had been using a high end Planet Waves cable that I bought in the 1980's... Once I found out the input jacks on the new Monster cable didn't fit into the Fender Strat jack I was a little disappointed... I didn't	3	5	2

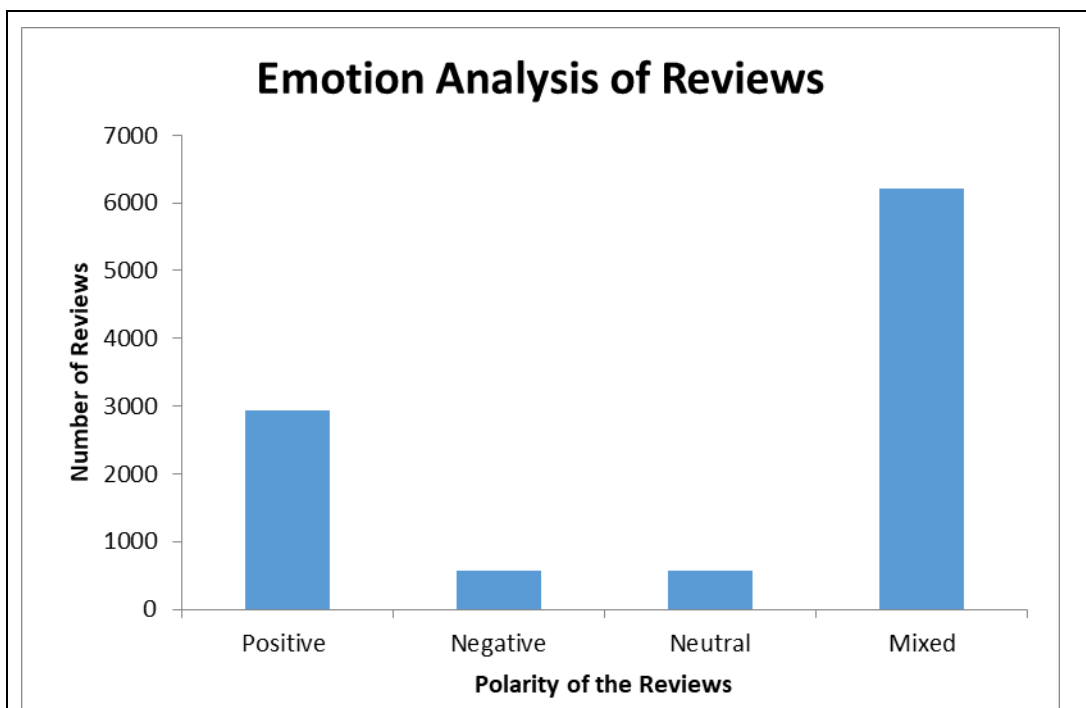
	return it and as stated I use it for the output on the pedal board. Save your money... I went back to my Planet Waves Cable...I payed \$30.00 back in the eighties for the Planet Waves which now comes in at around \$50.00. What I'm getting at is you get what you pay for. I thought Waves was a lot of money back in the day...but I haven't bought a guitar cable since this one...20 plus years and still working...Planet Waves wins.			
4	If you are not use to using a large sustaining pedal while playing the piano, it may appear little awkward.	3	0	0

It is observed that the NRC sentiment returns value based on the emotions, if present, in the review comment. The following rule-set is applied to assess the different classification of the newly generated classes. These classes are based on the emotional values by the NRC values.

**Table 2. Rule set for the emotion classification**

Rule#	Description	Class
1	Positive non-zero score	Positive
2	Negative non-zero score	Negative
3	Positive zero score and negative zero score	Neutral
4	Positive non-zero score is and negative non-zero score	Mixed

The number of emotions that falls into the different categories based on the rule set defined as in Table 2 are shown in Figure-2.



**Figure 1. Emotion analysis of review categories**

## 5. Conclusion

Sentiment analysis is an attractive area of research. It analyses the opinions share by the buyers of product or service in a common platform. The deficiency of such analysis is not concerned the emotion of the people. While the sentiments are assessed based on polarity the emotions are assessed based on valance. This research has taken a dataset in which the sentiments were already analysed in terms of its polarity. The opinions available in the dataset have weightage ranges between 1 and 5 that means all are with positive magnitude. When the emotion analysis of such opinions is applied, only 28.53% of the opinions are found to be positive. The remaining opinions are fit into either negative or neutral also.

## References

- [1] T. Thanapattheerakul, K. Mao, J. Amoranto, and J. H. Chan, “Emotion in a Century,” Proceedings of the 10th International Conference on Advances in Information Technology - IAIT 2018, (2018).
- [2] S. Poria, N. Majumder, R. Mihalcea, and E. Hovy, “Emotion Recognition in Conversation: Research Challenges, Datasets, and Recent Advances,” IEEE Access, vol. 7, (2019), pp. 100943–100953.
- [3] K. Hulliyah, N. S. Awang Abu Bakar, and A. R. Ismail, “Emotion recognition and brain mapping for sentiment analysis: A review,” 2017 Second International Conference on Informatics and Computing (ICIC), Nov. (2017).
- [4] E. Tyagi and A. K. Sharma, “An intelligent framework for sentiment analysis of text and emotions - A review,” 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), Aug. (2017)
- [5] A. Yadollahi, A. G. Shahraki, and O. R. Zaiane, “Current State of Text Sentiment Analysis from Opinion to Emotion Mining,” ACM Computing Surveys, vol. 50, no. 2, (2017), pp. 1–33.
- [6] C. Clavel and Z. Callejas, “Sentiment Analysis: From Opinion Mining to Human-Agent Interaction,” IEEE Transactions on Affective Computing, vol. 7, no. 1, (2016), pp. 74–93.
- [7] E. L. van den Broek, “Ubiquitous emotion-aware computing,” Personal and Ubiquitous Computing, vol. 17, no. 1, (2011), pp. 53–67.
- [8] R. Meo and E. Sulis, “Processing Affect in Social Media,” ACM Transactions on Internet Technology, vol. 17, no. 1, (2017), pp. 1–25.
- [9] D. Jiang, X. Luo, J. Xuan, and Z. Xu, “Sentiment Computing for the News Event Based on the Social Media Big Data,” IEEE Access, vol. 5, (2017), pp. 2373–2382.
- [10] Q. You, “Sentiment and Emotion Analysis for Social Multimedia,” Proceedings of the 2016 ACM on Multimedia Conference - MM '16, (2016).
- [11] J. K. P. Seng and K. L.-M. Ang, “Multimodal Emotion and Sentiment Modeling From Unstructured Big Data: Challenges, Architecture, & Techniques,” IEEE Access, vol. 7, (2019), pp. 90982–90998.
- [12] D. Zimbra, A. Abbasi, D. Zeng, and H. Chen, “The State-of-the-Art in Twitter Sentiment Analysis,” ACM Transactions on Management Information Systems, vol. 9, no. 2, (2018), pp. 1–29.
- [13] Z. Jianqiang, G. Xiaolin, and Z. Xuejun, “Deep Convolution Neural Networks for Twitter Sentiment Analysis,” IEEE Access, vol. 6, (2018), pp. 23253–23260.
- [14] D. Naskar, S. R. Singh, D. Kumar, S. Nandi, and E. O. de la Rivaherrera, “Emotion Dynamics of Public Opinions on Twitter,” ACM Transactions on Information Systems, vol. 38, no. 2, (2020), pp. 1–24.
- [15] K. Tago and Q. Jin, “Influence analysis of emotional behaviors and user relationships based on Twitter data,” Tsinghua Science and Technology, vol. 23, no. 1, (2018), pp. 104–113.

- [16] D. Al-Hajjar and A. Z. Syed, “Applying sentiment and emotion analysis on brand tweets for digital marketing,” 2015 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT), Nov. (2015).
- [17] L. Bing, T.-L. Wong, and W. Lam, “Unsupervised Extraction of Popular Product Attributes from E-Commerce Web Sites by Considering Customer Reviews,” ACM Transactions on Internet Technology, vol. 16, no. 2, (2016), pp. 1–17.
- [18] S. Kausar, X. Huahu, W. Ahmad, M. Y. Shabir, and W. Ahmad, “A Sentiment Polarity Categorization Technique for Online Product Reviews,” IEEE Access, vol. 8, (2020), pp. 3594–3605.
- [19] X. Fang and J. Zhan, “Sentiment analysis using product review data,” Journal of Big Data, vol. 2, no. 1, Jun. (2015).
- [20] Y. Li, B. Jia, Y. Guo, and X. Chen, “Mining User Reviews for Mobile App Comparisons,” Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, vol. 1, no. 3, (2017), pp. 1–15.
- [21] L. Gao, Y. Wu, X. Xiong, and J. Tang, “Discriminating Topical Influencers Based on the User Relative Emotion,” IEEE Access, vol. 7, (2019), pp. 100120–100130.
- [22] L. Yue, Z. Chunhong, T. Chujie, Z. Xiaomeng, Z. Ruizhi, and J. Yang, “Application of data mining for young children education using emotion information,” Proceedings of the 2018 International Conference on Data Science and Information Technology - DSIT '18, (2018).
- [23] X. Wang, D. Jin, M. Liu, D. He, K. Musial, and J. Dang, “Emotional Contagion-Based Social Sentiment Mining in Social Networks by Introducing Network Communities,” Proceedings of the 28th ACM International Conference on Information and Knowledge Management - CIKM '19, (2019).
- [24] R. Zhang, Z. Wang, K. Yin, and Z. Huang, “Emotional Text Generation Based on Cross-Domain Sentiment Transfer,” IEEE Access, vol. 7, (2019), pp. 100081–100089.
- [25] K. B. Vamshi, A. K. Pandey, and K. A. P. Siva, “Topic Model Based Opinion Mining and Sentiment Analysis,” 2018 International Conference on Computer Communication and Informatics (ICCCI), Jan. 2018, (2018).
- [26] L. Luo, “Network text sentiment analysis method combining LDA text representation and GRU-CNN,” Personal and Ubiquitous Computing, Oct. 2018, (2018).
- [27] <https://www.kaggle.com/eswarchandt/amazon-music-reviews>