

University of Sheffield

Identifying complaints in social media using deep learning with transformers



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Declaration

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Abstract

A complaint is a statement made by a person or an entity with the intent to indicate something is unacceptable or unsatisfactory. This is commonly used in various aspects of day-to-day life including when conducting business operations. With the proliferation of social media across our lives and the active enablement of such platforms by organisations for user engagement, it has become a common medium for users to raise complaints. With such complaints being publicly visible, it is imperative for organisations to identify, prioritise and respond to these complaints swiftly. Automatically identifying complaints in social media is an active area of research. In the past few years, the focus has been on using NLP approaches driven by developments in transfer learning and transformer-based models.

In this paper, the use of these approaches are extended by assessing 'lightweight' transformer based models such as DistillBERT, MobileBERT, BERT tiny/small which are meant to reduce the time required for fine-tuning as well as inference. The performance of these 'lightweight' models is compared with the traditional transformer models including BERT, ROBERTA, BERTweet for this particular task. The dataset used consists of anonymised and annotated (complaint or not) Twitter data utilized in previous research and currently available in the public domain. In addition, the act of complaining and the nature of complaints are analysed from a linguistic perspective along with discussions on state-of-the-art approaches for such NLP tasks.

****Update with high level results****

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Chapter 1

Introduction

1.1 Background

In the act of complaining, dissatisfaction or annoyance is expressed by a person or entity in response to a previous or ongoing event that has negatively impacted them [7]. It provides an avenue to direct dissatisfaction to the appropriate organisation or individual with the hope of rectification or redressal. The event or action could be concerning a product or service procured by the concerned person or entity. The need to recognise, acknowledge and act on complaints is of significant importance to businesses and organisations to retain their customers while maintaining their reputations.

Until the advent of online platforms and specifically social media, the impact of negative word-of-mouth was confined to a relatively limited audience. However, since then complaints posted online have the potential to rapidly go viral, reaching millions of individuals and significantly damaging a company's brand reputation and goodwill in a short period [11]. Customers are able to express their complaints directly, conveniently, and with enhanced effectiveness to organisations through multiple social media channels and platforms [1].

In addition to the timely addressing of customer complaints, automated detection of complaints in natural language has a number of other purposes. Linguists could gain a more detailed understanding of the context, intent, and various types of complaints on a larger scale while psychologists could utilise this information to identify the underlying human traits that drive the behaviour and expression of complaints. Developing downstream natural language processing (NLP) applications, such as dialogue systems is another use case of this task [8].

Attempting to identify complaints manually through the multitude of posts and streams coming through the various social media channels is neither practical nor scalable. Various approaches to automate this task have been explored. The traditional vector-space method utilizing dictionaries has been applied in other text classification tasks [6]. Latent Semantic Indexing based on Singular Value Decomposition along with linguistic style features has

been utilised to classify emails as complaints or not [3]. In recent years, we have seen the use of various Machine learning and Natural Language Processing (NLP) based approaches for similar classification problems. The performance of logistic regression over various types of feature spaces against neural-network based models like Multi-layer Perceptron (MLP) and Long Short Term Memory (LSTM) has been analysed by [8] on Twitter feeds. The use of more advanced approaches using transformer networks has shown to have better results as explored by [4]. As part of this paper, the use of the BERT and its many variants, including that of lightweight versions that have been created in the recent past will be assessed further on a publicly available Twitter dataset.

1.2 Aims and Objectives

****TO UPDATE****

Chapter 2

Literature Survey

2.1 The act of complaining

In a traditional sense, as per [7], the speech act of complaining can be understood from the perspective of the speaker stating their displeasure or dissatisfaction to a target entity or individual. This is done as a reaction to an unfavourable event that is currently taking place or has already occurred. To result in a complaint being made, the authors believe a few preconditions have to be satisfied. This includes the speaker's belief the entity or individual is responsible for the unfavourable outcome and the speaker suffering from the consequences. The result is a verbally expressed complaint. The authors further delve into the intentions of the speaker in making the complaint. They argue this is carried out with either the hope of repair of the situation or as a 'Face Threatening Act' with the purpose being to damage the face of the individual or entity against whom the complaint is made.

Analysing further into which types of customers complain more, [10] have looked at how personality traits like impulsivity and self-monitoring impact customer complaining behaviour. Impulsivity as defined by [9], refers to a consistent inclination of customers to act spontaneously and immediately, without much reflection or careful consideration of available options or potential consequences. This trait remains relatively stable over time for such customers. [2] defines self-monitoring as the inclination to adjust one's behaviour based on the actions or behaviour of others. High self-monitoring individuals are sensitive to others' expressions and behaviour, relying on social cues for their actions, while low self-monitoring individuals may be influenced by personal traits. From their experiments, [10] concluded that individuals with high impulsiveness tend to complain more than those with low impulsiveness, whereas individuals with high self-monitoring tend to complain less than those with low self-monitoring. However, these effects are more pronounced in situations where the level of dissatisfaction is high.

2.2 Complaining online

The act of complaining exists online in various forms and with varying degrees of intensity and this widespread leading to the emergence of third-party organisations that provide online channels for customers' ease and convenience [11]. Notably, there are complaint websites like complaintsboard.com, review websites like trustpilot.com as well as consumer organisations' sites such as consumeraffairs.com, where customers can share their negative experiences and exchange information with others. The impact of negative word of mouth is quite high due to the ease with which negative reports can rapidly reach millions of people, potentially causing significant harm to a company's brand. Various user-generated content platforms such as YouTube, Twitter, and Facebook serve as spaces for expressing complaints. With numerous options available online, companies can experience significant repercussions arising from actions taken by dissatisfied customers [11].

As part of [11], 431 online complaints were assessed. Of these 96% followed what they call a double deviation. This occurs when customers experience both a product or service failure followed by multiple unsuccessful attempts to resolve the issue, resulting in them feeling they have been violated twice. The urge for such customers to resort to online complaining is driven by how they felt betrayed rather than simply being dissatisfied or with malicious intentions to hinder business operations.

Chapter 3

Methodology

3.1 Data used and pre-processing applied

The data used for the experiments is from Twitter. The data set used is the one created by [8] and further used by [4]. The particular version ¹ used for the experiments is the one enhanced by [5] with the addition of labels for the severity of complaints.

3.2 Another Section

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3.3 Ethical, Professional and Legal Issues

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¹The data can be found here - https://archive.org/details/complaint_severity_data

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Chapter 4

Results and discussion

4.1 Risk Analysis

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4.2 Project Plan

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Chapter 5

Conclusions

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Bibliography

- [1] BALAJI, M. S., JHA, S., AND ROYNE, M. B. Customer e-complaining behaviours using social media. *The Service industries journal* 35, 11-12 (2015), 633–654. Place: London Publisher: Routledge.
- [2] BECHERER, R. C., AND RICHARD, L. M. Self-Monitoring as a Moderating Variable in Consumer Behavior. *The Journal of consumer research* 5, 3 (1978), 159–162. Place: CHICAGO Publisher: Journal of Consumer Research.
- [3] COUSSEMENT, K., AND VAN DEN POEL, D. Improving customer complaint management by automatic email classification using linguistic style features as predictors. *DECISION SUPPORT SYSTEMS* 44, 4 (2008), 870–882. Place: AMSTERDAM Publisher: Elsevier B.V.
- [4] JIN, M., AND ALETRAS, N. Complaint Identification in Social Media with Transformer Networks.
- [5] JIN, M., AND ALETRAS, N. Modeling the Severity of Complaints in Social Media.
- [6] LIANG, C.-Y., GUO, L., XIA, Z.-J., NIE, F.-G., LI, X.-X., SU, L., AND YANG, Z.-Y. Dictionary-based text categorization of chemical web pages. *Information Processing & Management* 42, 4 (2006), 1017–1029.
- [7] OLSHTAIN, E., AND WEINBACH, L. Complaints: A study of speech act behavior among native and non-native speakers of Hebrew. 195–208.
- [8] PREOTIUC-PIETRO, D., GAMAN, M., AND ALETRAS, N. Automatically Identifying Complaints in Social Media.
- [9] ROOK, D. W., AND FISHER, R. J. Normative Influences on Impulsive Buying Behavior. *The Journal of consumer research* 22, 3 (1995), 305–313. Place: CARY Publisher: University of Chicago Press.
- [10] SHARMA, P., MARSHALL, R., ALAN REDAY, P., AND NA, W. Complainers versus non-complainers: a multi-national investigation of individual and situational influences on customer complaint behaviour. *Journal of marketing management* 26, 1-2 (2010), 163–180. Place: Helensburg Publisher: Taylor & Francis.

- [11] TRIPP, T. M., AND GREGOIRE, Y. When unhappy customers strike back on the Internet. *MIT Sloan management review* 52, 3 (2011), 37. Place: Cambridge Publisher: Sloan Management Review.

Appendices

Appendix A

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Appendix B

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