

Temporal Sentiment Analysis

- Trends in reviews over time

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Abstract

Every report must include an abstract. This abstract must be one paragraph, and may not exceed 200 words. The abstract should provide a concise summary of your project's purpose, method, and results. Note that the abstracts of all projects will be published on the course website.

Your report should contain between 2,000 and 4,000 words, corresponding to approximately 4–8 pages of single-spaced text. This guidance excludes the title and abstract, as well as any non-textual elements such as figures, tables, mathematical formulas. Even references are excluded from this guidance.

Acknowledgments

I'm deeply indebted to Zelda, my cat, for her unparalleled support and patience.

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1 Introduction

Opinions are often presented as the count of positive and negative views of the audience. This is common for elections, but also on social media platforms like Twitter or product reviews where it can be used for information retrieval [4]. However, for certain products or situations the opinion might change over time e.g. stock market or presidential elections. This is also more common for software products (e.g. applications, games or services) since these are continuously changed over time [2]. As described in [2] this is an important view of the users and developers for either deeming if the game is a good investment or what issues to prioritize.

1.1 Aim

For this report the aim is to implement an automated approach for performing sentiment analysis on text data in a time-series approach. The outcome is a package with modular components that has the ability to digest text with a certain topic, classify each entry based on sentiment and then visualize with respect to time.

1.2 Motivation

This project was chosen to utilize text mining for temporal insights of a topic, which can be important for decision making. This will also result in an usable application that can be used and improved in the future.



2 Theory

Present relevant theoretical background, and in particular the models that you have used. Where appropriate, use mathematical formulas.

The main purpose of this chapter is to make it obvious for the reader that the report authors have made an effort to read up on related research and other information of relevance for the research questions. It is a question of trust. Can I as a reader rely on what the authors are saying? If it is obvious that the authors know the topic area well and clearly present their lessons learned, it raises the perceived quality of the entire report.

After having read the theory chapter it shall be obvious for the reader that the research questions are both well formulated and relevant.

The chapter must contain theory of use for the intended study, both in terms of technique and method. If a final thesis project is about the development of a new search engine for a certain application domain, the theory must bring up related work on search algorithms and related techniques, but also methods for evaluating search engines, including performance measures such as precision, accuracy and recall.

The chapter shall be structured thematically, not per author. A good approach to making a review of scientific literature is to use *Google Scholar* (which also has the useful function *Cite*). By iterating between searching for articles and reading abstracts to find new terms to guide further searches, it is fairly straight forward to locate good and relevant information, such as [7].

Having found a relevant article one can use the function for viewing other articles that have cited this particular article, and also go through the article's own reference list. Among these articles one can often find other interesting articles and thus proceed further.

It can also be a good idea to consider which sources seem most relevant for the problem area at hand. Are there any special conference or journal that often occurs one can search in more detail in lists of published articles from these venues in particular. One can also search for the web sites of important authors and investigate what they have published in general.

This chapter is called either *Theory*, *Related Work*, or *Related Research*. Check with your supervisor.




3 Data

The data used is queried from Steam Web API [6] using Python for the games used in the project. Data is stored in parquet file format [1] for efficient storing and good interaction with Pandas. Code used for extracting and storing is available in the repository [3].

The data from the reviews API consists of a summary of the statistics for the game, information about the author and the review itself with meta data. The full specification is available on Steam review API page [6].

Processing of the data consisted of converting between different data types and creating a consistent dataset from the API. Data types were converted to the most suited for use with the Python packages, such as Scikit-learn, Numpy and Pandas. Mostly this involved datetime conversions.

The data was also stripped of personal information about the author, recommendationid and author, which could easily be used to trace the user accounts. Due to the Term of Use for Steam Web API [5] data is not provided with the project.



4 Method

Explain how you carried out your study. Aim to be detailed enough for others to reproduce your results.

In this chapter, the method is described in a way which shows how the work was actually carried out. The description must be precise and well thought through. Consider the scientific term replicability. Replicability means that someone reading a scientific report should be able to follow the method description and then carry out the same study and check whether the results obtained are similar. Achieving replicability is not always relevant, but precision and clarity is.

Sometimes the work is separated into different parts, e.g. pre-study, implementation and evaluation. In such cases it is recommended that the method chapter is structured accordingly with suitable named sub-headings.

delat i modular: extraction, classification and evaluation

4.1 Pre-study

similar research ..
steam reviews ..
Text extraction ..
Sentiment classification ..
evaluation ..

4.2 Implementation

4.3 Evaluation

For evaluation the similar Steam Reviews will be used for a game the author has knowledge about. The author will predict the behaviour of the reviews based on knowledge about the game and by reading update notes from the developers to see what issues have been present in the game. Then in this section there will be a prediction made before investigating the reviews and looking at the graphs presented by Steam. This will later be used as a benchmark for the analysis package under [section YY](#).

The game chosen is a PC game named *Wolcen: Lords of Mayhem*, which started as a kickstarter with the name *Umbra*. [8] The game is available at Steam [9] and was released on February 13 2020 after a 4 year early access for a limited audience. The audience had very high hopes for the game from the very successful kickstarter campaign and glimpses of the game during development. However, the release was not as smoothed as anyone could have hoped for with server issues and unstable gameplay. At the same time it was a somewhat new take on the genre and had many positive elements that could evolve into the game that was expected.

The development team then released small patches and hotfixes to the game without any new content for almost a year. The 3 December 2020 a large new content update was released that have been very sought for in the community. This were another implementation of what was promised during the kickstarter campaign along with rebalancing and restarting the game and economy that had been affected by the early bugs at release. During the last month more hotfixes and small pathces has been released without any new content.

At the time of writing the game has 54 000 reviews which will be used for evaluating the work performed in this report. With the information about the game, over 100 hours of gameplay and looking over the patch notes and updates certain patterns are expected. There has been lots of game breaking issues around release of the game, suggesting that there should be a fair amount of negative reviews. Also looking at where in the development process according to the kickstarter campaign, these are not yet fulfilled at release meaning that content is missing that has been promised.

During a game release there will always be most active players just after release and later if there is large content releases. This is where peaks in the reviews are expected, both negative and positive. There should be several magnitudes of reviews more around release date than around the large content update in December. It is also expected that there are a very low number of reviews in between these releases. Since the content update still not completed the kickstarter roadmap, there is probably a high number of negative reviews at the time for this update.

5 Results

Present your results in an objective way. Use tables and charts, but do not forget to also include a summary in text form. Do not interpret your results.

This chapter presents the results. Note that the results are presented factually, striving for objectivity as far as possible. The results shall not be analyzed, discussed or evaluated. This is left for the discussion chapter.

In case the method chapter has been divided into subheadings such as pre-study, implementation and evaluation, the result chapter should have the same sub-headings. This gives a clear structure and makes the chapter easier to write.

In case results are presented from a process (e.g. an implementation process), the main decisions made during the process must be clearly presented and justified. Normally, alternative attempts, etc, have already been described in the theory chapter, making it possible to refer to it as part of the justification.

Table 5.1: Model result on train data.

Model	TP	FP	FN	TN	Accuracy
Dummy Classifier (stratified)	24015	24172	24179	24221	0.50
Multinomial Naive Bayes	41980	6207	5356	43044	0.88
Linear SVM (SGD)	40443	7744	3350	45050	0.89
Logistic Regression	42155	6032	3049	45351	0.91
KNN	34689	13498	2900	45500	0.83
Random Subspaces (SVM)	38322	9865	6028	42372	0.84
True Classification	48187	0	0	48400	

Table 5.2: Model result on test data.

Model	TP	FP	FN	TN	Accuracy
Dummy Classifier (stratified)	10480	10324	10276	10315	0.50
Multinomial Naive Bayes	18042	2762	2841	17750	0.86
Linear SVM (SGD)	16851	3953	1794	18797	0.86
Logistic Regression	17084	3720	2015	18576	0.86
KNN	13461	7343	1709	18882	0.78
Random Subspaces (SVM)	16446	4358	3005	17586	0.82
True Classification	20804	0	0	20591	

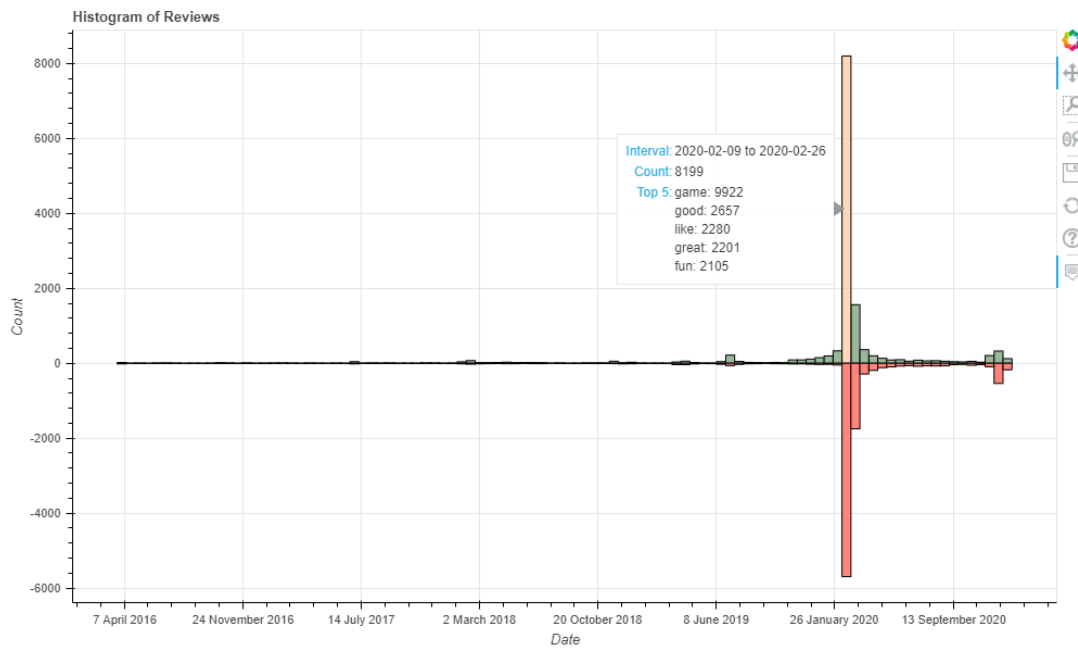
Table 5.3: Majority Voting on test data.

Model	TP	FP	FN	TN	Accuracy
Majority Voting	17210	3594	1891	18700	0.87

Table 5.4: Model result on validation data.

Model	TP	FP	FN	TN	Accuracy
Multinomial Naive Bayes	8839	1828	2945	10721	0.80
Linear SVM (SGD)	8137	2530	1746	11920	0.82
Logistic Regression	8342	2325	2092	11574	0.82
Majority Voting	8420	2247	1914	11752	0.83
True Classification	10667	0	0	13666	

Figure 5.1: Demo plot





6 Discussion

Analyse your results and discuss the possibilities and limitations of your technical approach. Compare your study to related work.

This chapter contains the following sub-headings.

6.1 Results

Are there anything in the results that stand out and need be analyzed and commented on? How do the results relate to the material covered in the theory chapter? What does the theory imply about the meaning of the results? For example, what does it mean that a certain system got a certain numeric value in a usability evaluation; how good or bad is it? Is there something in the results that is unexpected based on the literature review, or is everything as one would theoretically expect?

6.2 Method

This is where the applied method is discussed and criticized. Taking a self-critical stance to the method used is an important part of the scientific approach.

A study is rarely perfect. There are almost always things one could have done differently if the study could be repeated or with extra resources. Go through the most important limitations with your method and discuss potential consequences for the results. Connect back to the method theory presented in the theory chapter. Refer explicitly to relevant sources.

The discussion shall also demonstrate an awareness of methodological concepts such as replicability, reliability, and validity. The concept of replicability has already been discussed in the Method chapter (4). Reliability is a term for whether one can expect to get the same results if a study is repeated with the same method. A study with a high degree of reliability has a large probability of leading to similar results if repeated. The concept of validity is, somewhat simplified, concerned with whether a performed measurement actually measures what one thinks is being measured. A study with a high degree of validity thus has a high level of credibility. A discussion of these concepts must be transferred to the actual context of the study.

The method discussion shall also contain a paragraph of source criticism. This is where the authors' point of view on the use and selection of sources is described.

In certain contexts it may be the case that the most relevant information for the study is not to be found in scientific literature but rather with individual software developers and open source projects. It must then be clearly stated that efforts have been made to gain access to this information, e.g. by direct communication with developers and/or through discussion forums, etc. Efforts must also be made to indicate the lack of relevant research literature. The precise manner of such investigations must be clearly specified in a method section. The paragraph on source criticism must critically discuss these approaches.

Usually however, there are always relevant related research. If not about the actual research questions, there is certainly important information about the domain under study.

6.3 The work in a wider context

There must be a section discussing ethical and societal aspects related to the work. This is important for the authors to demonstrate a professional maturity and also for achieving the education goals. If the work, for some reason, completely lacks a connection to ethical or societal aspects this must be explicitly stated and justified in the section Delimitations in the introduction chapter.

In the discussion chapter, one must explicitly refer to sources relevant to the discussion.



7 Conclusion

Based on your results and their analysis, what new knowledge do you take away from your project?

This chapter contains a summarization of the purpose and the research questions. To what extent has the aim been achieved, and what are the answers to the research questions?

The consequences for the target audience (and possibly for researchers and practitioners) must also be described. There should be a section on future work where ideas for continued work are described. If the conclusion chapter contains such a section, the ideas described therein must be concrete and well thought through.



Bibliography

- [1] URL: <https://parquet.apache.org/>.
- [2] Dayi Lin, Cor-Paul Bezemer, Ying Zou, and Ahmed E. Hassan. "An Empirical Study of Game Reviews on the Steam Platform". In: *Empirical Software Engineering* 24 (Feb. 2019). DOI: 10.1007/s10664-018-9627-4.
- [3] MiniDlicious. *MiniDlicious/temporalsentimentproject*. URL: <https://github.com/MiniDlicious/temporalsentimentproject>.
- [4] Alexander Pak and Patrick Paroubek. "Twitter as a Corpus for Sentiment Analysis and Opinion Mining". In: vol. 10. Jan. 2010.
- [5] *steam web api terms of use*. URL: <https://steamcommunity.com/dev/apiterms>.
- [6] *User Reviews - Get List (Steamworks Documentation)*. URL: <https://partner.steamgames.com/doc/store/getreviews>.
- [7] Johnny Walker. "On Whiskey". In: *Communications of the AA* (1999).
- [8] *Wolcen: Lords of Mayhem*. URL: <https://www.kickstarter.com/projects/wolcenstudio/umbra/description>.
- [9] *Wolcen: Lords of Mayhem*. URL: https://store.steampowered.com/app/424370/Wolcen_Lords_of_Mayhem/.