JINAV: Journal of Information and Visualization *ISSN: 2746-1440 (online)*
Vol. 5 No. 1 (2024)
https://doi.org/10.35877/454RI.jinav2772

Text Mining Sentiment Analysis On Mobile Banking Application Reviews Using TF-IDF Method With Natural Language Processing Approach

Muhammad Dhuha Bimantara* & Ilka Zufria

Departement of Computer Science, Faculty of Science and Tecnology, Universitas Islam Negeri Sumatera Utara, Medan, 20236, Indonesia

Abstract

As part of its efforts to improve digital banking services, PT Bank Rakyat Indonesia (Persero) Tbk (BRI) has launched a mobile banking application called BRImo. This move is in line with the global trend where financial institutions are increasingly focusing on digitalization to meet the evolving needs of customers who demand faster and more efficient accessibility to banking services. BRImo comes as an innovative solution to provide a better banking experience to BRI customers. This research was conducted to find out the reviews of the BRImo application on the App markets google playstore, In BRImo mobile banking's efforts to remain competitive with other mobile banking applications, understanding positive and negative reviews from users is very important. The fundamental issue that must be addressed is how to analyze positive reviews to strengthen the advantages of the BRImo app and identify negative reviews to address weaknesses that may hinder its competitiveness. This research was conducted to find out the reviews of the BRImo application on the App markets google playstore, In BRImo mobile banking's efforts to remain competitive with other mobile banking applications, understanding positive and negative reviews from users is very important. The method used in the calculation is TF-IDF and NLP approach and the calculation of SVM algorithm is trained using training data. The calculation results show that the model has an accuracy of 92%. or Precision Score of about 92%, Recall Score has 100% and F1 Score has 0.95 or approximately 95%.

Keywords: text mining, natural languange processing, sentiment analysis

Received: 10 April 2024 Revised: 8 July 2024 Accepted: 20 July 2024

1. Introduction

In the era of information technology advancement, the role of mobile banking applications has increasingly become an integral part of people's daily lives. Facilitating various financial transactions, fund transfers, and bill payments, these applications provide convenience and efficiency in managing aspects of personal finance. Easy access anytime and anywhere allows users to control and monitor their financial activities more flexibly (Rifaldi et al., 2023).

As part of its efforts to improve digital banking services, PT Bank Rakyat Indonesia (Persero) Tbk (BRI) has launched a mobile banking application called BRImo. This move is in line with the global trend where financial institutions are increasingly focusing on digitalization to meet the evolving needs of customers who demand faster and more efficient accessibility to banking services. BRImo comes as an innovative solution to provide a better banking experience to BRI customers. The app is designed with advanced features and ease of use, allowing customers to access their accounts, conduct transactions, and manage finances practically through their mobile devices. based on download data on the app store or Playstore until January 2024, the BRImo mobile banking application has been downloaded 10 million times.

This research was conducted to find out the reviews of the BRImo application on the App markets google playstore, In BRImo mobile banking's efforts to remain competitive with other mobile banking applications, understanding positive and negative reviews from users is very important (Firdaus & Firdaus, 2021). The fundamental issue that must be addressed is how to analyze positive reviews to strengthen the advantages of the BRImo app and identify negative

* Corresponding author.
E-mail address: dhuhabimantara123@gmail.com

reviews to address weaknesses that may hinder its competitiveness. By understanding the overall user sentiment, BRImo mobile banking can take strategic steps to improve user experience, rectify shortcomings, and strengthen its position in competition with other mobile banking (Asri et al., 2023).

App markets such as Google Playstore provide a new mechanism for software distribution, where users get applications directly from developers and also the application user review process can be done directly through comments. Reviews on Google Playstore have a rating from 1 to 5. However, users often give ratings that do not match the reviews so that this is not enough to describe the quality of the application. Therefore, it is necessary to analyze user sentiment in the form of application reviews on the Google Play site (Trianto et al., 2020). The research uses TF-IDF weighting method with Support Vector Machine (SVM) algorithm classification and natural language processing (NLP) approach to be classified into 2 classes (positive and negative). By utilizing the integration of TF-IDF with classification with the Support Vector Machine (SVM) algorithm and NLP research can produce more accurate and relevant sentiment analysis (Darwis et al., 2020).

Sentiment analysis is a computational process that uses text analysis techniques to manage, understand, and categorize textual data based on emotional aspects, be it positive or negative. Sentiment analysis is becoming increasingly popular due to the increasing need for individuals or groups to understand someone's opinion on something (Widayat, 2021). Sentiment Analysis can also be defined as a study that uses computerized technology to analyze opinions, arguments, attitudes, judgments, feelings towards something such as events, products, services, issues, topics and others that are interrelated.

Text Mining is a process of exploring and analyzing large datasets in the form of text to obtain useful information for certain purposes (Ikhsan & Kurniawan, 2023). Text mining is a branch of data mining which has a much higher commercial value than data mining. This happens because 80% of every company has documents that contain information in the form of text. Text mining in general, has three stages namely preprocessing, text mining operations, and postprocessing. The process in text mining has several techniques in the process, namely statistical, mathematical, and artificial intelligence techniques.

Natural Language Processing (NLP) is the analysis of linguistic data, generally processing input in the form of textual data such as documents or publications, using computational methods. Natural Language Processing (NLP) is a field of artificial intelligence that studies human-computer interaction using natural language (Furqan et al., 2023). The aim of natural language processing is to build representations of text and to add structure to unstructured natural language, by utilizing linguistic values. This structure can be syntactic in nature such as capturing the grammatical relationships among text constituents, or more semantic in nature by capturing the meaning conveyed by the text, One popular application of NLP is in the research area of sentiment analysis.

The Term Frequency-Inverse Document Frequency (TF-IDF) method is a way of weighting the relationship of a word to a document. TF-IDF is a statistical measure used to evaluate how important a word is in a document or in a group of words. TF-IDF is done to obtain the numerical value of each text to be grouped. The TF-IDF stage starts from calculating the Tf value which is the value of the text based on how often the text appears in the data, followed by the idf calculation process which focuses on how often the text appears in the data focuses on how often the text appears in different data and ends with the multiplication process between the tf and idf values to obtain the numerical value of each text (Kurniawan R & Zufria, 2022).

The Support Vector Machine (SVM) method is a type of supervised machine learning that requires sample data. Support Vector Machine (SVM) is an algorithm developed by Boser, Guyon, and Vapnik in 1992. Support Vector Machine (SVM) has a concept that is combined from previous computational theories. This method can transform training data to higher dimensions using non-linear patterns. This method is also often used in supervised learning classification and has a clear mathematical concept. When compared to other methods, this method has a higher accuracy rate (Pratiwi et al., 2021).

Python is an interpretive programming language that is considered easy to learn and focuses on code readability. In other words, Python is said to be a programming language that has very clear, complete, and easy to understand programming codes. Python generally takes the form of object-oriented programming, imperative programming, and functional programming. Python can be used for various software development purposes and can run on various operating system platforms.

This method makes it possible to identify positive and negative sentiment patterns in reviews, as well as extract key words that might influence users' perception of the quality of service provided by BRImo mobile banking. Thus, this sentiment analysis can serve as a foundation for the company to identify areas of improvement and reinforce positive

aspects in the development and improvement of the BRImo mobile banking application (Nofandi et al., 2023). Based on the problems and descriptions of problem solving above, the researcher is interested in raising a title: "*Text Mining Sentiment Analysis on Mobile Banking Application Reviews Using the TF-IDF Method with a Natural Language Processing Approach*".

2. Research Method and Materials

The formulation of the problem to be discussed in this research is how the TF-IDF method with the classification of the Support Vector Machine (SVM) algorithm and the Natural Language Processing approach can be used effectively to extract sentiment information from user reviews of the BRImo mobile banking application.

Researchers collect data using scrapping techniques with the help of Google Colab. Scrapping data is used to retrieve comment or review data from a web page or android application from the Google Play Store which is then processed into a format that can be stored using python in google colab with the BRImo application destination link, namely "id.co.bri.brimo" using the pandas and numpy libraries. The scrapping results are 1500 user review data. The following is the flow in scrapping data in the Figure 1.

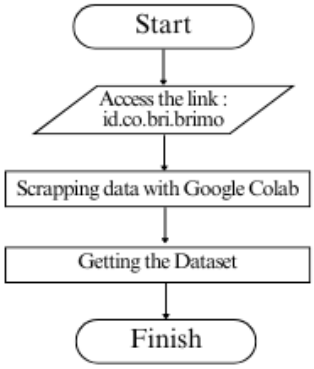

Figure 1. Data Collection

Google colaboratory more commonly referred to as "google colab" or just simply "colab" is a research project for prototyping machine learning models on powerful hardware options such as GPUs and TPUs. Google colab provides a serverless notebook jupyter environment for interactive development. Google colab allows users to access powerful computing resources and use a convenient development environment and integrates with popular tools such as Jupyter Notebook (Asri et al., 2022).

In analyzing data that will go through 2 (two) processing stages, namely data preprocessing using the NLP approach, the NLP features used in this research are removing emoticons and symbols, Tokenizer, Lowercase folding, Word Normalizer and Stemming (Ramlan et al., 2023). The use of NLP approaches in data pre-processing to improve classification accuracy is very necessary. The Word Normalizer feature serves to correct unstandardized language and abbreviations used in reviews. In the next stage, word weighting is carried out using TF-IDF, where each word will be used as numerical data from the document to be processed, and classified with the Support Vector Machine (SVM) algorithm (Muktafin et al., 2020).

After the data is analyzed using the TF-IDF method with the Support Vector Machine (SVM) algorithm and the natural language processing approach, the next step is to draw conclusions from the analysis that has been done. The analysis in this study will produce a percentage value of accuracy, precision, recall of positive and negative sentiment (Lubis et al., 2022).

In this research, all stages carried out can be described through a Flowchart on Figure 2.

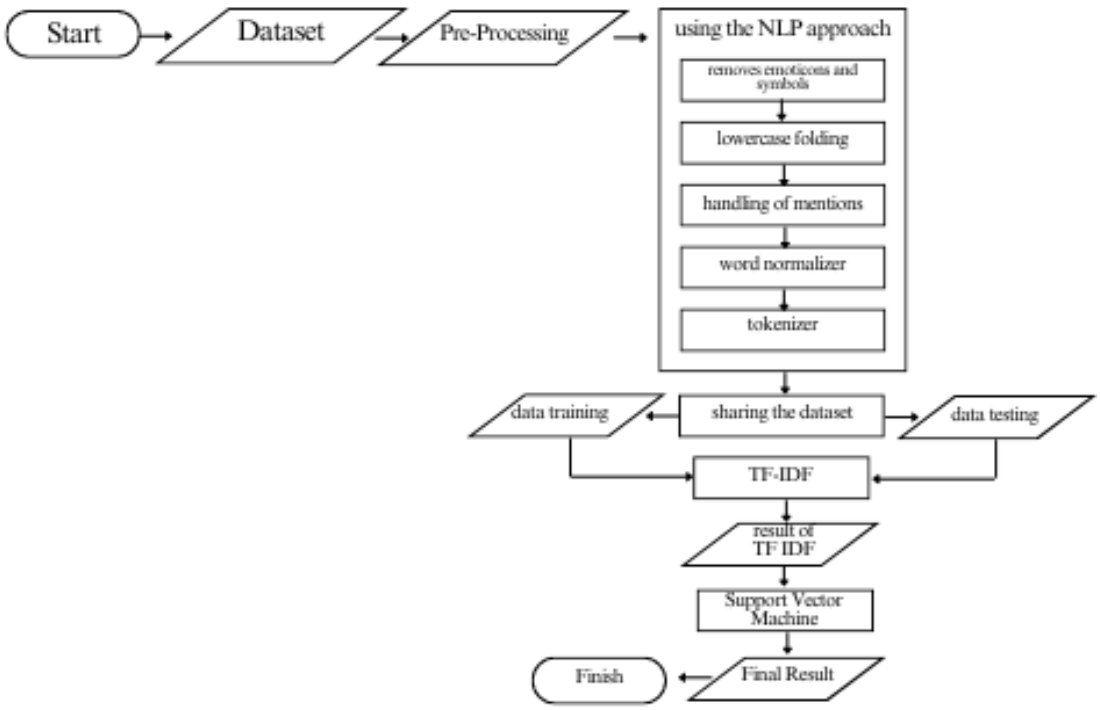

Figure 2. Flowchart System

3. Results and Discussion

3.1. BRImo App Review List

The reviews used were obtained from the BRImo application in April 2024 on the Play Store. Reviews are taken from the BRImo application user comment data from the Play Store application. Sentiment analysis methods are used to gain an understanding of the feelings and opinions contained in the text. Sentiment labels are assigned manually and use the reasoning of the human mind to determine them. In this study, researchers used the book Cendekian Berbahasa by Erwan Juhara et al. to study the meaning of words. In the book, linguists interpret the meaning of words based on the flavor they contain. Therefore, the researcher used the manual method to label positive, negative, and neutral. For example, a sentence is labeled "positive" if it praises the BRImo app well and with a pleasant taste, labeled "negative" if it contains criticism and tends to be bad, and labeled "neutral" if it is considered to be neither pro nor con and the labeling is given on a score value where >3 is positive, =3 is neutral and <3 is a negative review. Examples of reviews used are shown in Table 1.

Table 1. Sample Brimo App User Review

No.	Username	Content	Score
1	Denny TM	Info dong deplove, knpa fitur lupa password sudah sesuai OTP dari email tapi tidak cocok terus....kalau untuk lupa user name saya coba baik-baik saja.	5
2	Uyi to	Saya mohon kalo kluar aplikasi jangan masukan ulang nikname+sandi lagi...ribet deh...tolong lah di permudah untuk akses masuk nya	2

3.2. Text Pre-Processing

Text Processing is preparing unstructured text documents into structured data that is ready to be used for further processing. In natural language processing (NLP), word normalization is the process of converting words or text into a

more consistent format to make text analysis, machine learning, or other tasks easier. The purpose of word normalization is to reduce the size of text data, remove noise, and improve the quality of text representation (Hilda Kusumahadi et al., 2019).

After passing the pre-processing process starting with the normalization, stopwords, tokens, and stemming stages, the data results obtained are shown in the example on Table 2.

Table 2. Result of Text Preprocessing

Content	Pre-processing				Label
	Word Normalize	Stopword	Tokens	Stemming	
Info dong deplove, knpa fitur lupa password sudah sesuai OTP dari email tapi tidak cocok terus....kalau untuk lupa user name saya coba baik-baik saja.	info dong deplove kenapa fitur lupa password sudah sesuai otp dari email tapi tidak cocok terus kalau untuk lupa user name saya coba baik baik saja	info deplove kenapa fitur lupa password sesuai otp email cocok terus kalau lupa user name coba baik baik	[info, ,deplove, kenapa, fitur,lupa, password, sesuai,otp, email, cocok, terus kalau, lupa,user name,coba, baik,baik,	info deplove kenapa fitur lupa password sesuai otp email cocok terus kalau lupa user name coba baik baik	Positive
Saya mohon kalo kluar aplikasi jangan masukan ulang nikname+sandi lagi...ribet deh...tolong lah di permudah untuk akses masuk nya	saya mohon kalau keluar aplikasi jangan masukan ulang nickname sandi lagi ribet deh tolong lah di permudah untuk akses masuk nya	mohon kalau keluar aplikasi masukan ulang nickname sandi lagi ribet deh tolong permudah akses masuk nya	[mohon,kalau, keluar, aplikasi, masukan, ulang, nickname, sandi, lagi, ribet, deh, tolong, permudah, akses, masuknya]	mohon kalau keluar aplikasi masuk ulang nikname sandi lagi ribet deh tolong mudah akses masuk nya	Negative

3.3. Word Weighting Using TF-IDF

Training data, or training data, is used to train machine learning models, which means that the models learn patterns and relationships from this data (Friska Aditia Indriyani et al., 2023). Meanwhile, test data, or test data, is used to evaluate the performance of the trained model on unseen data, which describes real-world situations. The reviews were used as a dataset with a composition of 1200 training data and 300 test data.

TF and IDF values are calculated for each word in the BRImo app user comments after obtaining the TF values of all the words (Umar et al., 2022). This is done by multiplying the TF and IDF values of each word that have been obtained. The calculation method of TF and IDF for each word is shown here.

$$tf - idf_{t,d} = tf_{td} x idf_t$$

For the TF- IDF value calculation process, the entire calculation process contained in the sample text used is not described. For the results of the IDF value of the whole word has been presented in the form of a Table 3.

Table 3. Result of TF IDF

Words	TF			DF	IDF	TF-IDF		
	T1	T2	T3			T1	T2	T3
Info	1	0	0	1	-3.332	-3.332	0	0
Fitur	1	0	0	1	-3.332	-3.332	0	0
Lupa	2	0	0	2	-2.639	-2.639	0	0
Sudah	1	0	0	1	-3.332	-3.332	0	0
Sesuai	1	0	0	1	-3.332	-3.332	0	0
Dari	1	0	0	1	-3.332	-3.332	0	0
Tapi	1	0	0	1	-3.332	-3.332	0	0
Tidak	1	0	0	1	-3.332	-3.332	0	0
Cocok	1	0	0	1	-3.332	-3.332	0	0
Terus	1	0	0	1	-3.332	-3.332	0	0

Words	TF			DF	IDF	TF-IDF		
	T1	T2	T3			T1	T2	T3
Kalau	1	0	0	1	-3.332	-3.332	0	0
Selesai	1	0	0	1	-3.332	-3.332	0	0
Hilang	0	1	0	1	-3.332	0	-3.332	0
Akun	0	1	0	1	-3.332	0	-3.332	0
Menu	0	3	0	3	-2.233	0	-2.233	0
Muncul	0	1	0	1	-3.332	0	-3.332	0
Sedikit	0	0	1	1	-3.332	0	0	-3.332
Kenapa	0	0	1	1	-3.332	0	0	-3.332
Rincian	0	0	1	1	-3.332	0	0	-3.332
Gak	0	0	1	1	-3.332	0	0	-3.332
Sangat	0	0	1	1	-3.332	0	0	-3.332
Segera	0	0	1	1	-3.332	0	0	-3.332
Akurat	0	0	1	1	-3.332	0	0	-3.332

3.4. Wordcloud

The frequency of words that are often used by users in the brimo application in the form of wordcloud shown in the Figure 3, 4, and 5.

Figure 3. Positive Worldcloud

Figure 4. Negative Worldcloud

Figure 5. Netral Wordcloud

3.5. Support Vector Machine using TF IDF

It can be seen that the use of NLP approaches in data pre-processing to improve classification accuracy is necessary. The Word Normalizer feature functions to correct non-standard language and abbreviations used in reviews, such as "tdk", "gak", "g", "tdak", "ga", and "gk" which can be uniformed into the word "not". Stemming and Stopword removal features can also improve classification accuracy, as evidenced by the application of these three features, which can result in an accuracy value of 92%, precision of 92%, and recall of 1.0. These results show that the NLP approach in text processing has produced an effective model in recognizing important review patterns.

```
SVM_Accuracy:  0.92
SVM_PrecisionScore:  0.92
SVM_RecallScore:  1.0
SVM_F1Score:  0.9583333333333334
confusion_matrix:
 [[276   0]
 [ 24   0]]
==================================================

              precision    recall  f1-score   support

       False       0.92      1.00      0.96       276
        True       0.00      0.00      0.00        24

    accuracy                           0.92       300
   macro avg       0.46      0.50      0.48       300
weighted avg       0.85      0.92      0.88       300
```

Figure 6. Support Vector Machine

4. Conclusion

In this research, sentiment analysis of feature reviews in the BRImo mobile application using Natural Language Processing (NLP) is carried out. The dataset used comes from the Google Play Store with the Google scrapper technique using the Google Colabs application. The dataset has a total of 1500 reviews. The review dataset has been labeled and resulted in 596 positive reviews, 136 neutral reviews, and 768 negative reviews. Reviews are used as a dataset with a composition of 1200 training data and 300 test data, then pre-processed with an NLP approach. The method used in the calculation is TF-IDF and NLP approach and the calculation of SVM algorithm is trained using training data. The

calculation results show that the model has an accuracy of 92%. or Precision Score of about 92%, Recall Score has 100% and F1 Score has 0.95 or approximately 95%.

References

Asri, M. F. N., Widodo, C. E., & Sediyono, E. (2023). *Trend Analysis of The Effect of LQ45 Stocks on Stock Price Index Fluctuations using The C4.5 Algorithm with Correlation-Based Feature Selection and Information Gain*.

Asri, Y., Suliyanti, W. N., Kuswardani, D., & Fajri, M. (2022). Pelabelan Otomatis Lexicon Vader dan Klasifikasi Naive Bayes dalam menganalisis sentimen data ulasan PLN Mobile: Analisis Sentimen. *PETIR*, *15*(2), 264–275. https://doi.org/10.33322/petir.v15i2.1733

Darwis, D., Pratiwi, E. S., & Pasaribu, A. F. O. (2020). Penerapan Algoritma Svm Untuk Analisis Sentimen Pada Data Twitter Komisi Pemberantasan Korupsi Republik Indonesia. *Edutic - Scientific Journal of Informatics Education*, *7*(1). https://doi.org/10.21107/edutic.v7i1.8779

Firdaus, A., & Firdaus, W. I. (2021). *Text Mining Dan Pola Algoritma Dalam Penyelesaian Masalah Informasi: (Sebuah Ulasan)*. *13*(1).

Friska Aditia Indriyani, Ahmad Fauzi, & Sutan Faisal. (2023). Analisis sentimen aplikasi tiktok menggunakan algoritma naïve bayes dan support vector machine. *TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika*, *10*(2), 176–184. https://doi.org/10.37373/tekno.v10i2.419

Furqan, M., Sriani, S., & Shidqi, M. N. (2023). Chatbot Telegram Menggunakan Natural Language Processing. *Walisongo Journal of Information Technology*, *5*(1), 15–26. https://doi.org/10.21580/wjit.2023.5.1.14793

Ikhsan, M., & Kurniawan, R. (2023). Penerapan Text Mining pada Sistem Rekomendasi Pembimbing Skripsi Mahasiswa Menggunakan Algoritma Naïve Bayes Classifier. *Indonesian Journal of Computer Science*, *12*(6).

Kurniawan R, R., & Zufria, I. (2022). Penerapan Text Mining Pada Sistem Penyeleksian Judul Skripsi Menggunakan Algoritma Latent Dirichlet Allocation(LDA). *Indonesian Journal of Computer Science*, *11*(3). https://doi.org/10.33022/ijcs.v11i3.3120

Lubis, A. H., Darta, A., & Filla, S. U. F. (2022). Islamophobia Sentiment Classifcation Using Support Vector Machine. *J. Intell. Comput. Health Inform*, *3*. https://doi.org/10.26714/jichi.v3i2.11179

Muktafin, E. H., Kusrini, K., & Luthfi, E. T. (2020). Analisis Sentimen pada Ulasan Pembelian Produk di Marketplace Shopee Menggunakan Pendekatan Natural Language Processing. *Jurnal Eksplora Informatika*, *10*(1), 32–42. https://doi.org/10.30864/eksplora.v10i1.390

Nofandi, A., Setiawan, N. Y., & Brata, D. W. (2023). Analisis Sentimen Ulasan Pelanggan dengan Metode Support Vector Machine (SVM) untuk Peningkatan Kualitas Layanan pada Restoran Warung Wareg. *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer*, *7*(1), 458–466.

Pratiwi, R. W., H, S. F., Dairoh, D., Af'idah, D. I., A, Q. R., & F, A. G. (2021). Analisis Sentimen Pada Review Skincare Female Daily Menggunakan Metode Support Vector Machine (SVM). *Journal of Informatics, Information System, Software Engineering and Applications (INISTA)*, *4*(1), 40–46. https://doi.org/10.20895/inista.v4i1.387

Ramlan, R., Satyahadewi, N., & Andani, W. (2023). Analisis Sentimen Pengguna Twitter Menggunakan Support Vector Machine Pada Kasus Kenaikan Harga BBM. *Jambura Journal of Mathematics*, *5*(2), 431–445. https://doi.org/10.34312/jjom.v5i2.20860

Rifaldi, D., Abdul Fadlil, & Herman. (2023). Teknik Preprocessing Pada Text Mining Menggunakan Data Tweet "Mental Health." *Decode: Jurnal Pendidikan Teknologi Informasi*, *3*(2), 161–171. https://doi.org/10.51454/decode.v3i2.131

Trianto, R. B., Triyono, A., & Arum, D. M. P. (2020). Klasifikasi Rating Otomatis pada Dokumen Teks Ulasan Produk Elektronik Menggunakan Metode N-gram dan Naïve Bayes. *Jurnal Informatika Universitas Pamulang*, *5*(3), 295. https://doi.org/10.32493/informatika.v5i3.6110

Umar, R., Sunardi, & Ardiansyah Nur, M. (2022). Penerapan Algoritma Support Vector Machine Pada Analisis Sentimen Hashtag Twitter. *JURIKOM (Jurnal Riset Komputer)*, *9*, 1607–1613.

Widayat, W. (2021). Analisis Sentimen Movie Review menggunakan Word2Vec dan metode LSTM Deep Learning. *Jurnal Media Informatika Budidarma*, *5*(3), 1018. https://doi.org/10.30865/mib.v5i3.3111