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Optimization Naïve Bayes Algorithm in Sentiment Analysis of Bukalapak App Reviews

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Abstract: Bukalapak application reviews on Google Play Store include useful information if processed correctly. The activity of analyzing application reviews is not enough to see the number of stars, it is necessary to see the entire contents of the review comments to be able to know the intent of the review. Sentiment analysis system is a system used to automatically analyze reviews. Review data is retrieved via the bukalapak application API and then classified using Naive Bayes Multinomial. A total of 1,000 reviews of bukalapak application users were collected to be used as dataset samples. The purpose of this research is to determine the accuracy level of sentiment analysis using the multinomial Naive Bayes algorithm. The stages of this research include, data collection, automatic labeling using python, pre-processing, sentiment classification, and evaluation. In the pre-processing stage there are 6 stages, namely Cleaning, Casefolding, Word Normalizer, Tokenizing, Stopword Removal and Stemming. TF-IDF (Term Frequency - Inverse Document Frequency) method is used for word weighting. The data will be grouped into two categories, namely negative and positive. The test results show an accuracy value of 90%, this result shows that the bukalapak application reviews tend to be negative. The research at this time only looks for accuracy values and provides an overview of the bulapak application to potential new users.

Keywords: Analisis Sentimen; Algoritma; Ecommerce; Naïve Bayes; TF-IDF

INTRODUCTION

The number of Internet users in Indonesia has been consistently rising each year. Indonesia ranks as the fourth-largest country globally, following China, India, and the United States, in terms of the population accessing the internet (Di Estika et al., n.d.). This substantial user base presents a significant opportunity for economic growth within Indonesia. The rapid adoption of internet technology can be harnessed by e-commerce companies to elevate their performance and service quality (Eko et al., 2019).

In Indonesia, a plethora of e-commerce platforms are readily available through popular mobile app stores like Google Play Store and Apps Store. Among these, Bukalapak stands as one of the prominent e-commerce companies, competing with several others in the Indonesian market (Saputra et al., 2021). Currently, Bukalapak holds the second position among the top 10 e-commerce platforms originating from Indonesia. This suggests that there is room for Bukalapak to ascend to the first position and maintain its popularity by enhancing the quality of its services.

To bolster and uphold service excellence, Bukalapak can utilize feedback from users of the Bukalapak application accessible on the Play Store. These user reviews encompass a wide spectrum of commendations, recommendations, and even critiques. The insights shared by users can serve as

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invaluable input for refining their services and can significantly influence users' decisions before engaging with the Bukalapak application.

However, managing the sheer volume of user reviews poses a challenge, making manual categorization and analysis a time-consuming endeavor (Maulana et al., n.d.). Thus, there arises a necessity for a method that can efficiently and automatically process this data to classify reviews into positive, negative, or neutral sentiments. One such approach for discerning sentiment trends within these reviews is through the application of sentiment analysis (Nugroho & Religia, 2021).

Sentiment analysis, also referred to as opinion mining, involves identifying user sentiments expressed in various topics or texts. It entails determining whether a piece of written content conveys a positive, negative, or neutral sentiment. In this study, sentiment analysis of user reviews will be conducted to enhance services using the Naïve Bayes algorithm (Case Study: Bukalapak).

LITERATURE REVIEW

Sentiment analysis, a fundamental task in natural language processing, plays a pivotal role in deciphering user sentiments and opinions within textual data (Gunawan et al., 2018). With the burgeoning popularity of e-commerce platforms, the scrutiny of user reviews has become paramount for businesses aiming to refine their services. This review centers on the optimization of the Naïve Bayes algorithm, a stalwart in text classification tasks, specifically tailored for scrutinizing app reviews on the Bukalapak platform. Understanding the nuances of customer feedback, ranging from commendations to grievances, holds immense potential for elevating user experience and refining platform functionality (Aridas et al., 2020). However, challenges persist, including the need to address contextual complexities, such as sarcasm and irony, along with achieving robust performance across diverse linguistic styles and domains. The review thus embarks on an exploration of techniques for enhancing the efficacy of the Naïve Bayes algorithm, encompassing feature engineering, imbalanced data handling, and hyperparameter tuning. By delving into previous studies on sentiment analysis in e-commerce, this review lays the foundation for an in-depth analysis of sentiment trends within Bukalapak app reviews. Leveraging these optimization strategies, coupled with a nuanced understanding of sentiment nuances, promises to yield insights instrumental in shaping the evolution of the Bukalapak platform. Future research endeavors may further advance these techniques or incorporate additional contextual cues for even more refined sentiment analysis outcomes (Anam & Santoso, 2018).

METHOD

The research flow used for this research can be seen in Figure 1 which illustrates the stages of the research. It consists of four main processes that will be carried out, namely: Data Selection, Pre-Processing, Transformation and Data Mining.

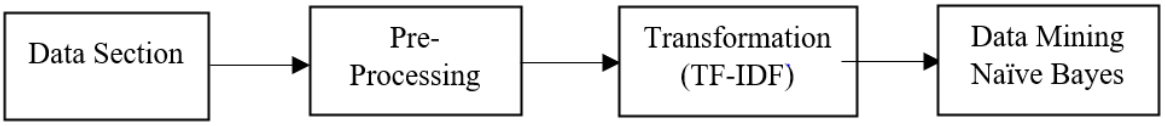

Fig. 1 Research Flow

Data Selection

Data selection, or data selection, refers to the process of selecting and retrieving a certain subset of available data to be analyzed or used in a certain context, in this research, the data selection process is to retrieve data from bukalapak application reviews (Informatika et al., n.d.). In Figure 2 is the process of automatically retrieving data using python. Then in Figure 3 the data that has been taken is labeled negative and positive.

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```
from google_play_scraper import Sort, reviews

result, continuation_token = reviews(
    'com.bukalapak.android',
    lang='id',  #
    country='id',
    sort=Sort.MOST_RELEVANT,
    count=1000,
    filter_score_with=None
)
```

Fig. 2 Review data capture process

	content	score	Label
853	Aplikasi yang sangat membantu seller menjual p...	5	Positif
13	Percuma pilih kurir gosend instan kalo lewat 4...	1	Negatif
649	terimakasih banyak bukalapak , tempat jual bel...	5	Positif
554	Dulu, belanja di B-Lapak belanja enak, free on...	1	Negatif
236	Parah sih, biaya layanannya lebih besar dari e...	1	Negatif
535	Saya krim saldo ke ke rek, lama bener masuk ny...	1	Negatif
524	Masak pengguna baru voucher nya ngk bisa di pa...	1	Negatif
222	Jgn pakai aplikasi BUKALAPAK pendusta kerja sa...	1	Negatif
509	Semakin banyak fitur kok makin kacau ya?? Saya...	1	Negatif
647	Jangan pakai aplikasi ini, orang awam saldo di...	1	Negatif

Fig. 3 Labelling data

Pre-Processing

Pre-processing is the initial process in data analysis or information processing where the raw data or initial input is prepared and modified to meet the needs of subsequent analysis or processing (Khairunnisa et al., 2021). The main purpose of pre-processing is to clean, organize, and prepare data so that it can be processed more effectively and provide more accurate results. In the research conducted this time, there are several stages of pre-processing, namely as follows. Text Cleaning, Removing special characters, punctuation, and symbols that do not provide meaningful information. Converting text to lowercase for consistency in analysis (Garbian Nugroho et al., n.d.).

1. Tokenization, Breaking the text into small units called "tokens" (words or short phrases). This facilitates analysis at the word level.
2. Stopword Removal, Eliminating common words like "the", "and", "is" that do not carry much information in sentiment analysis.

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3. Stemming or Lemmatization, Converting words to their base form (lemmas) to reduce morphological variations. For example, changing "running" to "run".
4. Removal of Less Meaningful Words, Removing overly common or overly specific words to minimize noise in the analysis.
5. Normalization of Numbers or Dates (if necessary), Replacing numbers or dates with symbols or a uniform format to streamline analysis.

text_clean	text_StopWord	text_tokens
aplikasi yang sangat membantu seller menjual p...	aplikasi membantu seller menjual produk produk...	[aplikasi, membantu, seller, menjual, produk, ...
percuma pilih kurir gosend instan kalo lewat ...	pilih kurir gosend instan kalo jam barang diki...	[pilih, kurir, gosend, instan, kalo, jam, bara...
erimakasih banyak bukalapak tempat jual beli...	terimakasih bukalapak jual beli yng aman semog...	[terimakasih, bukalapak, jual, beli, yng, aman...
ulu belanja di blapak belanja enak free ongki...	belanja blapak belanja enak free ongkir ok put...	[belanja, blapak, belanja, enak, free, ongkir,...
arah sih biaya layanannya lebih besar dari ec...	parah sih biaya layanannya ecommerce yg	[parah, sih, biaya, layanannya, ecommerce, yg]

Fig. 4 Result Pre-Processing

Transformation

Feature extraction with TF-IDF, or Term Frequency-Inverse Document Frequency, is a crucial step in natural language processing (NLP) and text mining (Nur Rozi & Harini Sulistyawati, 2019). It involves the conversion of raw textual data into a numerical format that can be used for machine learning algorithms and other statistical analyses. TF-IDF is a statistical measure that evaluates the importance of a term within a document relative to a collection of documents, typically a corpus. It considers both the frequency of a term in a specific document (Term Frequency, TF) and the rarity of the term across the entire corpus (Inverse Document Frequency, IDF) (Wati et al., 2023). The product of these two values forms the TF-IDF score, which is higher for terms that are significant within a document but infrequent across the corpus. Furthermore, Figure 3 is the config and the results of the TF-IDF process.

```
from sklearn.feature_extraction.text import TfidfVectorizer

tfidf_vectorizer = TfidfVectorizer()
tfidf_train = tfidf_vectorizer.fit_transform(X_train)
tfidf_test = tfidf_vectorizer.transform(X_test)
print(X_train.shape)
print(y_train.shape)
print(X_test.shape)
print(y_test.shape)
```

```
(745,)
(745,)
(187,)
(187,)
```

Fig. 5 Config and results TF-IDF

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Data Mining

Data mining is the process of extracting or mining valuable patterns or knowledge from large or complex datasets. The main objective of data mining is to identify hidden relationships, patterns, or valuable insights that can provide a deeper understanding of the analyzed data (Dirjen et al., 2017). There are many types of data mining and algorithms for this research using one of the data mining algorithms, namely naive baiyes. Naive Bayes is a classification method in data mining and statistics. This method is based on Bayes' theorem with the assumption that the attributes used in classification are independent of each other. In the context of classification, Naive Bayes works by calculating the probabilities of each class for each data instance, and then selecting the class with the highest probability as the prediction. Although this method is called "naive" due to the assumption of attribute independence, in many cases, Naive Bayes provides satisfactory results and is considered a fast and efficient classification algorithm (Damanik et al., 2021). Naive Bayes has been applied in various fields, including text classification (such as spam filtering), sentiment analysis, medical diagnosis, and others. While the assumption of independence among attributes may not always be met in real-world cases, Naive Bayes often yields competitive results and can be a good choice, especially when computational resources are limited. Formulas commonly used in calculating the naive bayes algorithm (1)

$$P(H \mid X) = \frac{P(X|H)P(H)}{P(X)} \quad (1)$$

RESULT

A total of 1000 reviews were conducted in this research and then after preprocessing the reviews used only 996 datasets. Then in Figure 6 is the results of the calculation of naive baiyes.

```
MultinomialNB Accuracy: 0.8983957219251337
MultinomialNB Precision: 0.9007633587786259
MultinomialNB Recall: 0.9516129032258065
MultinomialNB f1_score: 0.9254901960784313
confusion_matrix:
 [[118   6]
 [ 13  50]]
=====================================================

              precision    recall  f1-score   support

     Negatif       0.90      0.95      0.93       124
     Positif       0.89      0.79      0.84        63

    accuracy                           0.90       187
   macro avg       0.90      0.87      0.88       187
weighted avg       0.90      0.90      0.90       187
```

Fig. 6 Result Calculation Naïve Baiye

In Figure 6, a confusion matrix is presented, displaying data in numerical form, from which various accuracy metrics can be derived. In this research, an impressive accuracy rate of 90% was achieved in

analyzing user reviews pertaining to the Bukalapak application. This figure signifies the success of the study, given the high level of accuracy attained. Furthermore, the research also involved the determination of precision, recall, and F1-Score values, categorized into two groups: reviews with negative sentiment and reviews with positive sentiment. The results are as follows:

Firstly, in the group of reviews with negative sentiment, a precision value of 90% was obtained, along with a recall value of 95%, resulting in an F1-Score of 93%. This demonstrates the model's exceptional capability in identifying negative reviews with a high degree of accuracy and precision.

Meanwhile, in the group of reviews with positive sentiment, a precision value of 89% was achieved, with a recall value of 79%, yielding an F1-Score of 84%. Although the recall and F1-Score values are slightly lower compared to the negative sentiment group, these results still reflect the model's effectiveness in identifying positive sentiment. Based on these findings, it can be concluded that the majority of reviews regarding the Bukalapak application tend to express negative sentiment. Users often voice concerns regarding features that may need improvement and a user interface that may be perceived as confusing. Furthermore, there is a noteworthy observation regarding application updates, which can impact its performance; sometimes, updates inadvertently lead to slower application performance. This, in turn, results in an increased number of negative reviews from users.

On the other hand, positive reviews often relate to the appreciation of substantial discounts and user-friendly features, especially with the offering of free shipping across Indonesia. This indicates that there are positive aspects that Bukalapak can maintain and enhance to retain its popularity among users.

DISCUSSIONS

This study has yielded significant insights into sentiment analysis, particularly when employing the Naive Bayes algorithm. The findings demonstrate an impressive accuracy rate of 90%, showcasing its efficacy compared to alternative algorithms. This suggests that Naive Bayes holds great promise in the realm of sentiment analysis, particularly for applications like Bukalapak. Furthermore, an intriguing observation arises from the user feedback on the Bukalapak application. It is evident that a substantial portion of users have expressed negative sentiments. This points to areas where the application can be enhanced to provide a more satisfactory user experience. These areas encompass not only functional aspects but also the overall user interface and user experience design. The implications of this research are significant, as they pave the way for actionable steps towards refining the Bukalapak application. By addressing the concerns raised in the negative reviews, Bukalapak has the opportunity to not only boost user satisfaction but also potentially attract new users. This underscores the practical importance of sentiment analysis and its potential impact on user-centric product development. In conclusion, the utilization of the Naive Bayes algorithm in sentiment analysis has proven to be a valuable approach, as evidenced by the high accuracy rate of 90%. The wealth of user feedback further emphasizes the relevance of this study. It offers a clear pathway for Bukalapak to make informed enhancements to their application, thereby cultivating a more positive user experience and potentially expanding their user base.

CONCLUSION

The research results reveal that an accuracy level of 90% was achieved. Additionally, precision outcomes of 90% and recall of 95% were obtained, resulting in an f1-score of 93% for negative comments. In the case of positive comments, precision stood at 89%, recall at 79%, and the f1-score at 84%. The survey utilized the TF-IDF weighting technique in conjunction with the Naive Bayes algorithm to classify user reviews into either negative or positive sentiments. Furthermore, the sentiment analysis of Bukalapak app users indicates a prevalent unfavorable sentiment towards the services provided by Bukalapak. This implies that there are areas where Bukalapak could enhance its performance, particularly in relation to features and other aspects. Based on the analysis, it can be deduced that the data gathered from the Google Play Store platform for the Bukalapak application suggests a higher frequency of negative reviews compared to positive ones. Negative feedback often centers around concerns related to the application's features, the shipping process, and the occurrence of frequent slow updates. Conversely, positive responses frequently underscore a range of promotions offered by Bukalapak, including complimentary shipping, product markdowns, and cashback benefits.

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