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IMPLEMENTATION OF MACHINE LEARNING IN IMPROVING WEBSITE USER EXPERIENCE AND SATISFACTION

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ABSTRACT
This research aims to analyze user satisfaction in accessing the Airlangga University library website through the application of machine learning algorithms. The benefit of this research is that it provides insight into improving the quality of digital library services based on data-based analysis. The methods used include user surveys, data preprocessing, and application of the Orange Data Mining with models Support Vector Machine (SVM) and K-Nearest Neighbor (kNN) algorithms to classify user satisfaction levels, as well as comparing the results of the two models. The results show that the SVM model is able to achieve a Recall accuracy of 0.587 in identifying user satisfaction, but the precision metric is greater in SVM and the AUC is greater in kNN so it still requires optimization. This research concludes that the application of machine learning, especially SVM, can be an effective tool for improving user experience and providing more precise recommendations for improving library services.

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I. INTRODUCTION

Technological advances in the current era of globalization are undeniable in their benefits. Almost every corner of human life uses technology to meet information needs because of its efficient, effective and easily accessible nature. According to [1] in almost every field of education, the use of technological developments is very necessary. In recent decades, the development of information technology has allowed libraries to provide access to digital collections more widely, even remotely. Internet technology makes it easy to establish communication and the process of retrieving information through cyberspace becomes very easy [2].

The influence of information technology developments has an impact on various sectors, including digital-based library services. In the digital era, online libraries are a relevant solution in meeting the information needs of users. However, the level of user satisfaction with online library services is often not optimal due to constraints such as ineffective interfaces, slow access to information, or lack of relevance in search results. According to [3], evaluation of user satisfaction is urgently needed to improve the quality of digital library services. In addition, [4] shows that traditional approaches in analyzing user satisfaction are often insufficient to capture complex needs and preferences.

Several previous studies have discussed the use of modern technology to improve library user satisfaction. For example, research by [5] shows that the application of machine learning-based recommendation systems can improve the user experience in finding relevant literature. Similarly, a study from [6] leverages sentiment analysis from user reviews to identify the strengths and weaknesses of library services. Another research by [7] developed a user satisfaction prediction model based on usage patterns and preferences. On the other hand, [8] underlines the importance of service quality by personalizing user needs which can be done in 2 (two) ways, namely assessing personal needs and work unit needs.

In terms of methods, machine learning-based approaches have proven effective in a variety of data analysis contexts. Research by [7] also shows that unsupervised learning methods, such as clustering, can group users based on behavioral patterns. In addition, the use of machine learning can measure and analyze satisfaction with the methods offered by machine learning, and can group data that will later be clustered and turned into labels. On the other hand, a study from [9] shows that using Structural Equation Modeling (SEM) in analyzing user satisfaction of library websites can find out user satisfaction or dissatisfaction in accessing the website. Complex patterns of

user review text data. In addition, in research conducted [10] revealed that the combination of sentiment analysis and natural language processing (NLP) provides deeper insights into user perceptions online.

This research offers a solution in the form of machine learning implementation to analyze user satisfaction of the library website at Airlangga University. In general, the processing of satisfaction survey data uses spss and as a reference for the results of the analysis. Using machine learning algorithms can provide solutions or other ways to analyze survey data, user reviews, and usage patterns. With this approach, it is hoped that libraries can identify the main factors that affect user satisfaction and provide recommendations for service improvement more effectively.

The urgency of conducting an evaluation in measuring library satisfaction with the aim of finding out how much benefit and quality of services the library provides to users so that it can be used as a benchmark to improve and improve the quality of services to be better in accordance with user expectations [11]

The structure of writing this research consists of four main parts. The first part is an introduction that explains the background of the research, in addition to discussing the literature review with the purpose of relevant previous research and research that reviews the satisfaction and dissatisfaction of users with information sources through the library website. The second part discusses the research methodology, including the machine learning approach used. The third part presents the results and discussion, while the fourth part contains conclusions and suggestions for further development.

The application of machine learning has become an increasingly popular approach in analyzing user satisfaction data, especially in the digital sector such as online library services. This technology allows library managers to analyze patterns and trends from user data, so it can provide deeper insights into user needs and expectations. According to [12], machine learning helps identify complex relationships between various features, such as user interaction, access time, and information quality, with user satisfaction levels. With the processing of large amounts of data, this technology is able to produce more accurate analysis results than traditional methods.

Various studies have examined the implementation of machine learning to improve digital services. For example, research by [13] shows that algorithms such as Support Vector Machine (SVM), Random Forest and Naive Bayes are highly effective at predicting user satisfaction levels in e-commerce applications. The results of this study are also relevant for the context of digital libraries, where the level of satisfaction is influenced by the accessibility and quality of digital services. More specifically, the SVM model has been used in various studies that focus on sentiment classification and analysis [14]. From the results of the research conducted [14] entitled "Analysis of the Use of Orange Data Mining for Binance USDT/BIDR Price Prediction" explained that the prediction model on the orange software uses the K-NN and SVM and Linear Regression methods.

SVM is capable of handling data that has high dimensions and works for both small and large datasets [15]. These advantage make SVM an ideal model for analyzing user satisfaction data, where variables such as user experience and service ratings are often complex. In addition, this method has the ability to optimally separate classes by maximum margin, providing more accurate prediction results.

In an article written by [13] it is stated that to measure user satisfaction, various types of machine learning can be used. In ancient times, user satisfaction was measured using the structural equation method (SEM) and the technology acceptance method (TAM). According to [16] in his article, it is stated that measuring user satisfaction using machine learning is a good solution to find out the characteristics of user experience, satisfaction factors, and as a benchmark for the success of a system built or created.

The use of machine learning in measuring user satisfaction levels is also applied in the KAI access application, with the aim of finding hidden knowledge in the database. Data mining is used with the aim of finding previously unknown patterns in data to achieve a result. The application of machine learning as a model for predicting the satisfaction of offenders with the KAI access application is more accurate because it can be calculated with accuracy and algorithms [17].

In addition to the use of orange data mining, rapidminer can also measure user satisfaction. In the article [18] said that the predicted value of user satisfaction can be calculated by using the Decision Tree C4.5 algorithm data mining classification method and testing using the Rapidminer application, with predictions of aspects of book completeness, number of available books, easy-to-reach shelves, air conditioning conditions, officer discipline, friendliness, and ease of access to information sources.

The implementation of machine learning in user satisfaction analysis is not separated from challenges. According to research by [19], the main challenge lies in the quality of the data used. Incomplete or biased data can reduce the accuracy of the model. Additionally, machine learning algorithms require precise parameter adjustments to produce optimal results. As such, it is important for libraries to ensure that the data collected reflects real conditions and is relevant to the needs of the analysis.

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Overall, the literature shows that the implementation of machine learning, especially SVM and K-NN, has great potential in analyzing online library user satisfaction. By implementing this model, library managers can significantly improve the user experience and make more informed data-driven decisions. This research fills the gap in the literature by applying SVM to analyze user satisfaction in the context of the Universitas Airlangga library, making an important contribution to the development of technology-based library services.

II. METHODOLOGY

2.1 Research Stages

The method used by the researcher based on previous experience and has been presented with the K-Means and Decission Tree methods can be used to group and provide data analysis from user satisfaction. Then the results of the data that have been clustered and classified are made into labels that can be processed by the Support Vector Machine (SVM) and K-Nearest Neighbor (KNN) techniques. The results of the classification conducted by the research will be re-evaluated regarding its performance as a consideration for the next step.

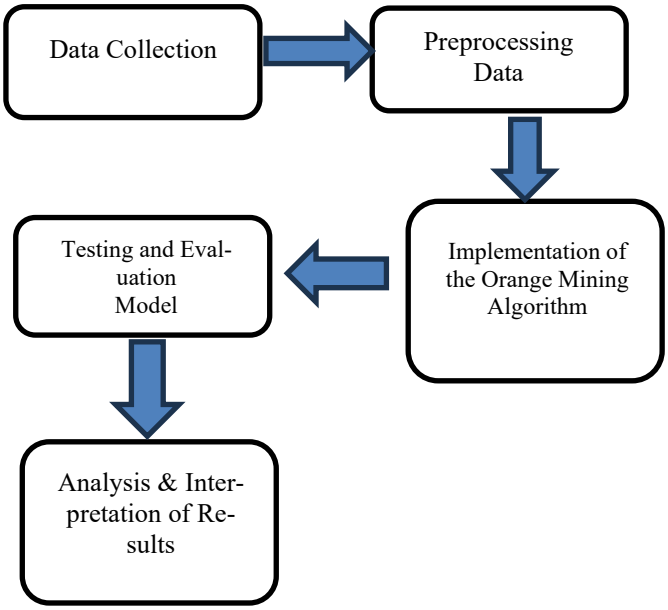

Figure 1. Methodology Overview Study

The research flow "Implementation of Machine Learning in Improving Website User Experience and Satisfaction" begins with the initial stage, namely the process starts from Problem Identification, where the main problems related to user satisfaction and experience are identified based on research needs. After that, Website User Data Collection is carried out through various methods, user satisfaction surveys conducted within 1 year 2 times, analysis of user activity logs, or data from the website system.

The next step is Data Preprocessing, which includes cleaning, normalizing, and transforming the data to be ready for use in the Machine Learning model. After the data is ready, the selection and implementation of Machine Learning algorithms that are in accordance with the research objectives, such as classification or prediction of user satisfaction, are carried out. The results of the model are then tested at the Model Testing and Evaluation stage to ensure the accuracy, efficiency, and relevance of the algorithm used.

Once the evaluation is complete, the model results are analyzed at the Analysis and Interpretation of Results stage to gain actionable insights. These results are then implemented on the website to improve the user experience in the Implementation of Results on Website stage. Finally, the study concludes with Conclusions and Recommendations, where key findings are drawn, and suggestions are provided for further development in the future. This flow provides a systematic framework for achieving research objectives.

III. RESULT

The results of the analysis for the comparison of the K-Nearest Neighbor Support Vector Machine method in the classification of library service assessment are as follows:

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3.1 Data Collection

At this stage, the researcher took initial data from the results of the user satisfaction survey of the Airlangga University Library, spreadsheets, as many as 155 data. It is hoped that it can increase library insights related to visitor satisfaction through the use of websites to meet information needs so that it can affect library services using machine learning.

3.2 Data Preprocessing

The second step is data preprocessing. From this activity, the researcher processed data in the form of Ms. Excel and then variables on the service data of users who accessed the library website and which were targeted were divided into very dissatisfied, dissatisfied, moderately satisfied, satisfied and very satisfied.

	wakili informasi per	Jenis Kelamin	Fakultas	Status	yang dimiliki Perpustakaan
1	Puas	Perempuan	FK	Mahasiswa	Puas
2	Puas	Perempuan	Vokasi	Tenaga Kependi...	Puas
3	Puas	Perempuan	FEB	Mahasiswa	Cukup Puas
4	Sangat Puas	Perempuan	FK	Mahasiswa	Sangat Puas
5	Puas	Perempuan	FK	Mahasiswa	Sangat Puas
6	Sangat Puas	Perempuan	FK	Mahasiswa	Puas
7	Puas	Perempuan	FK	Mahasiswa	Puas
8	Sangat Puas	Perempuan	FK	Mahasiswa	Sangat Puas
9	Puas	Perempuan	FF	Mahasiswa	Cukup Puas
10	Cukup Puas	Perempuan	FEB	Mahasiswa	Cukup Puas
11	Puas	Perempuan	FK	Mahasiswa	Puas
12	Sangat Puas	Perempuan	FK	Mahasiswa	Sangat Puas
13	Sangat Puas	Perempuan	VOKASI	Mahasiswa	Sangat Puas
14	Sangat Puas	Laki laki	FEB	Mahasiswa	Cukup Puas
15	Sangat Puas	Perempuan	FIB	Mahasiswa	Sangat Puas
16	Cukup Puas	Perempuan	VOKASI	Mahasiswa	Puas
17	Puas	Perempuan	VOKASI	Mahasiswa	Sangat Puas
18	Tidak Puas	Perempuan	VOKASI	Mahasiswa	Cukup Puas
19	Puas	Perempuan	FEB	Mahasiswa	Puas
20	Puas	Perempuan	FH	Mahasiswa	Sangat Puas
21	Puas	Perempuan	FK	Mahasiswa	Sangat Puas
22	Cukup Puas	Perempuan	FST	Mahasiswa	Cukup Puas
23	Tidak Puas	Perempuan	VOKASI	Mahasiswa	Tidak Puas
24	Tidak Puas	Laki laki	VOKASI	Mahasiswa	Tidak Puas
25	Sangat Puas	Perempuan	FST	Mahasiswa	Sangat Puas
26	Tidak Puas	Perempuan	FST	Mahasiswa	Tidak Puas
27	Cukup Puas	Perempuan	FEB	Mahasiswa	Sangat Puas
28	Sangat Puas	Perempuan	VOKASI	Mahasiswa	Sangat Puas
29	Puas	Laki laki	FEB	Mahasiswa	Sangat Puas

Figure 2. Table Data Processing in Orange Data Mining

3.3 Implementation Orange Data Mining Algorithm

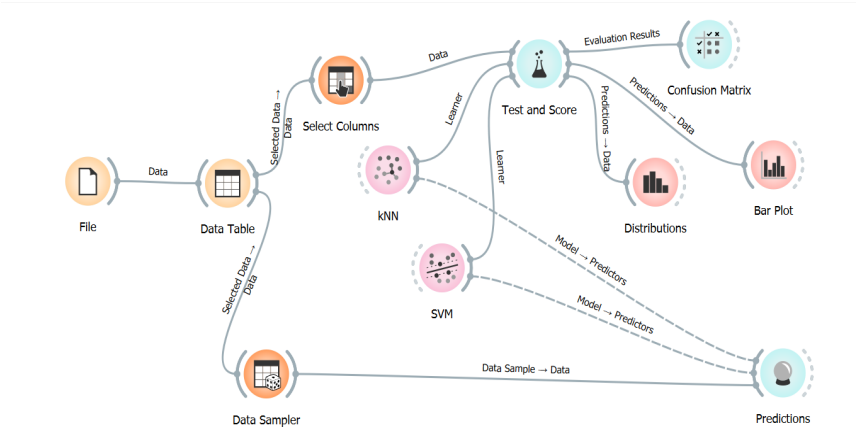

Figure 3. Orange Data Mining Process Model

The image above is a process model using the Orange Data Mining algorithm, starting with the input of data files that have been processed and then displayed in the form of a table through a Data Table that allows researchers to view and filter relevant data. The selected data is then further processed through Select Columns to determine the features to be used in the analysis. Data Sampler is used to retrieve a subset of data, usually for the division of data into training data and test data. The prepared data is then fed into several learning algorithms, such as kNN

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(K-Nearest Neighbor), and SVM (Support Vector Machine), which will be trained to create predictive models. Based on previous research that measured Binance's USDT/BIDR price prediction using SVM and K-Nearest Neighbor orange data mining [14].

Furthermore, the results of the models are evaluated through the Test and Score node, which generates evaluation metrics such as accuracy, precision, recall, or others. The Confusion Matrix provides a visualization of the classification results to see the details of the prediction right or wrong. In addition, the Distributions node is used to analyze the prediction distribution. Finally, the prediction results from the model are combined in the Predictions node, which provides the final output of this analysis process. This diagram as a whole illustrates the systematic flow in the implementation and evaluation of the Machine Learning model.

3.4 Model Testing

Model	AUC	CA	Prec	Recall
kNN	0.768	0.542	0.573	0.542
SVM	0.758	0.587	0.598	0.587

Figure 4. Test Results and Score

Based on the table of model evaluation results above, k-Nearest Neighbors (kNN) shows a higher Area Under the Curve (AUC) (0.768) compared to the Support Vector Machine (SVM) (0.758). This indicates that in general, kNNs have a better ability to distinguish between positive and negative classes in this classification scenario. However, SVM excels in other metrics, such as Classification Accuracy (CA), Precision, and Recall, which are each higher compared to kNN. This suggests that while kNNs are better at overall discrimination, SVMs are more effective at making more precise predictions for specific classes, resulting in better levels of accuracy and precision of predictions.

In the context of previous research, these differences can be attributed to the characteristics of each algorithm. A study by (Fahmi Limas et al., 2023) shows that kNNs tend to be more adaptive to complex data distributions and have an advantage in handling outliers, which can explain higher AUC values. However, SVMs often excel in scenarios with higher feature dimensions and more structured data distribution, which can lead to better accuracy and precision (Müller & Guido, 2016). Therefore, in real-world applications, model selection should consider specific needs, such as whether the primary goal is to improve overall discriminating power (AUC) or improve prediction accuracy and precision.

3.5 Analysis and Evaluation

After conducting the test and score results on the input data, analysis and evaluation are carried out. In prediction data using visualize distributions produces the following image.

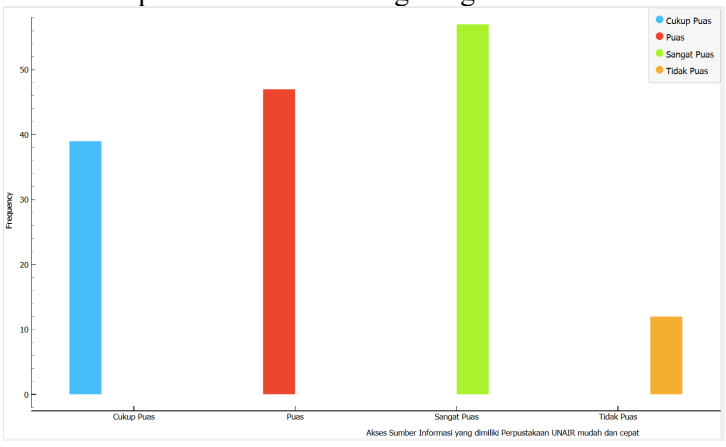

Figure 5. Widget Distribution Results

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Based on the bar chart above, the level of user satisfaction with access to information sources in the UNWAR Library shows that the majority of respondents are in the Very Satisfied category, followed by Satisfied and Quite Satisfied. The number of respondents who expressed dissatisfaction was relatively small compared to other categories. This shows that overall, users have a positive experience in accessing information, which is most likely due to factors such as ease of finding sources, speed of access, and completeness of available collections. According to research conducted by [20], the quality of digital library services that include ease of access and efficiency in searching for information contributes significantly to user satisfaction.

However, even though the majority of users are satisfied, there are still a small percentage who express dissatisfaction. This shows that there are several aspects that need to be improved, such as the wider availability of information, optimization of the search system, or increasing the speed of access to digital resources. A study by [21] emphasizes that although digital libraries offer ease of access, the user experience can be affected by technical factors such as system interface, network stability, and the relevance of search results. Therefore, to improve overall user satisfaction, libraries need to conduct continuous evaluations of access systems and improve factors that are still obstacles for some users.

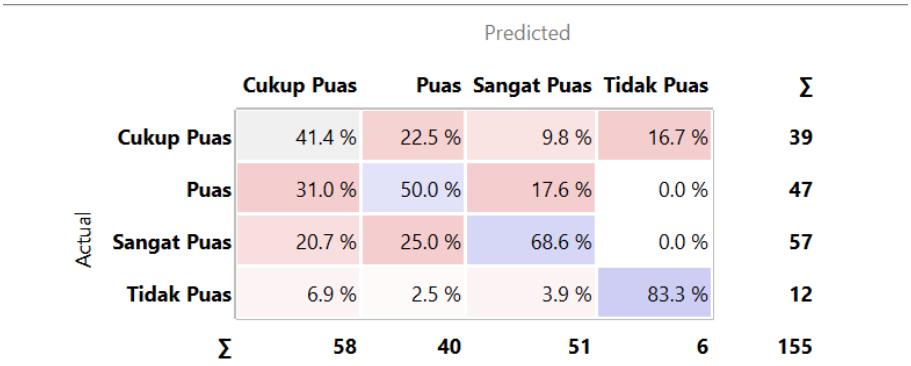

Figure 6. Confusion Matrix Result kNN

The Confusion Matrix method is used to calculate accuracy, recall, accuracy, and error rate [22]. The confusion matrix in this study includes choices such as moderate, dissatisfied, satisfied, and very satisfied, which describes the percentage of each service category.

The results of the confusion matrix above provide an overview of the performance of the k-Nearest Neighbors (kNN) model in predicting the level of respondent satisfaction. In general, the model performed well in the majority category, especially "Very Satisfied," with an accuracy of 68.6%. With the number of respondents 57 who expressed satisfaction with the library's online services. However, for other categories, such as "Quite Satisfied" and "Satisfied," the prediction accuracy was only 41.4% and 50%, respectively, indicating that the model was biased towards the majority category that appeared more frequently.

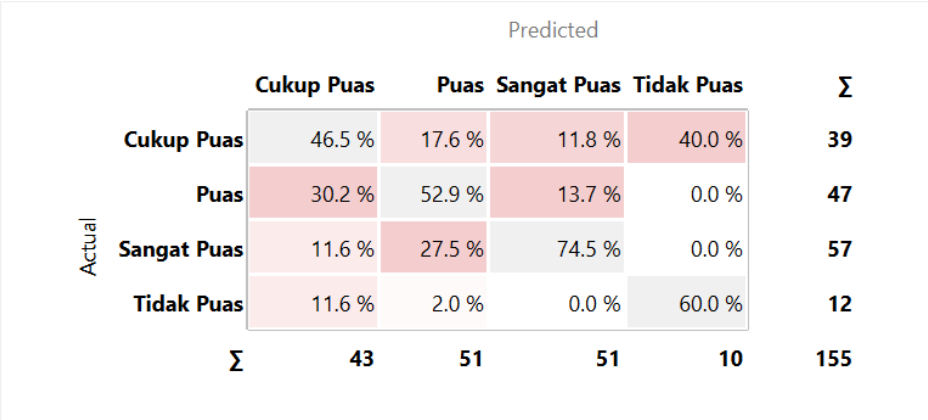

Figure 7. Confusion Matrix SVM Results

The confusion matrix above shows the results of the evaluation of the SVM (Support Vector Machine) model in predicting the level of respondent satisfaction. Overall, the model performed quite well in the majority categories such as "Very Satisfied" and "Satisfied," where the prediction accuracy for the "Very Satisfied" category reached 74.5% of the total actual data in the category with a total of 57 user respondents. However, in the "satisfied" category with actual and predicted results of 52.9%. In the study [23] said that the evaluation of the accuracy level of the SVM algorithm using the Confusion Matrix obtained accurate results.

There is a fairly widespread distribution of predictions, especially in the "quite satisfied" category where 40% of the actual data is wrong with the prediction "not satisfied". This indicates the need for model improvement or evaluation, such as additional data collection to train the model on the development of algorithms that are more sensitive to category differences. Evaluation is expected to identify the factors that cause errors so as to minimize errors in the future.

Model	AUC	CA	Prec	Recall
kNN	0.768	0.542	0.573	0.542
SVM	0.758	0.587	0.598	0.587

Figure 8. Comparison of Method Results

Based on the results of the model evaluation in the table above, k-Nearest Neighbors (kNN) shows a higher AUC (0.768) compared to the Support Vector Machine (SVM) (0.758), which indicates that kNN has a better performance in distinguishing between positive and negative classes. However, SVM excels in accuracy (CA), precision, and recall, which are each higher than kNN. This shows that although kNNs are better at classification probabilities, SVMs are more reliable in providing more accurate and consistent predictions. According to research by (Bishop, 2006), SVMs are often more effective at handling datasets with high dimensions and more complex patterns, while kNNs rely more on the local distribution of data. Therefore, in model selection, the main consideration should be tailored to the specific needs of the application, whether to prioritize overall power of discrimination (AUC) or more stable classification accuracy.

IV. Discussion

The results of the test conducted by the researcher using the machine learning Support Vector Machine model are an effective method to assess the satisfaction of library users related to access to information sources through the library website compared to the kNN (K-Nearest Neighbor) model which shows results of 0.542% and SVM 0.587%. The results of this study show that library users are satisfied with the facilities provided by the library. In addition to this, for further research, the researcher hopes that this research can be carried out further and access to information will further improve the performance of the model. And as an evaluation, the researcher has the hope that the methods used can be diverse so as to create a comparison of results to be more optimal. [7] In the article an analysis of online library user satisfaction by utilizing K-Means Decision Tree machine learning produces accurate data. Based on research that has been conducted [6] produced a sentiment analysis of Unisbank's SmartCampus application reviews on the Google Play Store and using the Naïve Bayes model is able to provide an accuracy of 84.6% and can be interpreted as this model is able to identify negative sentiment with 100% accuracy.

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