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Implementation Naive Bayes Algorithm in Sentiment Analysis for Netflix Reviews on Google Playstore

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Abstract−Developing technology has had an impact in many ways such as watching a movie, in the past watching a movie had to be through television or cinema media. This resulted in difficulties due to inefficient broadcast schedules, as well as the inability to replay. But unlike the current era, watching movies can be done anywhere and anytime by utilizing a streaming application. One of the existing applications is Netflix, in this application there are many types of movies from all walks of life, not only that the monthly subscription system in this application is relatively cheap. The existing streaming applications are not only Netflix but there are still many other applications, therefore Netflix needs to pay attention to the reviews given by users so that this application continues to grow and is not defeated by other applications. Reviews given by users can be used as evaluation material, to see reviews cannot be seen at a glance but must be detailed. Because there are quite a lot of reviews that manual processes cannot be applied, it is necessary to use a sentiment analysis process and utilize existing algorithms such as data mining. This study aims to conduct sentiment analysis based on user reviews of the Netflix application on the google playstore. The review data of 1,000 was taken by the author and then obtained the results of the research that the reviews given by users tended to be negative and the naïve bayes algorithm got an accuracy level of 82%.

Keywords: Algorithm Naive Bayes; Data Mining; User Reviews; Netflix; Streaming Apps

1. INTRODUCTION

Technology and the expansion of internet acTechnology and the expansion of internet access have significantly transformed how people consume media, particularly in watching movies. Historically, movie-watching was limited to cinemas or television broadcasts with fixed schedules, requiring audiences to adjust their time and location accordingly [1]. However, the advent of streaming applications has revolutionized this paradigm, offering on-demand access to a vast selection of content anytime and anywhere via internet-connected devices like smartphones, tablets, or smart TVs. This shift not only enhances convenience but also personalizes the entertainment experience, aligning with modern consumer preferences [2].

One of the most prominent players in the streaming industry is Netflix. Established in 1997 as a DVD rental service, Netflix transitioned to digital streaming in 2007 and has since expanded to over 190 countries. With a subscription-based model, Netflix offers a diverse catalog of content, including original productions branded as Netflix Originals [3]. Its popularity is evidenced by over 1 billion downloads on the Google Playstore, highlighting its widespread adoption. Users provide reviews on the platform, reflecting their experiences with usability, performance, and content quality. These reviews are invaluable for understanding user satisfaction and identifying areas for improvement [4]. However, manually analyzing such a large volume of reviews is impractical, necessitating the use of automated techniques like sentiment analysis [5].

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Sentiment analysis involves using Natural Language Processing (NLP) and text analysis to extract and categorize opinions expressed in text, such as positive, negative, or neutral sentiments [6]. This method is widely applied to understand user feedback across various platforms. In the case of Netflix, sentiment analysis can uncover insights about user perceptions of the app's features, usability, and content offerings [7]. The Naïve Bayes algorithm is frequently utilized for such analyses due to its simplicity and effectiveness in handling textual data [8]. By applying

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Naïve Bayes, this research aims to classify user reviews on Netflix and derive actionable insights into user satisfaction and app performance [9].

The application of sentiment analysis in platforms like Netflix not only aids in understanding user feedback but also supports data-driven decision-making for content curation and platform enhancements. By analyzing user sentiments, Netflix can identify patterns in viewer preferences, such as genres or types of content that resonate most with audiences. Additionally, feedback related to technical issues, such as app stability or user interface challenges, can be promptly addressed. This proactive approach not only improves the user experience but also helps in fostering customer loyalty and retention by ensuring that the platform evolves in alignment with user expectations and demands.

A similar study used as literature review material was conducted by Putra et al. conducting research on the JNE Industry. JNE, as one of the largest expedition companies in Indonesia, has a distribution network that covers more than 83,000 locations, supported by more than 8,000 outlets and 50,000 employees. The MY JNE app, released in 2016, has been downloaded more than 5 million times, but has received a low rating (1.5 stars) from more than 123,000 reviews. Research using 996 user reviews on Google Play shows that the majority of reviews are negative (96.8%). Sentiment classification using Naïve Bayes' algorithm results in 96% accuracy with 80% training data and 20% test data [10].

The second research conducted by Birilian et al. examined the development of e-commerce in Indonesia, including the popularity of Shopee in Semarang, encouraging the analysis of user review sentiment to measure customer satisfaction. The study used 1,000 reviews from the Play Store that were categorized into positive, neutral, and negative sentiments. The analysis involved pre-processing, feature extraction with TF-IDF, and classification using Random Forest, Naïve Bayes, and Support Vector Machine (SVM) algorithms. As a result, Random Forest had the highest accuracy (96.19%), followed by SVM (95.71%) and Naïve Bayes (84.76%), highlighting the superiority of Random Forest and SVM in sentiment classification [11]

The third research conducted by Fani et al, comes from User reviews of streaming applications have a big impact on the image of the application, depending on the quality of services provided by the developer. During this time, the best app ratings were generally based solely on the number of downloads and ratings, but user reviews were also important to take into account. Given the sheer volume of review data, manually classifying reviews can be difficult. This study aims to analyze user reviews of movie streaming applications on the Play Store using the Support Vector Machine (SVM) algorithm. Previous research has shown that this algorithm has a high level of accuracy in classifying the positive and negative responses of users of movie streaming apps on the Google Play Store. In this study, the data used consisted of 1,000 reviews, with each application contributing 200 reviews. The results of the analysis show the highest accuracy level as follows: Iflix 92.67%, Disney Hotstar 69.33%, WeTV 64.67%, Netflix 81.33%, and Vidio 62.00% [12].

These studies reveal gaps and opportunities for further research. While they establish the importance of sentiment analysis in understanding user feedback, limited focus has been given to the streaming industry, particularly Netflix. Additionally, a comparative evaluation of algorithms such as Naïve Bayes specific to Netflix reviews remains underexplored. Addressing this gap, this study aims to conduct sentiment analysis of Netflix user reviews on the Google Playstore to identify strengths and weaknesses of the platform and evaluate the accuracy and effectiveness of the Naïve Bayes algorithm in this context. The findings will benefit various stakeholders, including potential Netflix users seeking informed decisions, developers aiming to enhance user satisfaction, and researchers exploring the application of sentiment analysis in media and technology.

2. RESEARCH METHODOLOGY

In this study, the author made a research flow contained in Figure 1, this research flow is used to facilitate the research that will be carried out by the author.

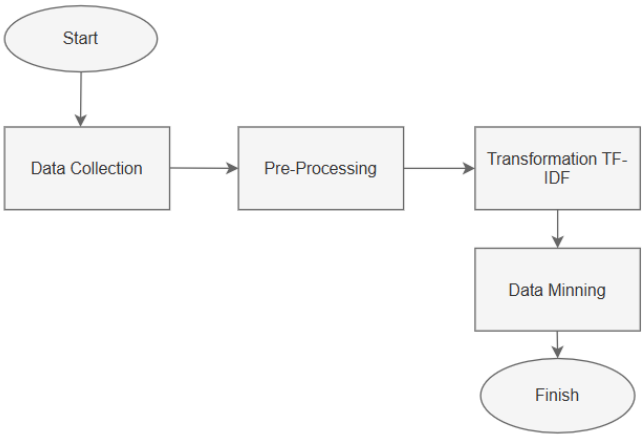

Figure 1. Research Flow

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It can be seen in figure 1 is the existing research flow, for details from Figure 1 as follows.

2.1 Data Collection

In this early stage, the author collects information and labels the data. Data was obtained from user reviews on the Netflix application on the Google Play Store using scraping techniques using Python programming. The data collection process is an important step in research because it ensures that accurate and relevant information is obtained to support the study [13]. The data taken is in the form of dates, usernames, reviews and the number of stars given by Netflix application users.

2.2 Pre-Processing

The pre-processing stage is the initial step in sentiment analysis to transform unstructured input data into structured data before a major process, such as classification or sentiment analysis, is performed [14]. The stages carried out in this stage can be seen in Figure 2.

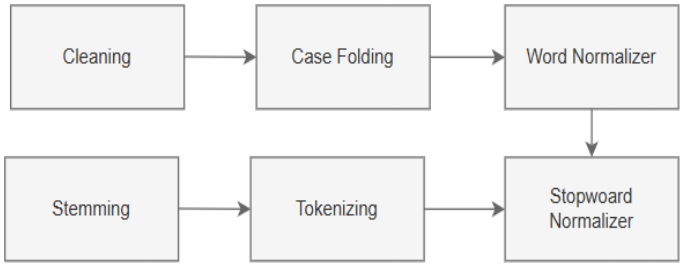

Figure 2. Pre-Processing Stages

In Figure 2 is the pre-processing stage, for details of the stages as follows.

a. Cleaning
In the pre-processing stage, the first thing to do is the cleaning process. This step involves cleaning up the emoticons and symbols present in the review. Emoticons and symbols are ignored because the study focuses on text analysis. Deleted characters include symbols such as ~, ', !, $, %, ^, &, *, (,), _, -, +, =, :, ', ,, ., and ?. As for examples of cleaning stages such as the review " Tolong deh ya apk Netflix ini, saya tadi mencoba login susah" after going through the cleaning process, the text will be " Tolong deh ya apk Netflix ini saya tadi mencoba login susah".

b. Case Folding
After the cleaning stage The second step is case folding, This process converts all text to lowercase. For example, the comment " Developer kok netflix nya agak ngebug ya" was changed to " developer kok netflix nya agak ngebug ya", where the uppercase "D" is changed to the lowercase letter "d".

c. Word Normalization
The next step when you have done case folding is the word normalization process, This technique is used to improve the words in the review to produce sentences that are in accordance with good and correct Indonesian grammar. This step makes it easier for the reader to understand the meaning of the sentence. For example, in the review *" bgmna susah login pada aplikasi"* will be changed to *" bagaimana susah login pada aplikasi "*, where the word *"bgmna"* is corrected to *" bagaimana*".

d. Stopword Removal
The fourth stage in the pre-processing process is stopwoard removal. Later, this stage involves removing words that are included in the list of conjunctions, such as *"and"*, *"in"*, *"which"*, *"to"*, *"from"*. The words were removed because they did not make a significant contribution to sentiment analysis.

e. Tokenizing
This technique breaks down the text into words by considering punctuation and spaces as borders. For example, there are reviews from users in the form of the sentence *" Netflix aplikasi bagus"* Later When entering the tokenizing stage, this sentence will be changed to tokens *"Netflix"*, *"aplikasi"*, *"bagus"*.

f. Stemming
The last step done in stemming, This process transforms words into basic forms or roots. For example, the word *"hasilnya"* is changed to *"hasil"*. Stemming is used to reduce word variation and improve consistency in further analysis or processing. This stage aims to improve the quality of data so that sentiment analysis can be carried out more accurately and efficiently.

2.3 Transformation TF-IDF

TF-IDF is a process used to remove unimportant words, the purpose of this process is to weight a review [15]**.** The formula can be seen in formula (1).

$$TF - IDF(t, d, D) = TF(t, d).IDF(t, D) \quad (1)$$

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Details of formula (1) TF is used to measure the importance of words in documents, IDF functions to reduce the weight of words that often appear in many documents (common words such as "and", "in", "which"). Furthermore, the TF-IDF symbol is used to give higher weight to words that often appear in certain documents, but rarely appear in other documents.

2.4 Data Mining

Data mining is a process carried out to extract various relevant information from a large dataset. This information is not only diverse, but also often in the form of large amounts of data. The main goal of the data mining process is to generate insights that can be used for decision-making, such as evaluating a product, whether it has positive or negative reviews [16]. One concrete example of the results of data mining is reviews from users who have used a system, such as a website or application [17]. In the process of applying data mining, there are various methods and algorithms that can be used to analyze data. Each algorithm has its own advantages and disadvantages, each depending on the context and type of data being processed [18]. One of the algorithms that is often used is the Naïve Bayes algorithm. This algorithm is known to be quite reliable in classifying and determining the level of accuracy, especially on text data or categorical data. By using the Naïve Bayes algorithm, the data can be processed efficiently to produce accurate predictions [19].

2.5 Algoritma Naïve Bayes

Naïve Bayes Algorithm is a probabilistic method based on Bayes Theorem assuming independence between features [20]. The formula in the naïve bayes algorima can be seen in the formula (2).

$$\mathrm{P}(\mathrm{C} \mid \mathrm{X}) = \frac{p(X|C).P(C)}{p(X)} \tag{2}$$

In formula (2) it can be interpreted that the symbol P(C|X) is the probability generated from a text X that is in a class C. Then for the symbol P(X|C) is the probability of words in the text appearing in a class. Next for P(C) is the probability generated from the beginning of the class and the last symbol of the formula P(X) is the probability of the word as a whole [21]. The application of the Naïve Bayes algorithm is particularly beneficial in various fields, such as sentiment analysis, spam detection, and document classification. The advantage of this algorithm lies in its computational speed and ability to work well on datasets that have independent features. However, feature independence assumptions are often not fully met on real-world data, which can affect model accuracy. However, for many practical cases, these algorithms still provide adequate results and are often used as a baseline in the classification process [22].

3. RESULT AND DISCUSSION

3.1 Data Collection

The results of data collection are in the form of user review data, reviews taken as much as a thousand data. The data collection process used in this study is an automatic data scraping technique. Data scraping is a process that aims to collect various information from websites or applications in the google playstore. In its application, the data scraping method can be done manually, but this process is not recommended because it takes a long time. In this study, the author collects data automatically using the python programming language. The results of scraping user review data on the Netflix application can be seen in Table 1.

Table 1. Review Data Scraping Results

	userName	score	at	content
0	*Fadhil Firdaus*	*5*	*2025-01-04 01:53:49*	*Saya sudah puas tapi terkadang ada bug di reso...*
1	*Steven Aldrin*	*1*	*2025-01-02 12:51:00*	*Kenapa dengan netflix, tiba2 film yg sementara...*
2	*Akun Kosan*	*1*	*2024-12-20 15:48:55*	*Gada yang salah dari ini apk. Cuman yang buat ...*
3	*Wido Pratama*	*5*	*2024-12-24 06:14:20*	*Bagus dan update filmnya. Lancar aplikasinya c...*
4	*lenn*	*3*	*2024-12-24 06:14:20*	*Bagus dan update filmnya. Lancar aplikasinya c...*
5	*Felix Lixz*	*1*	*2025-01-04 16:48:12*	*Apa ini sekarang mau buka selalu gak bisa deng...*
6	*agung santoso*	*1*	*2025-01-04 15:53:39*	*no komen, mau daftar ga bisa² kocak*
7	*Serongga Serongga*	*1*	*2025-01-04 13:16:10*	*Tolong deh ya apk Netflix ini, saya tadi menco...*
8	*Nathan*	*1*	*2025-01-04 10:38:31*	*Apk aneh baru download aja mau daftar ribet ga...*
...	...	...	...	...
999	*Lipta chyia*	*3*	*2025-01-04 14:31:11*	*Netflix ku eror kali ya setiap bulan saya baya...*

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It can be seen in Table 1 is the data that has been retrieved through the Netflix application google playstore API, the data retrieved contains usernames, number of stars, dates and user reviews. After the data is taken, the data is labeled. Review labels are divided into two groups, namely negative reviews and positive reviews for labeling results can be seen in Table 2.

Table 2. Review data labeling results

content	Score	Label
Apa ini sekarang mau buka selalu gak bisa deng...	*1*	*Negatif*
no komen, mau daftar ga bisa² kocak	*1*	*Negatif*
Saya sudah puas tapi terkadang ada bug di reso...	*5*	*Positif*
Bagus cuma harus masukin email,sandi email,pdh...	*2*	*Negatif*
Buruk!!! Error vedio tidak bisa di putar!	*1*	*Negatif*
Aplikasinya suka kadang ga bisa di tonton gajelas	*1*	*Negatif*
Netflix saya mau tanya,kenapa saya sudah melak...	*4*	*Positif*

In Table 2 is the result of a review of the data labeling process. In table 2, the author shows an example of the results of the review that has been labeled. The table content contains reviews from Netflix application users and then for the score, which is the number of stars given by the user. Furthermore, in the label column are the results of reviews that have been categorized as negative or positive.

3.2 Pre-Processing

The next step after scraping and labeling the data whose results can be seen in Tables 1 to Table 2, the author continues the pre-processing stage. This stage is used so that the data can be calculated using naïve bayes. In the pre-processing stage, there are six stages carried out by the author. The first stage is cleaning whose results can be seen in table 3.

Table 3. Hasil Pre-Processing Tahapan Cleaning

Content	text_clean
Apa ini sekarang mau buka selalu gak bisa deng...	*Apa ini sekarang mau buka selalu gak bisa deng...*
no komen, mau daftar ga bisa² kocak	*no komen mau daftar ga bisa kocak*
Tolong deh ya apk Netflix ini, saya tadi menco...	*Tolong deh ya apk Netflix ini saya tadi mencob...*
Apk aneh baru download aja mau daftar ribet ga...	*Apk aneh baru download aja mau daftar ribet ga...*
Gw coba buat akun yang lama malah ga bisa, dan...	*Gw coba buat akun yang lama malah ga bisa dan ...*

In Table 3 is the result of the cleaning stage, there are two column of tables, namely content containing reviews from Netflix application users and column text_clean is the result of reviews that have been successfully cleaned by the author. In this clean text, it aims to remove the punctuation symbols provided by the user. Furthermore, it can be seen in Table 4 is the second stage of pre-processing, namely Case Folding.

Table 4. Hasil Pre-Processing Tahapan Case Folding

text_clean	text_CaseFolding
Apa ini sekarang mau buka selalu gak bisa deng...	*apa ini sekarang mau buka selalu gak bisa deng...*
no komen mau daftar ga bisa kocak	*no komen mau daftar ga bisa kocak*
Tolong deh ya apk Netflix ini saya tadi mencob...	*tolong deh ya apk netflix ini saya tadi mencob...*
Apk aneh baru download aja mau daftar ribet ga...	*apk aneh baru download aja mau daftar ribet ga...*
Gw coba buat akun yang lama malah ga bisa dan ...	*gw coba buat akun yang lama malah ga bisa dan ...*

In Table 4 stages Case Folding is used to change capital letters. It can be seen in table 4 that there are 2 columns, namely the clean text column and the text_CaseFolding result column. It can be seen that there is a difference in the use of letters before and after the casefolding stage. Then the next stage is Stopword, table 5 is the result of this stage.

Table 5. Hasil Pre-Processing Tahapan Stopword

text_CaseFolding	text_StopWord
apa ini sekarang mau buka selalu gak bisa deng...	*buka gak keterangan bug nyaudh hapus data memo...*

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no komen mau daftar ga bisa kocak	*no komen daftar ga kocak*
tolong deh ya apk netflix ini saya tadi mencob...	*tolong deh ya apk netflix mencoba netflix paka...*
apk aneh baru download aja mau daftar ribet ga...	*apk aneh download aja daftar ribet ga*
gw coba buat akun yang lama malah ga bisa dan ...	*gw coba akun ga gw coba berkali kali ttp ga ya...*

In Table 5 is the result of text_StopWord, this stage results in changes in user reviews to make it easier to use in token creation. Since after this stage, the author continues the pre-processing of tokenizing, the results can be seen in Table 6.

Table 6. Hasil Pre-Processing Tahapan Tokenizing

text_StopWord	text_tokens
buka gak keterangan bug nyaudh hapus data memo...	*[buka, gak, keterangan, bug, nyaudh, hapus, da...*
no komen daftar ga kocak	*[no, komen, daftar, ga, kocak]*
tolong deh ya apk netflix mencoba netflix paka...	*[tolong, deh, ya, apk, netflix, mencoba, netfl...*
apk aneh download aja daftar ribet ga	*[apk, aneh, download, aja, daftar, ribet, ga]*
gw coba akun ga gw coba berkali kali ttp ga ya...	*[gw, coba, akun, ga, gw, coba, berkali, kali, ...*

In Table 6, there is column text_tokens. This result is based on a breakdown of Netflix user reviews that have successfully gone through several pre-processing processes. So it can be concluded that tables four to 6 are a series of stages carried out by the author to complete the pre-processing stages.

Furthermore, in the pre-processing stage, the author also gets the results of the final step of pre-processing, namely the stemming stage. This stemming results from reviews that have gone through the tokenizing process, in looking for author stemming using the Literary python library. Library Sastrawi is a Python library or library used for text processing in Indonesian, especially for stemming tasks. Stemming is the process of converting affixes into root words. For example, words like "description," would be changed to the root word, which is "light." The results of stemming can be seen in Figure 3.

```
1 : buka : buka
2 : gak : gak
3 : keterangan : terang
4 : bug : bug
5 : nyaudh : nyaudh
6 : hapus : hapus
7 : data : data
8 : memori : memori
9 : masuk : masuk
10 : aplikasi : aplikasi
11 : no : no
12 : komen : komen
13 : daftar : daftar
14 : ga : ga
15 : kocak : kocak
16 : tolong : tolong
17 : deh : deh
18 : ya : ya
19 : apk : apk
20 : netflix : netflix
21 : mencoba : coba
22 : pakai : pakai
23 : sandiemail : sandiemail
24 : langsung : langsung
25 : habis : habis
26 : suruh : suruh
27 : tf : tf
28 : pas : pas
```

Figure 3. Results of the stemming process

In Figure 3 above, an example of the stemming process is illustrated, highlighting a critical step successfully implemented by the author in the data pre-processing workflow. Stemming involves reducing words to their root forms by systematically removing suffixes, prefixes, or other morphological variations. For instance, words like "*Keterangan"* are reduced to their root form, "*terang*." This process ensures that different variations of the same word are treated uniformly, thereby enhancing the consistency and accuracy of text analysis.In the context of Netflix app user reviews, stemming plays a crucial role in standardizing the textual data by eliminating redundancies caused by linguistic variations. By focusing on the root forms of words, stemming simplifies the dataset, making it more manageable and easier to analyze. This process is particularly important for subsequent steps, such as TF-IDF weighting, where the relevance of words is determined based on their frequency and distinctiveness across the dataset.As the final step in the pre-processing phase, stemming serves as a bridge to the analytical phase, ensuring that

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the data is optimally prepared for advanced techniques like sentiment analysis or classification. Its implementation not only streamlines the data but also contributes to the overall effectiveness and reliability of the analytical outcomes.

3.3 Transformation TF-IDF

After the pre-processing stage of Netflix app user reviews, the next stage is tf-idf weighting. This weighting is used to determine the level of importance of a word contained in a review that has been given. The results of the process in tf-idf weighting can be seen in Figure 4.

```
array([[0, 0, 0, ..., 0, 0, 0],
       [0, 0, 0, ..., 0, 0, 0],
       [0, 0, 0, ..., 0, 0, 0],
       ...,
       [0, 0, 0, ..., 0, 0, 0],
       [0, 0, 0, ..., 0, 0, 0],
       [0, 0, 1, ..., 0, 0, 0]])
```

Figure 4. Results of the TF-IDF process

The TF-IDF results in Figure 4 show a representation of the document in the form of a matrix, where each row represents a document, and each column represents a unique word in the corpus. The number in the matrix is the TF-IDF weight which shows how important a word is in a particular document compared to other documents. A value of 0 means that the word does not appear or is irrelevant, while a value other than 0 indicates the important weight of the word. This matrix is sparse in nature because most of the values are 0, reflecting that not all words appear in every document. So, it can be concluded that the result of the process of weighting many word reviews given by users of the Netflix application is not releven.

3.4 Data Mining

Data mining is the last step carried out in this study, the data mining used is the use of the naïve bayes algorithm. The naïve bayes calculation performed by the author uses a colab application and the python programming language. This result was obtained after going through the data collection process through the Google Playstore API, Netflix application and the pre-processing process of user review data. The results obtained by the author can be seen in figure 5.

```
MultinomialNB Accuracy: 0.8212290502793296
MultinomialNB Precision: 0.8417721518987342
MultinomialNB Recall: 0.95
MultinomialNB f1_score: 0.8926174496644296
confusion_matrix:
 [[133   7]
 [ 25  14]]
==================================================

              precision    recall  f1-score   support

     Negatif       0.84      0.95      0.89       140
     Positif       0.67      0.36      0.47        39

    accuracy                           0.82       179
   macro avg       0.75      0.65      0.68       179
weighted avg       0.80      0.82      0.80       179
```

Figure 5. Final Result of Algorithm Calculation

As can be seen in Figure 5, user reviews given in the Netflix application tend to be negative with a precision score of 84% while in positive reviews this score is only 67%. Then in negative reviews it gets 95% and positive reviews 36%. The final result in the f1-score negative review gets a score of 89% and a positive review of 47%. So it can be concluded that this application still needs to be developed to make the application even better, even though those who use this application quite a lot reach 10 billion does not guarantee that this application will get positive reviews from users.

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4. CONCLUSION

After conducting various stages of research, starting from the collection of review data that was successfully taken as many as a thousand reviews, data processing was then carried out tf-idf weighting and the last is the process of calculating the accuracy level using the Naïve Bayes algorithm, it can be concluded that this study was successful because it obtained an accuracy level of 82%. Not only the accuracy of this study found that the Netflix application in the google plastore tends to have negative reviews from users, this is evidenced by the acquisition of scores from the precision calculation process of 84%, then in the calculation of 95% recall and finally the acquisition of f1-score of 89%. This result is very inversely proportional to the acquisition of negative reviews, the process of calculating the precison gets 67%, then for the recall score gets a score of 36% and the acquisition of the f1-score is 47%. With this number, this application needs to be developed so that it is not inferior to other streaming applications. Users who give negative reviews are disappointed with the login feature which sometimes can't, then when movie playback often pauses. For positive reviews, the average user is satisfied with the movies in the Netflix application because they are always up. It is hoped that future research can use more datasets and algorithms used not only that.

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