

Implementation of Naive Bayes Classification Method for Sentiment Analysis on Community Opinion to Indonesian Criminal Code Draft

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ABSTRACT

Current developments of technology greatly facilitate the public to access information by both print media and social media. One example of social media that is widely used by the public is Twitter, because users can also comment on issues that are being discussed. One of them is an issue related to the controversy article in the draft law on criminal law to cause demonstrations conducted by students in several regions in Indonesia. Many people who think, both positive and negative opinions obtained from twitter. The method used in this study is the Naive Bayes Classification method which is a classification method with a simple probability that applies the Bayes theorem with high (independent) assumption. The advantage of the Naive Bayes method is that this method has high speed and accuracy when applied in large databases and diverse data. From the analysis, it was obtained a total of 3561 tweet data consist of 30.27% positive sentiment and 69.73% negative sentiment. Then from the classification result obtained an accuracy of 93.12%, a recall of 99.20%, a precision of 91.65% and an area under curve (AUC) value of 89.08%, which means the classification is very good.

Keywords: *The draft law on criminal law, Text Mining, Sentiment Analysis, Classification.*

1. INTRODUCTION

Nowadays, information technology grows fast related to the presence of internet which makes information accessible anywhere quickly and without limits. Based on a survey conducted by the Indonesian Internet Service Providers Association (APJII), the number of internet users in Indonesia during 2017 was 143.26 million, so it become a necessity of the community in various activities in various fields.

One of the most widely used social media in Indonesia to date is Twitter. Twitter is a social media service that provides users to communicate with other users by sending messages that have a capacity of 280 characters with the tweet designation [1]. On January 1, 2019 in the ranking of social media in the category of Internet and Telecom Social Network, Twitter received 4th place and received 6th place in the Global Rank. [2]

By using Twitter social media, users can request opinions related to the issue being discussed. He has been discussing the past few months with regard to articles that are considered controversial in the Draft on draft law on criminal procedure code (RUU KUHP). The drafting of the Civil Code Bill allows a lot of problems due to lack of socialization or uneven dissemination of information to the people of Indonesia.

The Penal Code bill is considered controversial, such as articles on corruption, insulting the President, treason, abortion, adultery and cohabitation, fornication, poultry and cattle omission, customary law and the imposition of fines

for homeless people. In addition to the Criminal Code Bill which became the main focus of student demonstrations was the revised version of new corruption eradication committee (KPK), because the new KPK approved not to strengthen the KPK intended to attach the functions of the KPK.

Along with some protests against RUU KUHP as a criticism of social media such as *Twitter*. Sentiment analysis can be used to filter out comments on social media related to the corruption, both positive and negative comments. Naive Bayes classification analysis can be used to do sentiment analysis of comments on the KPK.

Sentiment analysis is a Natural Language Processing (NLP) and information extraction to find out the writer's feelings in the form of positive or negative comments. This is done by analyzing documents in large numbers [3]. Sentiment analysis which is also referred to as opinion mining is a branch of research in the domain text mining

Naive Bayes is a statistical classification that can be used to estimate the probability of a class group and has proven to have a high level of accuracy and speed when applied to a large database. [4] Sentiment analysis on Twitter to improve television program performance with a combination of Vector Machines has been carried out by Tiara and Veronikha (2015) [5]. In this study sentiment analysis was carried out on a tweet about the RUU KUHP using Naive Bayes Classifier method on tweets data or comments.

1.1. Text Mining and Naïve Bayes Classifier

Text mining is a process of discovering new and unknown information using a computer, by automatically extracting information from a variety of different and unstructured text sources. The essence of this process is to combine information from various sources that have been successfully extracted [6]. Text mining which is also called knowledge discovery in text (text data mining) is a technique used to deal with problems such as information extraction, clustering, classification, and information retrieval [7]. Text mining is a process of mining data in the form of text sourced from the data [8]. There are two stages in text mining: (a) text preprocessing which includes the stages of normalization, case folding, tokenizing, and filtering. (b) feature selection in the form of weighting of words using Term Frequency (TF) - Inverse Document Frequency (IDF). [9]

Naïve Bayes Classifier (NBC) is one of the simplest algorithms in machine learning methods. Although the NBC algorithm is simple, it is high in capability and accuracy [10]. The existing algorithm in NBC is part of Bayes learning algorithm. Bayes learning algorithm is done by calculating the explicit probability value to describe the hypothesis being sought. The data used for NBC is represented by the conjunction of attribute values and a target function $f(x)$. These values can have any value from the set of domains [11]

$$P(F_1, \dots, F_n | C) = \frac{P(C)}{Z} \prod_{i=1}^n P(F_i | C) \tag{1}$$

Eq. (1) is a model of Naïve Bayes theorem which furthermore utilized in classification. The evaluation process of classification system can be derived using *k-fold cross Validation* and *confusion matrix* as *recall*, *precision*, *accuracy*, and *f-measure* values.

Table 1. Confusion Matrix

	Detection by system	
	Positive	Negative
Positive	True Positive (TP)	False Negative (FN)

2. METHODOLOGY

Retrieval of data from Twitter was conducted using the scrapping method using the Twitter API in the period from

Negative	False Positive (FP)	True Negative (TN)
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Based on parameters in Table 1, *recall*, *precision*, *accuracy*, and other calculations can be defined as follow:

a. *Recall (Positive Predicted Value)* :

$$Recall = \frac{TP}{(TP+FN)} \cdot 100\% \tag{2}$$

b. *Precision (Sensitivity)* :

$$Precision = \frac{TP}{(FP+TP)} \cdot 100\% \tag{3}$$

c. *Accuration* :

$$Accuration = \frac{TP+TN}{(FP+TP+TN+FN)} \cdot 100\% \tag{4}$$

d. *Spesificity* :

$$Spesificity = \frac{TN}{(TN+FP)} \cdot 100\% \tag{5}$$

e. *False Positive Rate (FPR)* :

$$FPR = 1 - Spesificity \tag{6}$$

f. *Area Under Curve (AUC)*

$$AUC = \frac{1+recall-FPR}{2} \tag{7}$$

Area Under Curve (AUC) value can be classified as several levels as listed in Table 2 [12].

Table 2. Classification of AUC values

AUC value	Classification Remark
0.91 – 1.00	Very good
0.81 – 0.90	Good
0.71 – 0.80	Enough
0.61 – 0.70	Bad
≤ 0.60	False

24-27 September 2019. About 3561 tweets were found, and the sorted data are (a) Years : how long the account exist (in year) (b) Criteria : being classified into pro (tends to agree with justification), and contra (tends to refuse).

The steps are presented in Figure 1.

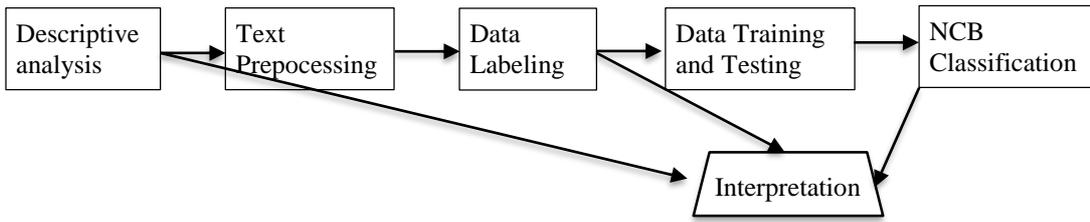


Figure 1. Flowchart Analysis

The purpose of preprocessing is to change information from each data source into a standard form or format before applying various methods of data retrieval to the document to be processed [13]. The *Isonlite* package converts data from the *json* format to *csv* format for the preprocessing process. In the preprocessing process there are stages of cleaning, case folding, filtering, and tokenizing [14].

Case folding is a step to change all the letters in a document to lowercase. Letters changed from 'a' to 'z' [15]. Cleaning, is a process of cleaning words in documents by removing punctuation marks such as commas (,), periods (.), Semicolons (;), colons (:), mentions, RT, hashtags, and others that are less important to reduce noise. Filtering, which removes less important words such as pronouns using Stopword. Tokenizing, is a process that is used to cut documents into small fractions that can be sentences, chapters, and words in this process will eliminate whitespace [9].

After was preprocessing, the data are characterized as positive and negative labelings of based on positive and negative dictionary of the the sentences which was performed for sentiment analysis. The data classification in this study is divided into positive and negative sentiments. In the classification review that contains positive statements such as expressions of thanks, praise, support, and others. For classification reviews that contain negative statements such as dissatisfaction, insults, disapproval.

Data sharing was further stepped to begin the classification process, in which data were divided into two training data and test data, which in detail it consists of 80% of training data and 20% of test data using Naive Bayes. From 20% of this test data used to measure how well the Naive Bayes classification process (NCB).

3. RESULTS AND DISCUSSION

3.1. The description on Age and negative sentiment proportion

The data presented in Figure 2 represents that the age of tweet accounts ranges from 0 - 12 years, as many as 20.3% of their age are not detected. It is also concluded that the majority of account ages are less than 10 years.

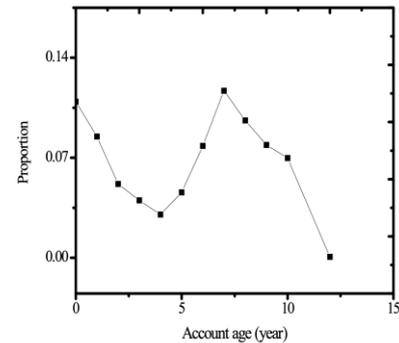


Figure 2. The proportion of account age distribution

The data classification in this study is divided into positive and negative sentiments. The positive sentiments contain statements such as expressions of thanks, praise, support, and others, in adverse, negative sentiments contain statements such as dissatisfaction, insults, disapproval, and others.

The number of tweeters observed was 3561 tweets and 2821 of them were retweets. In each age group, the percentage that makes a negative statement (against the ratification of the Criminal Code Bill) ranges from 64% - 80% (see Figure 3.). Only in the 11-year age group the percentage opposed was 50% and in the 12-year group it was 100%. In both groups the sample size is very small as indicated from Figure 2.

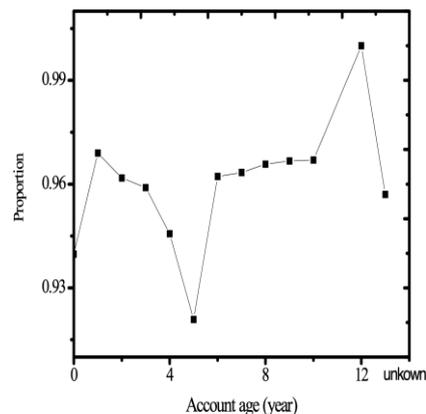


Figure 3. The proportion of account with negative sentiment

In general, the tweets tend to refuse the draft are at the proportion of 0.697%. From the analysis result obtained a total of 3561 tweet data consisting of 1078 (30.27%) positive (Pro) and 2483 (69.73%) negative (Contra) opinion tweet data.

Testing on proportional parameter for tweet user with negative statement can be performed by binomial distribution approach. Confidence interval $(1-\alpha)100\%$ for the proportional parameter based on simple asymptotic statistics can be expressed as in Eq. 8.

$$p - Z_{\left(\frac{\alpha}{2}\right)}\sqrt{\frac{p(1-p)}{n}} - \frac{1}{2n} \leq \pi \leq p + Z_{\left(\frac{\alpha}{2}\right)}\sqrt{\frac{p(1-p)}{n}} + \frac{1}{2n} \tag{8}$$

By the confidence interval of 95%, it is found that:

$$0.6821 \leq \pi \leq 0.7125$$

The confidence interval $(1-\alpha)100\%$ for proportional parameter on Wilson Score statistics with continuity correction can be expressed as in Eq. 9.

$$\frac{p + \frac{z_{\alpha/2}^2}{2n} - z_{\alpha/2}\sqrt{\frac{p(1-p)}{n} + \frac{z_{\alpha/2}^2}{4n^2}}}{\left(1 + \frac{z_{\alpha/2}^2}{n}\right)} < \pi < \frac{p + \frac{z_{\alpha/2}^2}{2n} + z_{\alpha/2}\sqrt{\frac{p(1-p)}{n} + \frac{z_{\alpha/2}^2}{4n^2}}}{\left(1 + \frac{z_{\alpha/2}^2}{n}\right)} \tag{9}$$

From the sample with confidence level of 95%, the range for confidence interval is:

$$0.6820 \leq \pi \leq 0.7122$$

Simple asymptotic method with continuity correction and Wilson Score method with continuity correction produce a relatively similar confidence interval, as well as same interval width of 0.0304 and 0.0302.

Description of world on each sentiment group

From positive sentiment group, the most often word appeared are "Takut", "Presiden" and "Mahasiswa" as shown at Figure 4. Meanwhile, from the negative sentiment group, the words that most often appear are "Jokowi",

"Presiden" and "DPR" as shown by bar diagram at Figure 5.

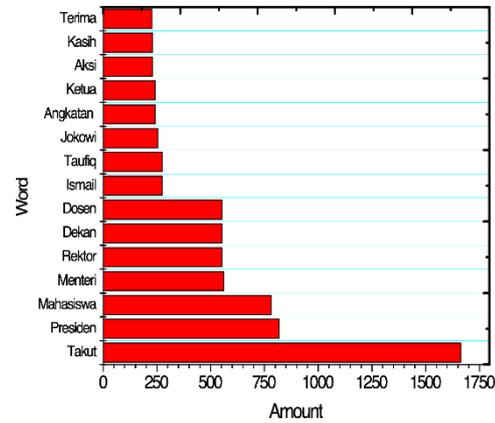


Figure 4. Distribution of the most often words from positive sentiment group.

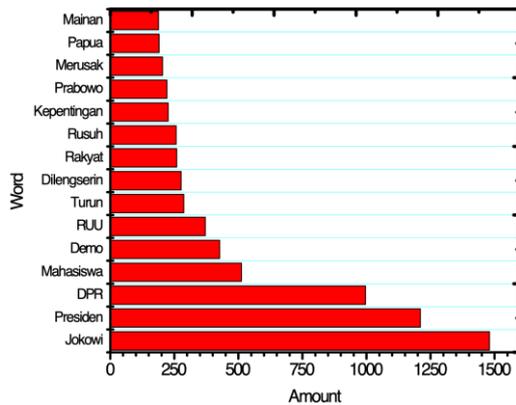


Figure 5. Distribution of the most often words from negative sentiment group.

Table 4. Association of word “Jokowi” in negative sentiment group

No	Associated with	Proportion
1	Prabowo	0.38
2	Dikritik	0.36
3	Barusan	0.35
4	Nyesel	0.35
5	Simple	0.35
6	Track	0.35
7	Khan	0.34
8	Dituntut	0.33

Based on classified as listed in Table 2, it is concluded that the association values are ranging from 0.25 to 0.5 suggesting the enough correlation.

3.3. Naïve Bayes Classifier

Before conducting the analysis with naïve Bayes classifier, the data was divided into two namely training data (training) and test data (testing). The data partitioning was done with a proportion of 80% for training data and 20% for testing data based on class classification. The amount of training data is greater than the testing data. This is thought to be the greater the amount of training data, the better model will be obtained. The total data of 3561 consisted of tweet and retweet data. Researchers used the proportion of 80% for training data, which were 2921 and 20% for test data, which were 730.

Based on the highest data, the obtained *Confusion Matrix* is presented in Table 5.

Table 5. Confusion Matrix

Prediction	Reference	
	Negative	Positive
Negative	494	45
Positive	4	169
Accuracy	0.9312	
Precision (Sensitivity)	0.7897	
Specificity	0.9920	
Recall (Positive Pred. Value)	0.9769	
Negative Pred. Value	0.9165	

False Positive Rate (FPR)	0.0231
Area Under Curve (AUC)	0.8730

Table 5 presents some values presented how well the classification is done using the Naïve Bayes method such as *Accuracy, Recall, AUC*.

- a. *Recall* is the success rate of the system in finding back information. From the calculation of recall obtained a result of 97.69%, implying that the success rate of the system is very good in finding back an information.
- b. *Precision* is the level of accuracy or accuracy in classification. In the precision calculation, the result is 78.97%, means that the level of accuracy or accuracy in the classification can be quite good.
- c. *Specificity* is used to measure the negative proportion that is correctly identified. From the calculation results obtained a value of 99.20% which can be interpreted that the identification made to measure negative proportions is very good.
- d. *AUC* values are used to measure discriminatory performance using estimated probabilities of results from randomly selected samples from a negative and positive population. Classification is said to be good if the higher *AUC* value. From the calculation of the *AUC* value, the results obtained are 0.8730 in the range of values of 0.81 to 0.90, which means good classification.

4. CONCLUSION

Naïve Bayes Classifier method can be utilized for analysis of sentiment on tweeter data. In the case of RUU KUHP refusal, respondent utilizing tweeter account are dominantly ranging from 0 – 10 years old. From the analysis result, it is obtained that the tweeter accounts are grouped by 30.27% positive sentiment and 69.73% negative sentiment. Naïve Bayes classifier method classify with the accuracy of 93.12%, Specificity 99.20% and AUC of 0.8730. Those indicators suggest that Naïve Bayes Classifier method can be utilized for sentiment analysis on tweeter data.

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