Sentiment analysis for Indonesia hotel services review using optimized neural network

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Abstract. In this paper, the sentiment model for the classification of review of hotel services in Indonesia is proposed to get a recommendation supporting the decision to search for the best hotel as the background in this study. The neural network model is applied to get the best model in this sentiment analysis. The stages of the research were carried out by first preprocessing the text data obtained through feature selection, in addition to optimizing the selection of attributes and optimizing the parameters carried out to improve the accuracy of the obtained classification. The genetic algorithm is proposed for parameter optimization due to limitations in neural networks in determining parameter values. Based on the results of the experiment, in the neural network model after optimization, the best accuracy rate is 88.99%.

1. Introduction

Social media, which has a great influence on the current conditions, cannot be avoided. Whatever is included in social media is always a matter of discussion both positive and negative. This rapid development has made social media as a measure in carrying out an assessment of things according to [1,2]. Although sometimes the assessment is still subjective but whatever the outcome, people begin to make their own assessment of it. One example is the review of a hotel. The ability of the hotel to perform a good service will certainly affect the number of tourists’ visit who will use their services; in addition, it will affect the economy of a particular area, especially its tourism as well as its traditional culinary[3].

Assessment of hotel sentiment based on the results of social media reviews or other sites that display data on social media user reviews is currently used as a decision support in assessing the hotel. Of course, each comment has a certain meaning whether it has a positive or not. Sentiment Analysis as part of text mining science is one of the methods used to extract text into valuable information, such as sentiment classification whether positive, neutral, or negative[4,5]. Various methods can be used as model sentiment analysis, including Neural Network (NN), Support Vector Machine (SVM), Naïve Bayes (NB), Decision Tree (DT) and others [6].

Previous studies related to sentiment analysis were conducted by finding the best mode, some of which used social media as the main data. Sentiment research in previous studies related to hotel reviews conducted by several researchers, the study was more associated with sentiment of tourists visiting a tourist attraction [7,8,9]. In addition, the optimization of the model for sentiment analysis was also carried out by researchers to improve the performance of the created model.
Neural network with its ability as part of the supervised learning method that can be used for classification is a method that can be applied to sentiment analysis [10,11]. The problem that arises in a text-based analysis are the number of features that affect the level of generated accuracy [12,13] and the selection of a parameter that still has difficulty in determining its value. Related to feature selection in this research, Information Gain (IG) is applied since its advantages can optimize the selection of appropriate features lead to an increase in accuracy [14].

The selection of appropriate parameters in the Neural Network becomes an obstacle in the experiments; hence, the difficulty of determining the value of this parameter affects the desired model [15]. This parameter selection problem does not only affect the classification model [16], but also affects a prediction forecast using the neural network model [17]. The Genetic Algorithm in this article is proposed to overcome the problem in determining parameter values. Optimization of parameters in the Neural Network in this study is the focus, so the purpose of the experiment is to find the best model using genetic algorithms to optimize the NN model applied to the sentiment analysis review of hotel services in Indonesia.

2. Method and Material
To achieve the desired results, this research performs several stages in its implementation. Experiments carried out to get the desired results and use appropriate tools to get the best results. Several steps were done including data pre-processing, model optimization, model validation and model evaluation.

2.1. Data Collection and Tools
The research data uses review sentiment text data from the site https://www.google.co.id/maps related to the sentiment assessment of the services of hotels in Central Java, Indonesian-language texts taken from 2019. In this research, to find the best model are used Rapid miner Studio and ms.excell as part of the manual calculation process.

2.2. Proposed Method
One of the solutions provided to overcome the problem that occur in the model is to apply Information Gain. This method is used to reduce the features that appear on the model. Therefore, it affects the level of generated accuracy. The method proposed in this paper is parameter optimization using genetic algorithms, where the determination of the optimal parameters contained in the Neural Network is optimized, so that it produces the appropriate value and has an effect on increasing accuracy, shown in Figure 1.

In the preprocessing data, the stages of filtering text, tokenizing and stop-wording are performed to the condition that the data is in accordance with the proposed model. The process of assigning weights to attributes that will be used use the Term Frequency-Inverse Document Frequency (TF-IDF) method [18]. The best attribute selection is done by using Information Gain (IG) so that the attribute used is really the attribute with the best weight that supports in the process of increasing accuracy.

The proposed model is an application of genetic algorithms; this model is applied to the Neural Network to find the best parameter values, namely learning rate, training cycle, and momentum. GA is proposed for the optimization of parameter values therefore the accuracy of the sentiment analysis classification of hotel ratings on the model has an increase and the best level of accuracy.
To get the desired level of accuracy, the model validation in this experiment uses cross validation, besides the criteria used are using precision, recall, and F1-score, using the formula:

\[
\text{Precision} = \frac{TP}{TP + FP}
\]

\[
\text{Recall} = \frac{TP}{TP + FN}
\]

\[
F1 - \text{Score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}
\]

Where, TP (true positive), TN (true negative), FP (false positive), and FN (false negative)

2.3. Neural Network
As an algorithm that enters supervised learning, NN is a method used for data classification. NN is a method that carries out the process of adopting an artificial neural network, where there are neurons that are used as input, learning processes and model output outcomes [1]. One of the NN models that
is often used is Back-propagation (BP), where in this BP there are three main components namely the neuron input layer, the hidden neuron layer and the output neuron layer where each neuron has a weight that is used to get the desired level of accuracy.

3. Result and Discussion

The experimental results are explained using two different models, namely experiments conducted using Information Gain-based Neural Networks (NN-IG) and experiments using the optimized NN +IG model (NN-IG+GA).

3.1. Neural Network –IG Experiment Result

In this study, the results of experiments using the NN-IG model produce values with varying degrees of accuracy. The NN-IG model using the “Stratified sampling” method produces a combination of accuracy as shown in the table. Table 1 shows the training cycle parameters in the 200 setting and the learning rate in the 0.01 setting resulting in the highest accuracy rate of 88.26%. Table 2 shows that the lowest value of the resulting accuracy is 87.72%.

| Momentum | accuracy | precision | recall |
|----------|----------|-----------|--------|
| 0.9      | 88.17%   | 88.91%    | 98.86% |
| 0.8      | 88.26%   | 88.77%    | 99.17% |
| 0.7      | 88.26%   | 88.70%    | 99.27% |
| 0.6      | 88.08%   | 88.53%    | 99.27% |
| 0.5      | 88.08%   | 88.53%    | 99.27% |
| 0.4      | 88.08%   | 88.46%    | 99.38% |
| 0.3      | 87.35%   | 87.74%    | 99.48% |
| 0.2      | 87.53%   | 87.69%    | 99.79% |
| 0.1      | 87.72%   | 87.72%    | 00.00% |

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|----------|----------|-----------|--------|
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| 0.7      | 88.26%   | 88.70%    | 99.27% |
| 0.6      | 88.08%   | 88.53%    | 99.27% |
| 0.5      | 88.08%   | 88.53%    | 99.27% |
| 0.4      | 88.08%   | 88.46%    | 99.38% |
| 0.3      | 87.35%   | 87.74%    | 99.48% |
| 0.2      | 87.53%   | 87.69%    | 99.79% |
| 0.1      | 87.72%   | 87.72%    | 00.00% |
Other experiments were carried out using the “shuffle sampling” method. The parameter value of the training cycle is 200 and the learning rate is 0.01, the results shown in Table 2 with the best accuracy rate of 88.26%. A graphic and the best model depiction of the experimental results using NN is shown in Figure 2 and Figure 3.
3.2. Experiment results with optimized NN

At this stage, an experiment was carried out using the NN-IG model that had been optimized using a genetic algorithm (NN-IG + GA). Optimization is done by optimizing the parameter values contained in the NN model and the optimization results are then used as a sentiment analysis model of hotel review ratings.

In this optimization, the algorithm parameter values have been set using population 5 and mutation type using Gaussian. The results of the NN-IG + GA experiment are shown in Table 3 and Figure 4.

| selection type | training cycles | learning rate | momentum |
|----------------|-----------------|---------------|----------|
| tournament     | 94              | 0.858911457   | 0.586464677 |
| roulette wheel | 63              | 0.862088995   | 0.557742476 |

**Figure 4.** Graphic experimental using NN-IG+GA model

3.3. Evaluation Model

Based on the results of experiments that have been obtained on the model used for the classification of hotel services sentiment review in Indonesia, a model with a different level of accuracy is obtained. In addition, the level of accuracy using an optimized model has a better level of accuracy compared to previous optimization as shown in Table 4 and Figure 5.
Table 4. Evaluation model

| No. | Model                  | Accuracy  |
|-----|------------------------|-----------|
| 1   | NN-IG                  | 88.26%    |
| 2   | NN-IG+GA (Proposed method) | 88.99%   |

Based on Table 4 and Figure 5, it can be seen that there is a difference in the accuracy values obtained. The level of accuracy performed after optimization results in a value of 88.99% higher compared to without optimization parameters, which is around 88.26%. The difference in the level of accuracy is influenced by the value of the parameters used in the NN and genetic algorithms so that if further experiments are carried out by setting these parameter values, the accuracy level obtained may be even better. In addition, the number of dataset and data pre-processing processes have an important role, one of which is the stemming process.

4. Conclusion
Sentiment review of hotel service has a significant impact on the increase in the number of hotel users. It shows that a hotel review sentiment has a significant impact on improving the economic area, especially in the tourism field. The data model of sentiment classification data mining using NN that has been optimized by using genetic algorithm (NN-IG+GA) is the best model obtained from experimental results by producing an accuracy rate of 88.99%. There are still deficiencies in the increased accuracy, especially in the optimization model used. There are a number of optimization models that can be used in addition to GA. Therefore, future research optimization models for the classification of hotel service sentiment in the future can be done with continued experiments. Hence the best model with the best and highest level of accuracy can be used.

Acknowledgement
This article is part of the results of research funded by the DRPM Ministry of Research and Technology of the Higher Education Republic of Indonesia through a PKPT scheme grant in the 2019 fiscal year.

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