PAPER NAME

954-Article Text-2441-1-10-20200928.pdf

AUTHOR

Hartono

WORD COUNT

4732 Words

CHARACTER COUNT

21536 Characters

PAGE COUNT

8 Pages

FILE SIZE

534.1KB

SUBMISSION DATE

Feb 25, 2024 12:27 PM GMT+7

REPORT DATE

Feb 25, 2024 12:28 PM GMT+7

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Jurnal Mantik
Volume 4, Number 2, Augustus 2020, pp. 1389-1396 E-ISSN 2685-4236
https://iocscience.org/ejournal/index.php/mantik

Implementation of Artifical Neural Networks with Multilayer Perceptron for Analysis of Acceptance of Permanent Lecturers

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ARTICLE INFO

Article history:
Received: 12/01/2020
Revised: 22/07/2020
Accepted: 01/08/2020

Keywords:
Classification, Lecturer Acceptance, Multilayer Perceptron

ABSTRACT

Lecturer acceptance selection is the first step in building an education. The Multilayer Perceptron method can be applied in the case of permanent lecturer admissions. The problem faced in the admission of permanent lecturers is that reception is still subjective. This research will prove the ability of the Multilayer Perceptron algorithm to classify eligibility as a lecturer or not. Inputs from this study were prospective applicants' data, namely age, grade point average (GPA), written test score, interview value, and home base status. Sample data amounted to 100 data. 75% of the data is used as training data, and 25% as test data. The test results of the accuracy of the data are known that the multilayer perceptron neural network method has an accuracy rate of 98.7% and with a ROC Area value of 0.989. This proves that the application of the model used belongs to the classification category very well because it has a ROC value between 0.90-1.00.

1. Introduction

Recruitment is a very important stage in human resource management. Recruitment and selection are some of the processes in the procurement of Human Resources (HR). The objectives to be achieved through the process of Human Resource Management (HRM) are professional HR who have noble, competent, and motivated characteristics [1]. Process in peng recruited late and completion faculty is the first step in determining whether the human resources that will be accepted will be qualified to work as a professional. Professional human resources will provide good output in the form of quality goods and services. If the quality of products and services produced will certainly have an impact on the welfare of the organization, individuals, and even the wider community.

Every college wants to get educators who are of good quality and with quantities that are following the criteria set by the tertiary institution. The quality of new prospective educators can be known early by recognizing patterns of lecturer characteristics that have existed in previous years by taking into account the grade point average (GPA) along with other test values as a reference for acceptance of new prospective lecturers.

Based on the description above, in this study, a system will be made to classify the admissions of new lecturers by taking data samples of odd candidates for the 2015-2016 Academic Year as many as 100 data. The data is divided into 2 parts, 75% of the data is used as training data, and the remaining 25% is used as test data. Input data will be processed using the Multilayer Perceptron algorithm to form a probability table as a basis for the classification process of lecturer admissions. In this study, artificial neural network techniques are used to find patterns of admission of new lecturers that have been accepted, then serve as the basis for predicting the admission of new lecturers in the following year.

Data mining in the process of analyzing one of them can use tools to find patterns and rules in the process of finding a data set. This tool or software is tasked with finding patterns or rules by identifying rules and features in the data. The tool used in data mining is expected to be able to recognize patterns that of the data with minimal input provided by the user or users [2].

Some of the other studies also gave significant results by applying artificial neural networks in different cases. As in identifying tropical diseases in a study conducted by Rika Rosnelly and Linda Wahyuni, which honored "Tropical Diseases Identification Using Neural Network Adaptive Resonance Theory 2" gave

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significant results to determine the type of tropical disease suffered by patients with a success rate of 91, 67%[3].

Other research conducted by Mimi, Fahreza Alghifari, Teddy Surya Gunawan by applying an intelligent system-based artificial neural network with the research title "The disruptometer: an artificial intelligence algorithm for market insights" This study has tested the algorithm with 4 brand case studies, 3 brands show Identical results obtained by professional investors[4].

Based on research conducted by Yunita Ardilla, Handayani Tjandrasa, and Isye Arieshanti with the title " Disease Detection Epilepsy with use Entropy Permutations, K-means clustering, and Multilayer Perceptron " it can be deduced that classification model multilayer perceptron will produce maximum performance when carried out executions in entropy permutation algorithm with the number of dimensions of between 3 to 6, expected in late perform three phases of the scenario. The initial scenario is to replace the number of permutation entropy dimensions. The next scenario is to replace the number of clusters in K-means clustering, and the last scenario is to replace the number of hidden layer neurons in the multilayer perceptron[5].

Based on research conducted by Amrin and Irawan Satriadi with the research title " Implementation of Artificial Neural Networks with Perceptron Multilayer for Credit Analysis " it can be concluded that the performance of the neural network model of the perceptron multilayer model for car loans is formed from training data and is validated in testing data provides an accuracy rate of 96.1% with an area under the curve (AUC) value of 0.999. This proves that the application of the model used includes a very good classification category because it has an AUC value between 0.90-1.00 [6].

Other research was also conducted by Rosenty Damanik, et .all, with the title of the research " Diagnosis of skin diseases in animals with the Multilayer Perceptron algorithm " it is known that the error value will decrease with increasing epoch. The number of hidden layers is directly proportional to the decrease in error value. The more hidden layers that are used, the faster the error value drops. Tests using 10 hidden layers and a maximum epoch of 100, resulting in a final error value that is already quite low, namely MSE = 0.01494 and RMSE = 0.12223 to accurately diagnose the disease[7].

Based on research conducted by Grace Tika and Adiwijaya with the research title " Classification of Indonesian Language News Topics using Multilayer Perceptron Grace " it can be concluded that the use of the Multilayer Perceptron method with TF-IDF feature extraction and without stemming can handle issues regarding the classification of Indonesian-language news topics, because has achieved the highest F1- Score accuracy of 77.44%. Both of these researchers are also very hopeful of subsequent research to use feature selection that might make the classification system of Indonesian news topics better[8].

Another study was also carried out by Muhammad Irfan Bakhtiar Alldino Ardi Sumbodo, and Ika Candr adewi, with the title " System of Classification Vehicle-Based Digital Image Processing Method of Multilayer Perceptron " with the title "Diagnosis of skin diseases in animals with algorithms Multilayer Perceptron " The results It is known that the percentage of the success of the vehicle type classification process in each frame, depends on the results of detection and selection of features that can represent each type of vehicle that will be used in the classification process and the number of data samples in the training process[9].

2. Research Methodology

2.1. Data Mining

Data Mining is an algorithm that uses calculation techniques in the fields of statistics, machine learning, and database management systems with an analysis system for the process of extracting information from a very large set of data [10]. Data mining is the process of analyzing different data and summarizing it into useful information that can be used to increase profits and reduce the cost of expenditure, or even both [11]. Another definition says Data Mining is an activity that includes the collection, use of historical data to find regularities, patterns, or relationships in large data [12][13]. From some of the definitions above, it can be concluded that Data Mining is a process or activity to collect large-sized data and then extract the data into information that can later be used.

Data mining is often called Knowledge Discovery in Database or abbreviated as KDD, is a series of activities that include collecting data, using historical data or track record data to find regularities, patterns, or relationships in large data sets [6]. The picture of the stages of making a data mining application is shown in Figure 1 below:

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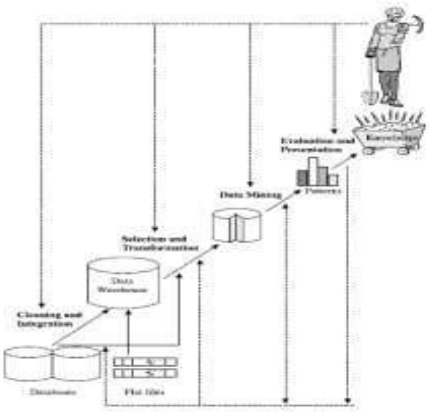

Fig 1. Stage of data mining

Figure 1 shows the steps in the data mining process. The process in the data mining phase consists of three main steps, namely [6]:

1. Data Preparation In this step, data is selected, cleaned, and preprocessed following the guidelines and knowledge of domain experts who capture and integrate internal and external data into the overall organizational review.
2. Data mining algorithm The use of data mining algorithms is carried out in this step to explore integrated data to facilitate the identification of valuable information.
3. Data analysis phase Outputs from data mining are evaluated to see whether the knowledge domain is found in the form of rules that have been extracted from the network.

2.2. Neural Network / Artificial Neural Network

A neural network or artificial neural network is one branch of Artificial Intelligent with the process of machine learning that is trying to simulate the process of learning artificial intelligence in the human brain. The term artificial here is used because this neural network is implemented by applying algorithms used on computers that are capable of performing the process of solving some calculations during the learning process [6].

One area where ANN can be applied well is in the forecasting or prediction field. Neural Network Backpropagation has the advantage because the learning is done by repeatedly to realize the pattern of the system to resist the damage and consistent work well [14]. The special attention is that the neural network is not programmed to generate a specific output. All output provided by artificial neural networks is based on the learning process carried out. In the learning process, artificial neural networks are entered into input (and output) patterns and then the network will be taught to provide acceptable answers [6].

2.3. MultilayerPerceptron

Multi-Layer Perceptron is one variant of Artificial Neural Network. MLP architecture can consist of 1 or more hidden layers (hidden layer) [15]. The training process (training) on the MLP consists of two main parts: the advanced computation (forward) and the countdown (backward). Forward calculations are used to calculate the output of each hidden layer based on input values, current weight values, and based on the activation function used. While the count down is used to update the weight value following a predetermined error value. The training process will stop when the MSE (Mean Square Error) value is acceptable.

The neural network approach is motivated by biological neural networks. In conclusion, a neural network is a set that is connected to an input/output unit, where each connection has a value or weight associated with it. Neural networks also have several functions that can make this algorithm popular at the clustering level. First, neural networks are inherently parallel and distributed processing architectures. Second, neural networks learn by adjusting the interconnection weights with data, this allows neural networks to normalize or stabilize patterns and act as extractor features for different groups. Third, neural networks process numeric vectors and require object patterns to be represented by quantitative features only[16]

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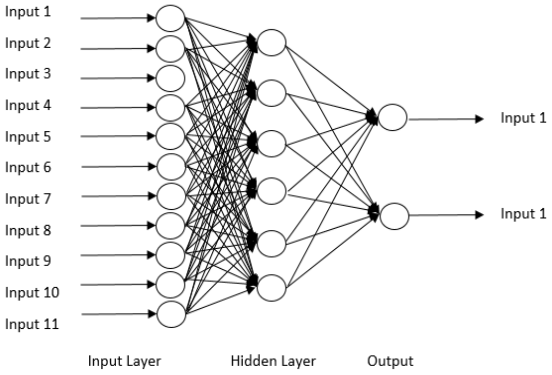

Fig 2. Neural Network Architecture

2.4. Data sources

The research methods used in this study include data collection methods, and neural network algorithm methods with multilayer perceptron using training data, as well as testing.

1. Data Collection Methods

This research was conducted using primary data. The primary data in the form of data from prospective applicants for the 2015-2016 school year is an odd number of 100 The data consists of several attributes, namely, age, cumulative achievement index (GPA), written test scores, interview scores, and home base status.

2. Training Data Collection Methods, and Testing Using Neural Network Algorithms

This study uses a Multilayer perceptron as a training process from the results of data collection. In the training process, the data is first transformed into new attributes, looks like table 1:

Table 1.
Transformed Data

No	Attribute	Attribute Value
1	Usia	1. Tu >=50 2. Sedang 35-49 3. Muda 23-34
2	Transcript Nilai	1. 2,76 – 3,00 Good 2. 3,01 – 3,50 Very Good 3. 3,51 – 4,00 Excellent
3	Nilai Test Tertulis	1. lulus>=70 2. Tidak lulus <70
4	Test Kesehatan	1. Positive 2. Negatif
5	Wawancara	1. lulus >=70 2. Tidak lulus <70
6	Lokasi Homebase	1. Ada 2. Tidak Ada

After transforming the data, the data will be used as training data, to conduct experiments on the Weka application. The results of this training data will be stored and used as a reference for learning data in determining decisions on new data to be tested again.

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Table 2.
Data Training

No	Usia	Transkip Nilai	Tes Tertulis	Tes Kesehatan	Wawancara	Home Base	Status
1	27 M	3,2 VG	70 L	N	89 L	Y	No
2	37 S	3,9 Ex	80 L	N	89 L	N	Yes
3	35 S	3,4 VG	85 L	N	89 L	N	Yes
4	35 S	3,8 Ex	90 L	N	68 TL	Y	Yes
5	36 S	3,9 Ex	90 L	N	80 L	N	Yes
6	36 S	3,8 Ex	95 L	N	68 TL	Y	Yes
7	47 T	3,9 Ex	70 L	N	65 TL	Y	No
8	35 S	2,8 G	70 L	N	70 L	Y	No
9	35 S	3,3 VG	70 L	N	70 L	Y	No
10	36 S	3,3 VG	70 L	N	70 L	Y	No
11	35 S	3,9 Ex	80 L	N	80 L	Y	Yes
12	35 S	3,8 Ex	85 L	N	89 L	Y	Yes
13	36 S	3,9 Ex	85 L	N	95 L	Y	Yes
14	40 S	3,9 Ex	85 L	N	88 L	Y	Yes
15	25 M	3,3 VG	70 L	N	70 L	Y	No
16	25 M	3,9 Ex	90 L	N	80 L	N	Yes
17	37 S	3,3 VG	70 L	N	70 L	Y	No
18	48 T	3,8 Ex	70 L	N	65 TL	Y	No
19	25 M	3,9 Ex	90 L	N	78 L	N	Yes
20	37 S	3,4 VG	65 TL	N	65 TL	N	No
21	35 S	3,8 Ex	80 L	N	68 TL	N	Yes
22	36 S	3,8 Ex	80 L	N	80 L	Y	Yes
23	49 T	3,9 Ex	70 L	N	65 TL	Y	No
24	40 S	3,8 Ex	80 L	N	68 TL	N	Yes
25	25 M	3,9 Ex	80 L	N	80 L	N	Yes
26	48 T	3,9 Ex	70 L	N	90 L	Y	Yes
27	38 S	3,9 Ex	70 L	N	90 L	Y	Yes
28	49 T	3,9 Ex	70 L	N	90 L	Y	Yes
29	27 M	3,3 VG	80 L	N	70 L	Y	No
30	38 S	3,8 Ex	85 L	N	68 TL	N	Yes
31	35 S	3,8 Ex	70 L	N	80 L	Y	Yes
32	27 M	3,4 VG	70 L	N	70 L	Y	No
33	48 T	3,9 Ex	70 L	N	80 L	Y	Yes
34	27 M	3,8 Ex	70 L	N	80 L	N	Yes
35	28 M	3,9 Ex	70 L	N	78 L	N	Yes
36	27 M	3,3 VG	70 L	N	70 L	Y	No
37	27 M	3,4 VG	70 L	N	80 L	N	Yes
38	27 M	3,3 VG	70 L	N	80 L	N	Yes
39	35 S	3,4 VG	65 TL	N	60 TL	N	No
40	48 T	3,9 Ex	80 L	N	78 L	Y	Yes
41	25 M	3,2 VG	65 TL	N	65 TL	Y	No
42	25 M	3,2 VG	65 TL	N	60 TL	N	No
43	39 S	3,0 VG	65 TL	N	65 TL	N	No
44	48 T	3,9 Ex	80 L	N	78 L	N	Yes
45	48 T	3,8 Ex	80 L	N	78 L	N	Yes
46	25 M	3,9 Ex	70 L	N	80 L	Y	Yes
47	48 T	3,9 Ex	70 L	N	80 L	N	Yes
48	28 M	3,4 VG	80 L	N	70 L	Y	No
49	35 S	3,7 Ex	85 L	N	80 L	N	Yes
50	35 S	3,4 VG	70 L	N	80 L	N	Yes
51	35 S	3,8 Ex	70 L	N	68 TL	Y	Yes
52	35 S	3,8 Ex	70 L	N	80 L	N	Yes
53	28 M	3,8 Ex	70 L	N	90 L	N	Yes
54	25 M	3,8 Ex	70 L	N	90 L	N	Yes
55	48 T	3,8 Ex	70 L	N	80 L	Y	Yes
56	25 M	3,3 VG	70 L	N	70 L	Y	No
57	35 S	3,8 Ex	80 L	N	80 L	N	Yes
58	38 S	3,4 VG	85 L	N	80 L	N	Yes
59	37 S	3,8 Ex	85 L	N	68 TL	Y	Yes
60	37 S	3,8 Ex	85 L	N	78 L	N	Yes
61	47 T	3,7 Ex	70 L	N	65 TL	Y	No
62	28 M	3,7 Ex	70 L	N	78 L	N	Yes
63	48 T	3,8 Ex	70 L	N	65 TL	Y	No
64	37 S	3,8 Ex	70 L	N	78 L	N	Yes
65	37 S	3,4 VG	80 L	N	90 L	N	Yes
66	37 S	3,8 Ex	85 L	N	68 TL	Y	Yes
67	35 S	3,8 Ex	70 L	N	80 L	Y	Yes
68	47 T	3,8 Ex	70 L	N	65 TL	Y	No
69	37 S	3,8 Ex	70 L	N	80 L	N	Yes
70	35 S	3,4 VG	70 L	N	90 L	N	Yes
71	37 S	3,8 Ex	70 L	N	68 TL	Y	Yes
72	25 M	3,9 Ex	80 L	N	80 L	N	Yes
73	47 T	3,9 Ex	85 L	N	65 TL	Y	No
74	25 M	3,9 Ex	85 L	N	80 L	N	Yes
75	35 S	3,3 VG	85 L	N	90 L	N	Yes

Due to the Health tests, all prospective applicants have a negative drug status, the health tests are not included in the processing of training data.

2.5. Model Evaluation and Validation

To measure the accuracy of the model, evaluation, and validation of the data will be tested. The experiment will be carried out using the Weka tool, one of the free tools for data mining experiments.

1. Experiment with a cross-validation rate of 10 folds

In the training data, an experiment will be conducted with a maximum of 10 fold cross-validations, then the classification results that appear are compared with the actual data. In addition to an experiment with a level of cross-validation of 10 folds, an experiment with a cross-validation level of 3 folds and 5 folds was also conducted, to determine the level of accuracy of the data being processed.

2. ROC (Reciever Operating Characteristic) Curves

The ROC curve shows accuracy and compares classification visually. ROC expresses the confusion matrix. ROC is a two-dimensional graph with false positives as horizontal lines and true positives as vertical lines. The area under the curve (AUC) is calculated to measure the difference in the performance of the method used. AUC is calculated using the formula:[6]

$$\theta^r = \frac{1}{mn}\sum_{j=1}^{n}\sum_{i=1}^{m}\psi\left(\mathrm{x}i^r, \mathrm{x}j^r\right)$$

Where:

$$\boldsymbol{\psi}(\mathrm{X},\mathrm{Y}) = \begin{cases} 1 & Y < X \\ \frac{1}{2} & Y = X \\ 0 & Y > X \end{cases}$$

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AUC's accuracy performance can be classified into five groups:
0.90 – 1.00 = Excellent Classification
0.80 – 0.90 = Good Classification
0.70 – 0.80 = Fair Classification
0.60 – 0.70 = Poor Classification
0.50– 0.60 = Failure

3. Results and Discussion

In this research data used as much as 100 Data applicants. From this data, 75% of the data (75 data) are used as training data, and 25 % of data (25 data) are as testing data. Input variables in this study consisted of six variables, namely: 1. Age, 2. Transcript Value, 3. Written Value, 4. Health Test, 5. Interview, and 6. Homebase Location. While the output variable is a decision variable. The software used to analyze is the Weka tool.

3.1. Application of the Perceptron Multilayer Model Neural Network.

The artificial neural network training process uses 75 % of the total data, in this process training will be conducted with different neural network architectures, so that the best network is obtained. Furthermore, the remaining 25 % is as testing data used to improve the shape of the model. Data that has been divided into training data and testing data are then applied to the perceptron multilayer model. The following is a picture of the Neural Network Diagram of the analysis of the recommendation of permanent faculty admissions at major potential universities by applying the multilayer perceptron algorithm. Here is a picture of the experiment using the Weka tool (Figure 3) and the Threshold Curve (Figure 4) as follows:

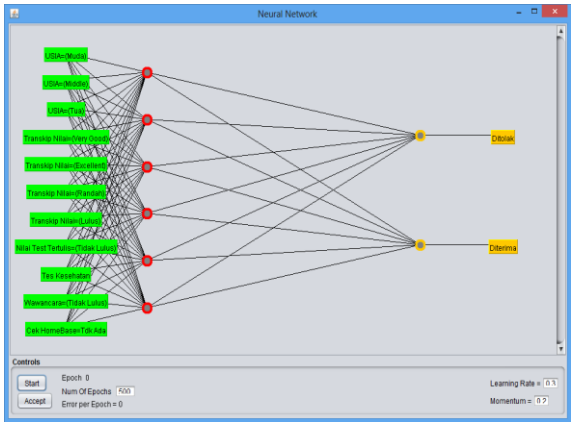

Fig 3. Experiments on the Weka Tool

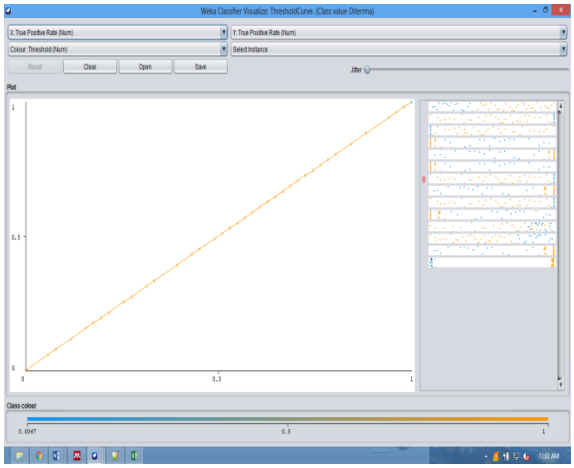

Fig 4. Threshold Curve

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3.2. Accuracy Level Training

Experiments on training data will be conducted with a maximum level of cross-validation of 10 folds. The experiment was carried out with Cross-Validation 3 Folds, 5 Folds, and 10 Folds. Each experiment is added in the table below.

Table 1.
Cross-Validation Experiments

No	Cross Validation (Folds)	Accuracy	Mean absolute error	ROC Area
1	3	96.0526	0.0433	0.912
2	5	98.6842	0.023	0.989
3	10	98.6842	0.022	0.989

From the above table, the lowest accuracy results are found in experiments with cross-validation values of 3 folds, and the best accuracy results are in experiments with cross-validation values of 5 and 10 folds. Experiments 5 and 10 fold validation have the same accuracy value but have a different mean absolute error. The best mean absolute error in trials with 10 folds validation. The model produced, including the classification is quite good because it has value ROC between 0.90-1.00, which amounted to 98.6842.

4. Conclusion

The conclusion that can be drawn based on this research is that the performance of the multilayer perceptron neural network model for the Analysis of Acceptance of Permanent Lecturers formed from training data and validated on testing data gives an accuracy rate of 98.7 % with experimental cross-validation level of 10 folds, and this result gives a mean absolute error of 0.22. This shows that the resulting model includes a very good classification category because it has a ROC value between 0.90-1.00.

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