

Human resources development strategy use Backpropagation Artificial Neural Networks

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Abstract: The strategy for developing human resources for recruitment so that at the same time becoming a reliable workforce as expected is the goal of personnel in certain offices or agencies. This step must be taken by the management of companies or institutions, both public and private, in order to improve human resources (HR). Until now, there has never been any research on the conventional acceptance of prospective employees to test how accurate their performance is. In this study the conventional selection system for prospective employees will be used as a basic concept to find methods for analyzing the performance of prospective employees using computer media with an artificial neural network system approach with the backpropagation method. So that the accuracy of the predictive patterns of prospective new employees is obtained. So that finally the personnel of government and private agencies obtain actual information about the performance of prospective employees who will be accepted as workers. The results of the study using hidden layers and learning constants obtained the fastest convergent value at 3377, and the final results of this study will be published in a national journal accredited SINTA 4 or better.

Keywords: Recruitment strategy for new workers, artificial neural networks, backpropagation, and human resources.

INTRODUCTION

Recruitment of new employees is one of the steps taken by the management of companies or institutions, both public and private, in order to improve human resources (HR). Every year, government and private agencies usually require new employees to fill various employee formations in their respective institutions. The acceptance of these prospective employees is based on the terms and conditions in accordance with the HR competency standards of the institution so that the prospective employees will be able to improve the company's performance. Currently, employee recruitment is only based on portfolios and does not prioritize the skills or experience of the prospective employee concerned. This fact can be seen that there is an employee with higher education as evidenced by the existence of a diploma but in practice he is unable to carry out his duties at the agency, conversely there is an employee with low education but is able to complete the job well in his agency.

Predicting the quality of prospective employees according to the requirements required by institutions with conventional systems when accepting new employees by taking into account administrative requirements, potential tests, medical tests, of course these requirements do not guarantee

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that the prospective employees will be able to work well. Until now, there has never been a study that examines how accurate the accuracy of performance is. In this research, the conventional selection system for prospective employees will be used as a basic concept to find methods for analyzing the performance of prospective employees using computer media with an artificial neural network system approach. So that the accuracy of the predictive patterns of prospective new employees is obtained. So that finally the personnel of government and private agencies obtain actual information about the performance of the prospective employees they will receive. Through this research, it is hoped that in the end it will be able to provide a pattern, especially regarding the principles of accepting prospective private and government employees, so that it can provide output that is suitable for meeting HR needs in line with the requirements of skills, expertise and profession needed in realizing the tasks and functions Indonesia's institutions and development goals as a whole.

LITERATURE REVIEW

Electrical power system planning is very important for electricity providers (PLN). One of them is forecasting the electric load. Backpropagation neural network is a good method to use in forecasting electric loads because it can provide high accuracy values. In practice, backpropagation neural networks often provide poor convergence speed in the training process. Therefore, it is necessary to carry out various combinations of training functions to accelerate the convergence of network training. In this study, a backpropagation neural network model was developed with a combination of gradient descent training functions (trainingdm, trainingda, trainingdx). The architectural design of this network model uses 24 inputs, 1 hidden layer consisting of 16 neurons and 1 output. This model uses peak load data from the Pemecutan Kelod substation and the number of kWh sold in the South Bali area as input variables. The results show that the best model uses the trainingdx training function. In this model, the training MSE value obtained is 1.03×10^{-8} and with a training convergence speed of 4 seconds and a testing MAPE value of 6.24% with a network accuracy of 93.75% (Teguh Pradnyana Yoga et al., 2020). Artificial neural networks are computer programs that can imitate thought processes and knowledge to solve a specific problem, decisions can be given intelligently. Backpropagation algorithm is one of the artificial neural network algorithms that is often used in solving complex problems because it has a good level of accuracy. The results of this study indicate that backpropagation has a good level of accuracy in predicting new students with a 5-1 neuron structure with 1 (one) hidden layer, the learning rate (lr) used is 0.1 and the MSE value is 0.001. The test was stopped at the 758th epoch, because the objective performance function had been reached ($MSE = 0.000998685 < 0.001$) indicating a good relationship between the target and the network output during the test. From testing the test data between network outputs, the target correlation coefficient (R) is 0.98779, where the best result is 1 (Nurhani et al., 2018), Metro Electronic and Furniture is a growing company in the field of electronics and furniture sales. This company really wants to increase profits every month, so an application is needed by this company to determine product sales predictions every month.

The artificial neural network system uses the backpropagation method which is applied in this study for product sales forecasting and is expected to help solve problems in product sales forecasting. Forecasting the product thus the expected result is to get accurate predictions for the next month for product sales at Metro Electronic and Furniture Sungai Full. In the process of processing data related to forecasting, the forecast pattern is in accordance with that determined by the backpropagation algorithm. An artificial neural network system using the backpropagation method is implemented using Matlab as software that supports product sales data from 2014 to 2016 (Satria, 2021), which can then be used to predict poverty rates by district/city in Central Java Province. The data used was obtained from the Central Bureau of Statistics for the Province Poverty is a problem that should be viewed as a complex (multidimensional) social problem. Based on data from the Central Bureau of Statistics, the percentage of national poverty in March 2019 was 9.41 percent. Meanwhile, Central Java Province has a higher poverty rate than the national poverty rate of 10.8 percent. High levels of poverty can lead to criminal acts, high unemployment, social, political chaos and so on. Therefore, this study aims to analyze the poverty rate by determining the model

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in Central Java from 2010 to 2019 which consists of data on Economic Growth Rates, Open Unemployment Rates, Human Development Indexes, and Poverty Rates by district/city. The method used is Backpropagation Neural Network. Backpropagation Neural Network has good performance in solving problems, one of which is the prediction problem. Based on the best architectural model produced in this study, namely the 3-35-1 architectural model, an accuracy rate of 95.2% can be produced using MSE in the testing process using test data. So it can be concluded that the Backpropagation Neural Network by applying the right model can produce a good level of accuracy which can then be used as an alternative to predict poverty rates according to districts/cities in Central Java Province in the future (Finaliamartha et al., 2022),

Open unemployment is the working-age population that does not have any job, who are actively looking for work. Backpropagation is one of the algorithms in artificial neural networks (JST) used to forecast or predict data. In this research, the Open Unemployment Rate (TPT) in Maluku Province will be predicted. Based on the results of training analysis, the average success rate of forecasting is 92.59% with the smallest error, namely MAPE = 0.0741%. The forecasting results for the next 5 years show fluctuating data from 2019 (9.5134) to 2023 (9.7924). (Lesnussa & Risamasu, 2020), In a service company there are customers who become consumers of the company. Customer satisfaction is formed from the level of performance and service of the company. One of the levels of customer satisfaction can be measured from the sales level of 3 Kg gas.

Therefore, the Pematangsiantar 3 kg LPG gas base needs to overcome the problem of overcoming the amount of 3 kg gas sales at each LPG base in order to improve their performance and service. So research is needed to predict the amount of 3 Kg gas sales through the Artificial Neural Network method with the backpropagation algorithm to find the best results that will be used to overcome the problems at hand (Tambunan et al., 2021), the increase in the number of requests for hand sanitizers by the regional apparatus operations (OPD) of the Medan City Government occurred due to the demand for the need to maintain hand hygiene during a pandemic. This resulted in an increase in the need for hand sanitizer products at the Medan City Government. To deal with the increasing need for hand sanitizer, product suppliers need to make forecasts to reduce the uncertainty that will arise from the supply of these products. This research was conducted using the backpropagation method on artificial neural networks to predict the product requirements. Data processing on the results of artificial neural network architecture is carried out using Matlab 6.1 software. The results of this study indicate that from January to March 2022 it is best to provide 637, 642 and 636 Hand Sanitizer products each month. The results of this forecasting show that the MSE values for each forecasting period are -0.027, 0.066 and -0.014. these three MSE values are still less than 10% so that the results of this prediction can still be said to be accurate (Mandasari et al., 2022), Pekanbaru State Vocational High School (SMK) 2 is a Vocational School in the Field of Industrial Technology. Currently there are 2400 students with 14 majors. In students the level of willingness in students is still low. This results in a low graduation rate for students. This happens because it is difficult to predict the pass rate of competency exams at SMK Negeri 2 Pekanbaru.

The purpose of this research is to assist in predicting the pass rate of competency exams so that it can produce predictions of student graduation. The method used is the Backpropagation method. With this method data processing can be carried out using the input value and the target you want to produce. So that it can predict student graduation in the skill competency test. Furthermore, the data to be managed is a recap of the average vocational scores for computer network engineering majors from semester 1 to semester 5 with the knowledge aspect of the 2017 and 2018 academic year student targets obtained from the sum of all subjects in each semester. The results of calculations using the Backpropagation method with the Matlab application will be a prediction in producing student passing grades in the future. So that the value of accuracy in predictions will be obtained. With the results of testing the prediction accuracy of student competency tests with the 5-4-1 pattern it reaches 85%, with the 5-6-1 pattern it reaches 95%, with the 5-8-1 pattern it reaches 70%, with the 5-10-1 pattern it reaches 85% and with a 5-12-1 pattern it reaches 85%. Of the five patterns, the best accuracy rate for the 5-6-1 pattern reaches 95%. The results of these predictions using the Backpropagation method can become knowledge in the next year. So that the system parameters

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used in testing can be recognized properly (Nandel Syofneri et al., 2019), Food has a fairly high price and the stability of food prices can affect entrepreneurs and the community in meeting their daily needs. This is often seen in sudden (extreme) price increases. Therefore, it is necessary to have precise and accurate forecasting or predictions to assist local governments in taking initial steps to stabilize food prices. Artificial Neural Networks (ANN) can be used to predict future food prices using the Backpropagation Algorithm. Pasar Sental is one of the trading centers for daily needs in Majene district, West Sulawesi. The study uses data taken from the Office of the Office of Cooperatives, UKM, Industrial Trade, Kab. Majene, in the form of weekly food price data.

The research aims to assist the Regional Government (PEMDA) of Majene in taking initial steps/policies to stabilize food prices. System design to predict food prices by applying Backpropagation Neural Networks, then reviewing the accuracy obtained in the food price prediction system for each commodity. The results of the study used a backpropagation neural network pattern with a total data of ± 156 for each commodity. The results of the study used N.Input of 2, N.Hidden of 3, and N.Output of 1. While the parameters used were Alpha of 0.3, error tolerance of 0.001, and maximum iteration of 100. The highest accuracy in predicting Commodity Price of Rice was 98.47 with computational time for training and testing processes of 1.69 and 0.004 respectively (Irianti et al., 2022), Competency testing is a process of assessment (assessment) both technical and non-technical through the collection of relevant evidence to determine whether a person is competent or not yet competent in a certain competency unit or job qualification. The implementation of the series of "tests" is basically to determine the level of knowledge, skills and personality of students. To find out the passing standards of student competence in facing exams, a method is needed to process the old student grade data to predict the value of students who will take the national exam, namely by using the artificial neural network method with Backpropagation, the results obtained are 0.55178871 with the number of squared errors. 0.004595309, then the result has reached the target, then the iteration stops (Handayani et al., 2021), Artificial neural networks are a branch of AI (Artificial Intelligence). Artificial neural network is an information processing paradigm which is inspired by the human brain system in receiving information and solving problems by carrying out the learning process through changes in the weight of its synapses.

Pos Indonesia is an Indonesian state-owned company engaged in postal services. Currently, the form of Pos Indonesia business entity is a Limited Liability Company and is often referred to as PT. Indonesian post. This research was conducted to obtain a time benchmark when the delivery process occurred so that it can be used as a reference in shipping management control. The number of shipments of goods can be predicted by one method for prediction, namely the Backpropagation method. The Backpropagation method is a learning algorithm to reduce the error rate by adjusting the weight based on the difference in output and the desired target. This study uses unemployment data from the previous 3 years as training test data and training target data. After conducting the discussion, it produces an error value of 0.020043915 in iteration I. The results cannot be used because the error rate has not reached the target, which is 0.01 (Rahmadani et al., 2021), Yields of rice grain in each region always change every year, including in Pesisir Selatan District. This is caused by several factors such as the long dry season, pest attacks and other factors that can inhibit rice growth and can even cause crop failure which can harm farmers. This study aims to make predictions to determine the yield of rice grain in Pesisir Selatan District using the Artificial Neural Network method with the Backpropagation algorithm. Artificial Neural Network is one of artificial intelligence that uses computer technology which is also called Artificial Intelligent. Backpropagation Neural Network is a multi-layered neural network consisting of input layer, hidden layer and output layer. Furthermore, the data is processed using the help of Matlab software. The data processed in this study is data on rice grain yields from 2015 to 2020 obtained from the Agriculture Office of Pesisir Selatan District. From the research that was carried out using several architectural models, one architecture was obtained that had an accuracy rate of 92.9% or an error rate of 7.1% with MSE = 0.00094783 (Maiyuriska, 2022), Student data is important information owned by a university. Large amounts of data can be used to identify a particular pattern. This study aims to predict the number of new students who will

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come by identifying data patterns using an Artificial Neural Network (ANN). ANN is an artificial intelligence that has characteristics such as biological neural networks and functions as an information processing system, one of which is the backpropagation model. Backpropagation trains the network to be able to recognize and identify patterns given during training and provide a response in the form of predictions for similar patterns, therefore backpropagation can be used well in forecasting. The input data used for training is new student data from 2000 to 2020, the desired output is the number of new students in the following year. This study tested 4 different ANN architectural models, with MSE 0.0001, learning rate 0.01, with a maximum of 1000 iterations. The training process uses a combination of the TANSIG-Purelin and LogSIG-Purelin activation functions, as well as the trainingDX, TRAINDA, and TRAINDDM acceleration functions. From the training conducted, it was found that the best network architecture is the 12-8-1 pattern, which means it uses 12 inputs, 8 hidden neurons, and 1 output. This pattern uses the purelin logsig activation function, the trainingda acceleration function, with an MSE of 0.0001 after 94 iterations (Suahati et al., 2022).

METHOD

Back Propagation Neural Network Model

The model of the neuron of the backward error propagation neural network is shown in the figure below

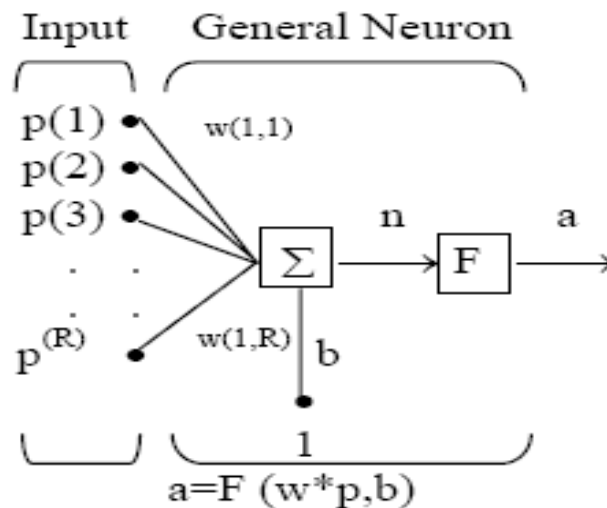


Figure 1 The backward error propagation neural network model

The activation functions that are often used for backward error propagation neural network models are logsig, tantig, and purelin (shown in the figure below).



Figure 2 Logsig Activation Function

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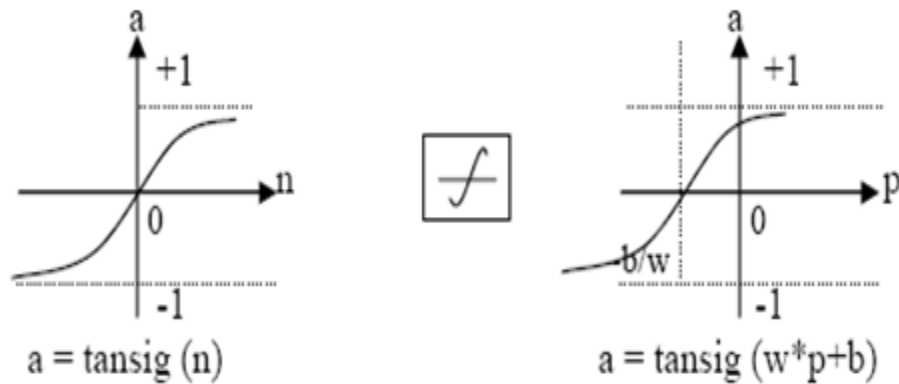


Figure 3 Hard limit Transfer Activation Function

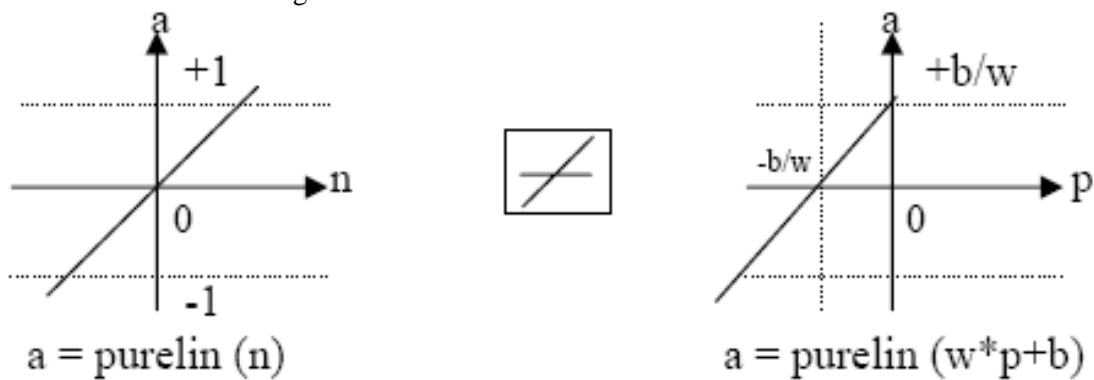


Figure 4 Linier Transfer Function

Initialize the initial weights and bias the backward error propagation neural network using the function
[W,b] = initff (P,S,F)

With

W = initial weight,

B = bias,

P=input pattern,

S = number of neurons,

F = activation function used.

If the backward error propagation neural network model used consists of an input layer, a hidden layer and an output layer, then the initialization function becomes

[W1,b1,W2,b2] = initff(P,S1,F1,S2,F2)

After initialization, the backward error propagation neural network is ready to be trained with a function (for example, there are three layers)

[W1,b1,W2,b2,epoch,tr] = trainbp (W1,b1,F1,W2,b2,F2,p,t,tp)

With

W1,W2 = neural network weights,

b1,b2 = biases,

epoch = number of iterations,

tr = number of errors,

F1,F2 = activation function,

P = pattern,

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T = targets

tp= [disp_freq max_epoch err_goal lr]

With

Disp_freq=display interval,

Max_epoch = maximum number of iterations,

Err_goal= allowed error value,

Lr= learning rate/learning constant

After the final weights are generated, the backward error propagation neural network can be tested with a function

A = Simuff (P,W1,b1,F1,W2,b2,F2)

In addition to the trainbp function which is often used to train backward error propagation neural networks, other functions are also known, such as trainbpm and trainbpx.

Trainbpm is the training of a backward error propagation neural network with additional momentum, the form of the function is as follows

[W1,b1,W2,b2,epoch,tr] = trainbp (W1,b1,F1,W2,b2,F2,p,t,tp)

Tp = [disp_freq max_epoch err_goal lr momentum err_ratio]

With Disp_freq = display interval

Max_epoch = maximum number of iterations,

Err_goal= allowed error value,

Lr= learning rate/learning constant,

Momentum = momentum constant

Err_ratio = error ratio

Trainbpx is a backward error propagation neural network training with additional momentum and adaptive learning constants, the form of the function is as follows

[W1,b1,W2,b2,epoch,tr] = trainbpx (W1,b1,F1,W2,b2,F2,p,t,tp)

With tp =

Tp(1) = view interval,

Tp(2) = maximum number of iterations,

Tp(3) = allowed error value,

Tp(4) = learning constant,

Tp(5) = learning constant increase,

Tp(6) = learning constant derivation,

Tp(7)= momentum,

Tp(8) = error ratio.

RESULT

The training process is carried out using MATLAB software. MATLAB has provided a training and testing toolbox on artificial neural networks with backpropagation algorithms. The training process is carried out to find the best configuration by changing the learning constants and the number of hidden layers by trial and error. The results of the training are shown in Table 1 below:

Table 1. Training Results with changes in learning constants and number of hidden layers

LT \ KB	0,01	0,02	0,05
10	38761	13785	TK
20	29115	12034	47373
30	17165	11365	72007
40	16484	8920	6986

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50	17421	8815	7810
60	14784	7017	8328
70	13270	6643	4012
80	13506	6770	4149
90	12722	6280	3377

Explanation:

KB = Learning Constant

LT = hidden layer

TK = Not Convergent

Testing is carried out in 2 stages, first testing on data on the results of the performance of trained employees and secondly testing on data on new employees who have never been trained before. The results of testing on 25 new employee data are obtained as follows:

Table 2 Test Results for Trained Employee Data

Number Respondents	New Employee Requirements						Performance	Target	OJ
	Administration	Psychological Test	English Test	Interview	Medical check up	Academic Potential Test			
1	7,90	6,68	8,48	7,00	6,96	7,63	92	01	01
2	7,92	6,82	8,19	7,86	6,77	9,64	94	01	01
3	7,96	6,98	9,72	8,22	6,68	8,47	94	01	01
4	7,72	6,52	8,82	8,43	7,06	8,21	93	01	01
5	7,54	6,82	8,82	7,45	6,41	8,79	94	01	01
6	7,53	6,98	9,29	8,22	7,06	8,47	94	01	01
7	7,25	7,15	8,82	7,71	6,59	7,8	95	01	01
8	7,71	7,54	9,29	7,58	6,77	7,33	95	01	01
9	7,04	6,98	10	7,71	7,06	8,21	95	01	01
10	7,51	6,4	8,82	8,03	7,4	7,99	94	01	01
11	7,72	8,01	8,48	7,33	9,96	8,47	94	01	01
12	7,96	7,76	9,72	7,45	6,77	7,63	95	01	01
13	7,54	6,27	8,82	8,68	6,77	8,21	94	01	01
14	7,06	7,15	7,95	7,45	6,77	7,8	94	01	01
15	7,96	6,98	8,19	7,86	7,53	7,99	95	01	01
16	8,9	6,15	8,19	8,43	6,96	8,79	96	10	10
17	7,37	6,68	8,48	7,71	6,5	7,99	96	10	10
18	7,37	6,53	9,29	8,03	7,17	8,21	96	10	10
19	8,21	7,34	8,82	8,22	7,28	8,47	96	10	10
20	7,37	6,53	9,29	8,03	7,17	8,21	96	10	10
21	8,21	7,34	8,82	8,22	7,28	8,47	96	10	10
22	7,37	6,53	9,29	8,03	7,17	8,21	96	10	10
23	8,21	7,34	8,82	8,22	7,28	8,47	96	10	10
24	7,45	8,11	9,7	8,35	6,31	8,72	97	10	10

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25	7,74	6,98	9,29	7,58	7,17	7,8	97	10	10
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The table above shows that the training performed by the artificial neural network reaches 100%. This is due to the training output displayed by the computer in accordance with the specified target. From the research results obtained the best pattern of experimental results as follows:

The configuration of the artificial neural network used.

DISCUSSIONS

The use of ANN with the backpropagation method as a tool for human resource development is one of the innovative approaches in dealing with challenges in managing human resources. ANN is a mathematical model that can recognize patterns or relationships in data, while backpropagation is a training method in ANN that can optimize the weight and bias in the network so that the network can learn from the data.

Advantages of Using ANN with the Backpropagation Method in HR Development The use of ANN with the backpropagation method in HR development has several advantages. First, ANN's ability to recognize patterns in data can be used to understand employee characteristics, including their strengths, weaknesses, and potential. With a better understanding of employee characteristics, HR development strategies can be designed more effectively and efficiently. Second, the backpropagation method as a training technique in ANN can optimize network performance by reducing prediction errors. Thus, the use of ANN with the backpropagation method can improve accuracy in identifying employee HR development needs. Third, ANN can be used to make predictions regarding employee career development, such as potential for promotion or promotion. This can help organizations plan employee career development more effectively.

Challenges in the Use of ANN with the Backpropagation Method in HR Development Although it has potential in developing human resources, the use of ANN with the backpropagation method also has several challenges. First, sufficient and quality data is needed to train the network to produce accurate predictions. Without sufficient data, the network may generate inaccurate or even incorrect predictions. Second, understanding the output and interpretation of ANN in HR development can be complex, because ANN is a complex model for recognizing patterns in data. Therefore, a good understanding of the basic concepts of ANN and backpropagation methods is important to ensure truly beneficial results in HR development. Third, the use of ANN with the backpropagation method also requires information technology resources.

CONCLUSION

From the results of calculations using each sigmoid function, and with the implementation during the research using matlab the learning constants are varied by 0.01, 0.02 and 0.05, so that for further research the learning constants are more varied so that the training program will produce the really best one exactly 1 (exact = 1). This is because the convergence of artificial neural networks can be done quickly if the learning constants and the number of hidden layers match.

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