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# Neural Network -Based Prediction Model for Determining Student Expertise

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***Abstract:** This study uses a neural network algorithm approach with backpropagation method to predict the accuracy level of determining the student's area of expertise. Neural network algorithm is an artificial neural system or artificial neural network is a physical cellular system that can obtain, store and use knowledge gained from experience, to activate using sigmoid bipolar where the output value ring is between -1 to 1. This area of expertise or concentration will taken by students through the selection of subjects of expertise that are in the curriculum of the study program offered. Academic supervisor / academic guardian who will direct students in choosing subjects according to the study interests desired by students. However, this direction is not well known by students. As a result, there is a possibility that students do not choose their field of expertise properly and it will affect the final score of the subject of expertise and competency testing. The analysis technique in this study uses descriptive statistical analysis which is an analysis of the frequency distribution, the size of the concentration, and the size of the spread. Because this study uses a neural network algorithm approach, the frequency distribution, the size of the concentration and the size of the spread are the number of hidden layers, iterations, learning rate, MSE and the confusion matrix (accuracy), which is to know the level of accuracy. The data to be analyzed is maining data or data which is training data consisting of 12 criteria (inputs) and 1 output (consisting of 3 areas of expertise), this data will be integrated into the Alyuda Neurointelligence software , from this software the number of hidden layers is determined , iterations, learning rate , MSE. The results of this study obtained the level of prediction accuracy model, namely: 84.8484% (hidden layer 2, neuron input layer = 13, learning rate = 0.1 and iterations = 500), 91.9191% (hidden layer 2, neuron input layer = 13, learning rate = 0.1 and iterations = 1000), and 95.9596% (hidden layer 3, neuron input layer = 13, learning rate = 0.1 and iterations = 2000).***

***Keywords:** Neural Network; Backpropagation; Areas of Expertise*

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## 1. INTRODUCTION

AMIK DCC is a university that can provide more expertise than an ordinary Intermediate Computer Expert. In addition to applying courses with a standard national curriculum, AMIK DCC also provides students with a local curriculum in the form of courses in the fields of expertise and skills which are the results of observations that are tailored to the needs of the world of work such as Software Application (SA), Computer Teaching (CT), Computer Network (CN) and Visual Effects Communication (KVE) (DCC Bandar Lampung, 2017). Taking the field of expertise at AMIK DCC is the final stage in the learning process by students, so that AMIK DCC graduates can seize job opportunities or entrepreneurship.

Students are young people who study and are active in higher education. The assertion that students are people who study in higher education clearly places the position of students as part of the higher education community, which is where all forms of knowledge are produced. Students are often referred to as agents of change for the order of life realistically and logically accepted by society. Therefore, the students should prepare themselves as early as possible, so that they can participate in real competition.

The big Indonesian dictionary says that an expert is a person who is proficient, fully understands a science. So that the field of expertise can be said to be proficient in a particular field. According to Marcus Buckingham & Curt Coffman (1999) expertise is the ability to do something about a role. At present, almost all jobs require an expertise in a particular field.
The selection of areas of expertise provides an opportunity to focus on the abilities/competencies of students. In choosing the field of expertise, students must be able to make the right decisions. This is because the selection of the right field of expertise will have an impact on the achievement of the value of the field of expertise that will be achieved by the student. In addition, the selection of areas of expertise aims to provide special abilities and skills regarding certain specifications of the field of science (DCC Academic Guidebook 2017). By selecting the right area of expertise, it can facilitate competency testing and the preparation of a final project to fulfill one of the requirements for obtaining a bachelor's degree.

This area of expertise or concentration will be pursued by students through the selection of subjects of expertise that are in the curriculum of the study program offered. Academic supervisor / academic guardian who will direct students in choosing subjects according to the study interests desired by students. However, this direction is not well known to students. As a result, there is a possibility that students do not choose their specialization well and will affect the final grades of the courses in the field of expertise and competency tests.

Research conducted by Sumanto (2010) used the application of Fuzzy C-means (FCM) to determine the appropriate TA specialization for students and also conducted by Samuel Lukas, Meiliayana, William Simson (2009) using the application of fuzzy logic in decision making for the path of specialization to determine student area of expertise. Research for determining majors in high school using the Fuzzy Logic Mamdani method was carried out by Gautama (2010).

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From the several studies above, it shows that there are many case studies for determining the classification of specializations. For this reason, in this study, the Backpropagation method of Neural Network Algorithm will be applied to determine students' areas of expertise in the hope of being more accurate.

The problem in the research begins with identifying the problem, making the scope of the problem and formulating the problem. Identification of the problem in this study is that the selection of students' areas of expertise is still influenced by non- technical factors such as friends, so that the selection of areas of expertise does not match their interests and abilities.

Field of expertise by applying the backpropagation method of the neural network algorithm at AMIK DCC Bandar Lampung with student data, interests, grades for compulsory courses, competency tests and grades for areas of expertise in the form of a dataset, then this dataset will be used as training data in the previous year and then evaluated with the current data (data testing).

Based on the background above, it can be concluded that many students get low scores in the courses in the field of expertise and many students do not pass the competency because the selection of the field of expertise is not in accordance with their abilities.

Meanwhile, research questions in this study are: How to apply the neural network algorithm backpropagation method to determine the classification of the student's area of expertise ?
The purpose of this research is to apply the backpropagation method of neural network algorithms to help make the right model in the selection of areas of expertise according to student abilities.

## 2. RESEARCH METHODS

This research is an experimental model using the application of a neural network to assist students in determining the area of expertise according to their interests and academic abilities. The type of data used in this study is primary data obtained directly from the source by taking student data and course grades.

Data collection methods used in this study are: primary data is data directly obtained from AMIK DCC Bandar Lampung. The data obtained is in the form of a dataset consisting of npm attributes, interests, and the value of compulsory courses that become training data in research. Secondary Data Is data obtained indirectly, for example from documentation, literature, books, journals, and other information that has to do with the problem under study.

Research support instruments. It uses tools such as: The system applied for taking the field of expertise is based on the value of the course and the table of relationships between the table of course scores and the table of expertise.

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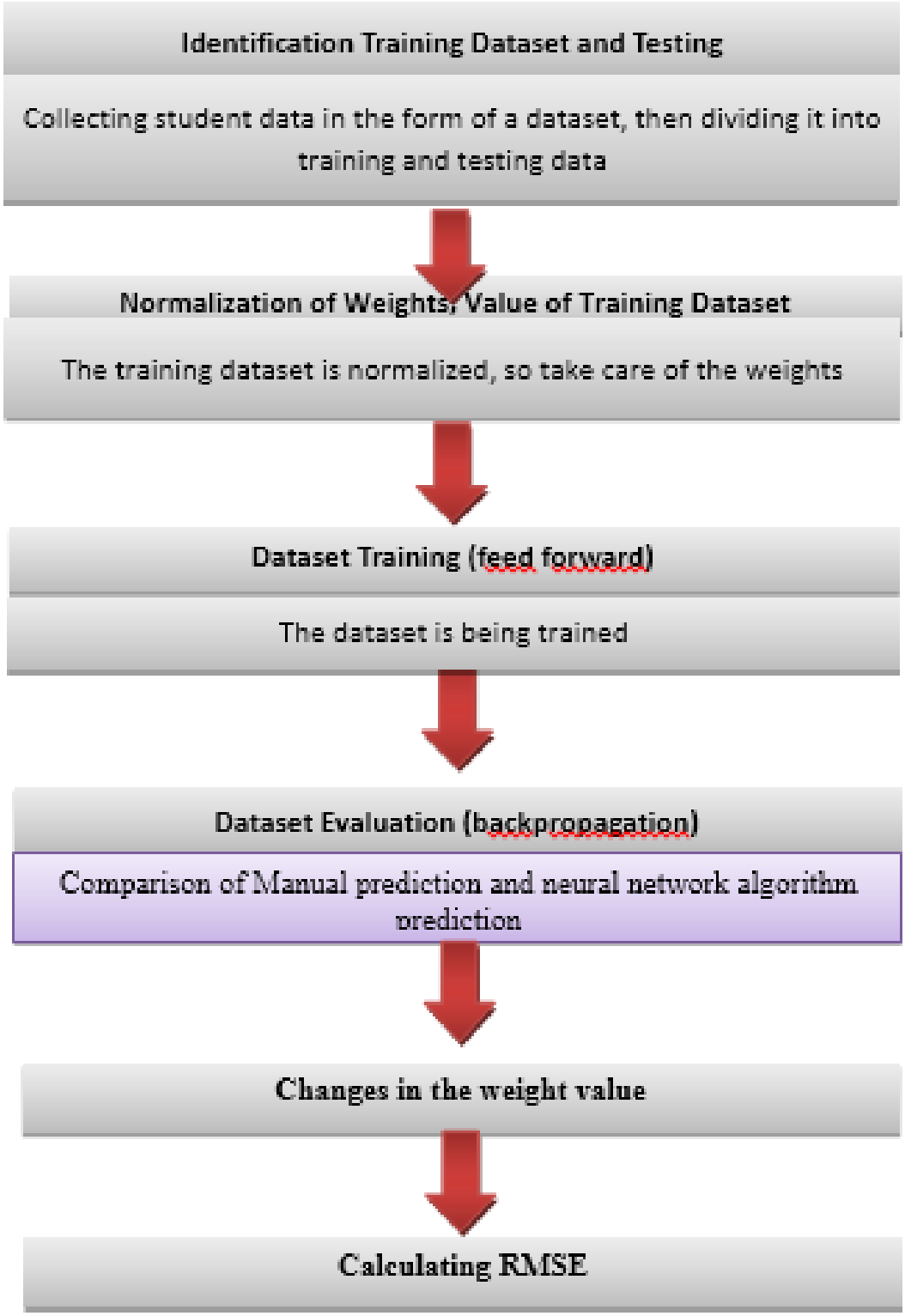



Figure 1. Research stages

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## 3. DISCUSSION

The compulsory courses that must be taken by students before choosing an area of expertise are as follows: Database Design, Programming Algorithms, Programming 1, Programming 2, Web Programming, Computer Graphics, Information Technology Concepts, Operating Systems, Computer Networks, Office Applications, Internet
The areas of expertise that students will choose are: Application Software (SA) , Computer Visual Effects (KVE) , Computer Network (CN) , Computer Teaching (CT)
Students can choose 4 areas of expertise according to their interests and abilities. From the area of expertise above, there is a correlation between the course of study and the field of expertise to be chosen, as shown in table 1 .

Table 1. Correlation of Course Relationships with Field of Expertise

| No. | Course Name | SA | CN | CT | KVE |
|---|---|---|---|---|---|
| 1 | Database Design | □ | - | - | - |
| 2 | Programming Algorithm | □ | - | - | - |
| 3 | Programming 1 | □ | - | - | - |
| 4 | Programming 2 | □ | - | - | - |
| 6 | Web Programming | □ | - | - | □ |
| 7 | Computer Graphics | - | - | □ | □ |
| 8 | Information Technology Concept | - | □ | □ | - |
| 9 | Operating system | - | □ | | - |
| 10 | Computer network | - | □ | □ | - |
| 11 | Office Apps | - | - | □ | - |
| 12 | Internet | - | - | □ | - |

Before the data is processed, the value is translated into a weighted numerical value to take the average value of each course that correlates the relationship between the course and the field of expertise and then the data is processed using a neural network.
This research will create an algorithm-based prediction model for the level of accuracy neural network, whether the application of the algorithm neural network to predict the level of accuracy in the selection of areas of expertise students can apply.

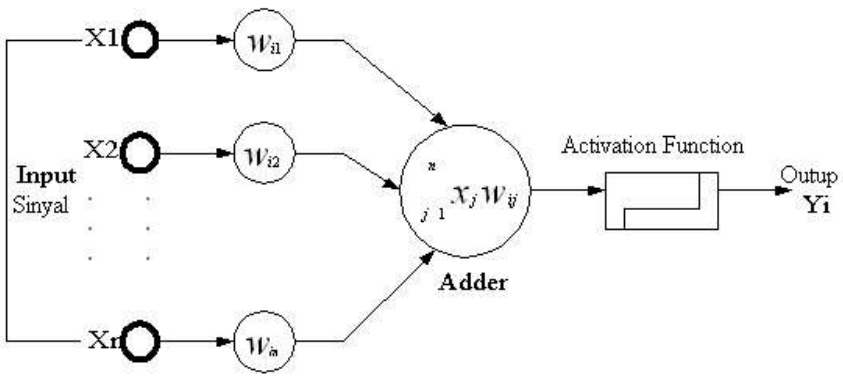



Figure 2. Neuron Structure

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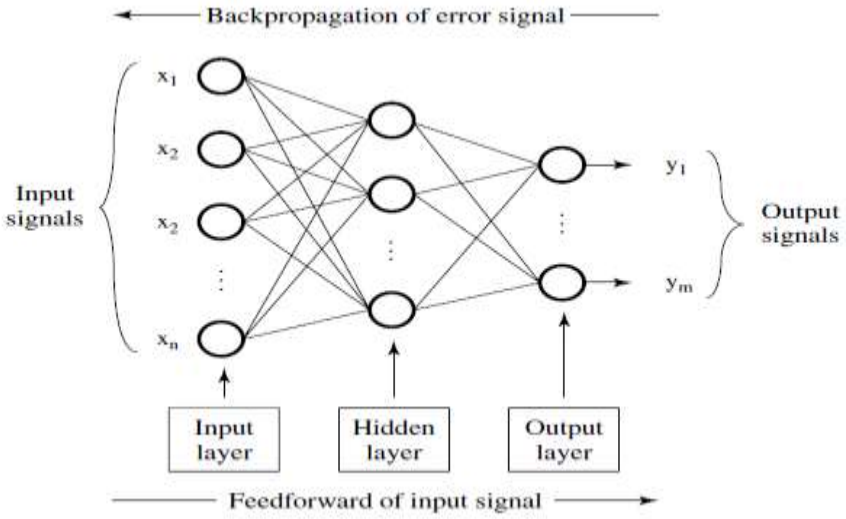



Figure 3. Multi – Layer

Structures and Propagation Signals in Networks
The identification of dataset attributes consists of course values that are correlated with areas of expertise, then the dataset will be divided into two, part of it becomes training data and the next is testing data.
According to Siang, JJ in 2005, the formula used for the process of converting the original testing data into data ranges to 0.1 and 0.9 because the activation function used is a singmoid function whose function value never reaches 0 or 1 (Siang, 2005) . The formula:

$$X' = \frac{0.8 * (X - a)}{b - a} + 0.1$$

Information :
X' = Data that has been normalized

X = Data that has not been normalized

a = smallest data

b = Biggest data

Dataset Training (Feed forward) _

**Step 0** : Initialize the weights.
In step 0, the initial weight value is initialized from the input layer to the hidden layer randomly, with the initial conditions from 0.1 to 0.9.
**Step 1** : If Conditions 2-9,
**Step 2** : For each training pair, do steps 3-8,

**Forward Propagation:**

**Step 3** : Each input unit $(x_i, i = 1, \ldots, n)$receives a signal $X_i$and

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transmit this signal to all units of the layer above it (hidden units),
**Step 4** : Each hidden unit ($x_i, i = 1, \dots, p$)sums the signal weights the input,

$$z_{in_j} = v_{oj} + \sum_{i=1}^{n} x_i v_{ij}$$

**Step 5** : Each unit of output ( $y_k$, k=1, …, m) sum the signal weights the input,

$$y_{in_k} = w_{ok} + \sum_{i=1}^{n} z_i w_{jk}$$

**Step 6** : Each output unit ( $y_k$, k=1,…, m) add up the signal weights input, following the change in weight on$w_{kj}$

$$\delta_k = (1 - y_k) y_k (t_k - y_k)$$

**Step 7** : calculate δthe hidden layer units based on the error in each hidden unit $Z_j$(j=1,2,3…p)

$$\delta_in_j = \sum_{k=1}^{m} \delta_k W_{kj}$$

**Step 8** : Calculating the weight change to the output layer
Changes in the weight value to the hidden layer have been obtained, then calculate the weight value to the output layer unit, the value can be seen below:

$$W_{kj}(\text{baru}) = W_{kj}(\text{lama}) + \Delta W_{kj}$$

**Step 9** : Calculating network performance validation
Validation is carried out as a process of testing network performance against samples that have not been given during the training process. Network performance can be assessed based on the RMSE (Root Mean Square Error) value in the generalization process to the new input-output data sample, the RMSE value can be denoted as:

$$\text{RMSE} = \frac{\sqrt{\sum_{i=1}^{n} (p - a)^2}}{n}$$

where:
p = predicted value generated by the network
a = target value assigned to the network
n = number of sample data in the validation data set

After passing through the dataset training phase, the next step is to test the dataset. After testing the dataset, the neural network algorithm will predict the accuracy of the comparison between the reality output value and the output value prediction.

Determination of the student's area of expertise using a neural network algorithm is expected to have an accuracy rate above 80%, this indicates that the level of accuracy is high and can be a predictive model of the field of expertise to assist students in determining the area of expertise to be taken according to their abilities.

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## 4. CONCLUSION

From the results of the research to determine the student's area of expertise using the backpropagation method of neural network algorithms, the following results were obtained: 84,8484% (hidden layer 2, neuron input layer = 13, learning rate = 0.1 and iterations = 500), 91,9191% (hidden layer 2, neuron input layer = 13, learning rate = 0.1 and iterations = 1000), and 95.9596% (hidden layer 3, neuron input layer = 13, learning rate = 0.1 and iterations = 2000).
The application of the backpropagation method of neural network algorithms for determining student areas of expertise can be applied because the predictions show an average value of above 80%.

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This paper has been presented in National Seminar on Technology, Business and Multidisciplinary Research in Yogyakarta, Indonesia, 23 – 24 August 2022. This work is supported by Institut Bakti Nusantara, Lampung, Indonesia. We gratefully appreciate this support.

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