

IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORK FOR CLUSTERING OF STUDENTS INTERESTING IN COMPUTING FIELDS

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ABSTRACT

The computing field interested is important for students of the Faculty of Computer Science. Student interest also relates to research for the thesis required for graduation. At the Faculty of Computer Science, University of Duta Bangsa Surakarta, there are several research topics that are of interest to students including: Information Systems, Decision Support Systems, Multimedia, Expert Systems and Intelligent Information Systems. Clustering is a method for grouping a number of data into several clusters or groups. Data that have closeness will be grouped into one cluster. Competitive Network is part of Artificial Neural Networks with unsupervised learning. This algorithm can be used for clustering. This study aims to produce a clustering system for mapping students interests on research topics at the Faculty of Computer Science, Duta Bangsa University Surakarta with a competitive network artificial neural network. The input data used were the results of the student's focus questionnaire on research topics which would be grouped into 5 clusters. The clustering process uses the Competitive Network algorithm with clustering parameters of the number of clusters 5, 1000 and Kohonen parameter of 0.01.

Key words: students, clustering, artificial neural network, competitive network

INTRODUCTION

Computing field interest is important for students of the Faculty of Computer Science, Universitas Duta Bangsa Surakarta. The interest in this field is related to career selection and student research (Marlinda & Lestari, 2020), (Hastuti et al, 2018), (Purnomo et al, 2017). At least students do research for the thesis required for graduation. The things that cause student difficulties in choosing a career or research, especially a thesis, are the students' abilities and interests. From preliminary observations of undergraduate students of the Information Systems department / study program class of 2018, initial data was obtained that 80% of students have not determined their field interests and have never been involved or conducted research. The Faculty of Computer Science, Universitas Duta Bangsa Surakarta directs and facilitates students to conduct research, especially in the fields / topics: Information Systems, Decision Support Systems, Expert Systems, Multimedia and Intelligent Information Systems.

The Competitive Network Algorithm is an algorithm on artificial neural networks that implements unsupervised learning (Kumar, 2005), (Lestari, 2015). This algorithm can be used to group data so that adjacent data will be in one cluster. Competitive Network is widely used for clustering in various fields. This clustering resulted in a mapping of students at the Faculty of Computer Science, Duta Bangsa University Surakarta, who have close interests in the field of computing. The benefits of clustering are: (1) Provide convenience for departments / study programs in directing, facilitating and guiding students in career selection, research and thesis, (2) Provides convenience in the formation of student research groups, (3) Produce student data mapping that can be used for various academic purposes.

THEORITICAL FRAMEWORK

Clustering

Clustering is a technique used to identify similar objects or individuals by paying attention to several criteria (Lestari, 2015), (K-IDue, 2010), (Nahdi & Raha, 2016). Clustering is a method for classifying similar elements as research objects into distinct and mutually exclusive clusters.

Another definition is an attempt to find a group of objects that represent the same or almost the same (similar) character between one object and another object in a group and have differences (not similar) with objects in other groups (Lestari, 2015), (Shovon & Haque, 2012), (Nahdi & Raha, 2016).

Clustering was widely applied to mapping students both academically and non-academically. Clustering is used to map student cognitive characteristics (Lestari, 2014), (Lestari, 2015), (Hastuti et al, 2018), (Purnomo et al, 2017), (Marlinda & Lestari, 2020), (Facca et al, 2011) . Clustering is used to map the characteristics of student graduation (Nahdi & Raha, 2016). Clustering is used to map student academic performance (Shovon & Haque, 2012), (Oyelade et al, 2010), (Anngarwal & Sharma, 2019). Clustering is used for the university's marketing strategy (Ong, 2013).

Competitive Network Algorithm

Competitive Network is an algorithm in Artificial Neural Networks that uses unsupervised learning which in the training process does not require supervision (target output) (Kumar, 2005), (Lestari, 2014).

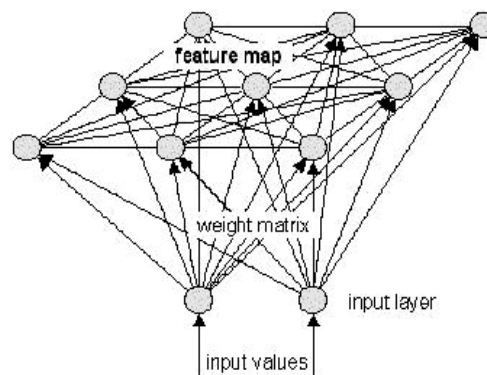


Figure 1. Competitive Network Architecture (Lestari, 2014)

Competitive Network Algorithm:

1. Initialize the input neurons $x_1, x_2, x_3, \dots, x_i$.
2. Initialize the output neurons by $y_1, y_2, y_3, \dots, y_j$.
3. Determine the weight between input and output neurons with a value between x_{min} and x_{max} .
4. Repeating steps 5 to 8 until no change in weights or iterations / epochs is maximal so that the output has converged.
5. Selection of one input from the existing input vector.
6. Calculation of the distance between data input and weight with each input neuron with the formula:

$$D_i = \sum_{i=1}^n (w_{ij} - x_i)^2 \dots\dots\dots (1)$$

Of all the weights (D_i), the smallest is sought. The index of the most similar weight (D_i) is called the winning neuron. For each w_{ij} weight, the connection weight is updated using the formula which can be seen in the equation:

$$w_{ij}(t+1) = w_{ij}(t) + \alpha(t)[x_i - w_{ij}(t)] \dots\dots\dots (2)$$

1. Updating bias weights:
2. Save convergent weights.

METHOD

This system consists of a data input process, a clustering process and a mapping process. As input data were the results of student questionnaires at the Faculty of Computer Science, Universitas Duta Bangsa Surakarta, batch 2018. The questionnaire contained student interest in

research topics: Information Systems, Decision Support Systems, Expert Systems , Multimedia and Intelligent Information System and courses supporting these topics. The clustering process served to classify input data into clusters. In this study, it was made into 5 clusters. The mapping process which functions to map input data to groups of specialization in the research field. The clustering system diagram can be described as follows:

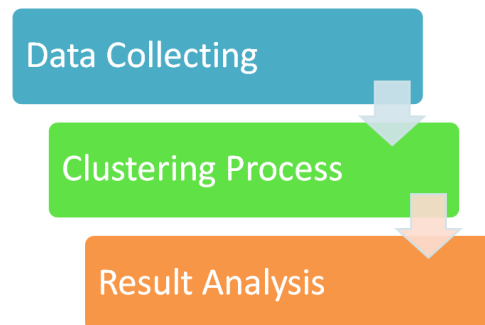


Figure 2. Research Methods Diagram.

This clustering application development used Matlab 7.0 software. For the development of the user interface used the Matlab GUI and coding in the M.file. The clustering process began with the load data process, then the data was used as input neurons which will be processed by clustering with the Competitive network algorithm. The clustering process used parameters such as the maximum number of clusters, the number of epochs (iterations) and the Kohonen parameter (learning rate).

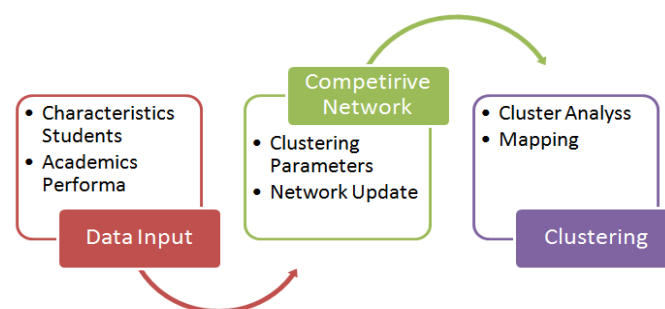


Figure 3. Clustering Process Diagram

DISCUSSION

The results of clustering for input data were selected on epochs which provide fixed and steady output results in accordance with the clustering process test. The results of clustering on epochs above 500 produced convergent distances so that the clustering results remain. This study used the following parameters: the number of clusters 5, epochs 1000 and Kohonen parameter 0.01. The results of the study were as follows:

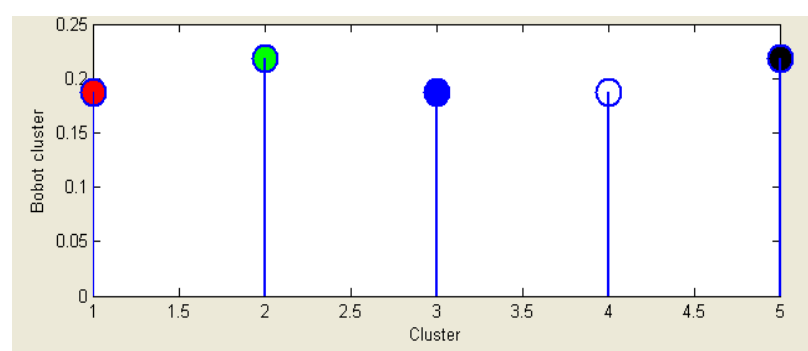


Figure 4. Cluster Distribution

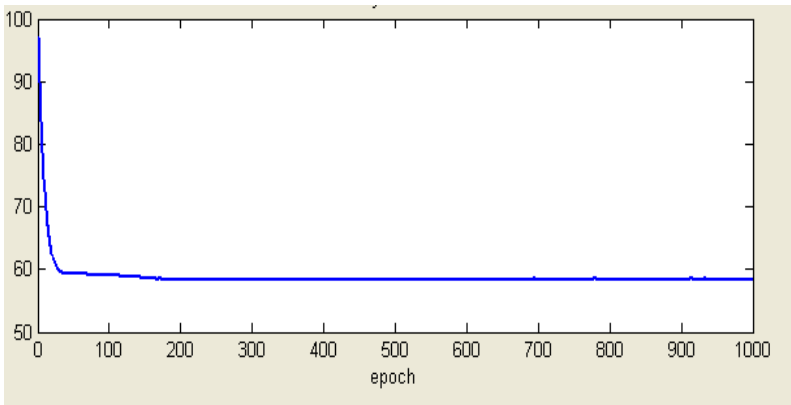


Figure 5. Convergence Epochs

From the clustering results above, it can be seen that for epochs 1000 the clustering output results are fixed. So that the resulting clusters have converged, regardless of whether the epochs are more than 500. The larger the epochs will only increase the time of the clustering process.

From the results of clustering, student mapping can be made based on their interest in research topics at the Faculty of Computer Science, University of Duta Bangsa Surakarta as follows:

Table 1. Students Mapping Result

Cluster	Members	Information of interest
1	M.09, M.11, M.12, M.18, M.19	Specialization on the topic of Information Systems, DSS, Expert Systems Intelligent Systems were lower, specialization in Multimedia was medium
2	M.05, M.06, M.15, M.20, M.21, M.29, M.31	High interest in information and multimedia systems, moderate interest in specialization in expert systems and Intelligent systems and lower SPK.
3	M.01, M.08, M.13, M.22, M.23, M.25	High interest in all topics
4	M.02, M.03, M.14, M.16, M.17, M.28	High interest in Multimedia, moderate in information system and low in DSS, expert system and Intelligent System
5	M.04, M.07, M.10, M.24, M.26, M.27, M.32	High specialization in expert systems, moderate specialization in DSS, Multimedia and Intelligent Systems and low interest in Information Systems.

CONCLUSION

The results of research conducted from the initial stage to testing, the application of the clustering system with the Competitive Network Artificial Neural Network, the following conclusions were obtained:

1. The clustering system with the Competitive Network Kohonen artificial neural network can be used to map students based on their interest in student research topics at the Faculty of Computer Science, Duta Bangsa University Surakarta.
2. The mapping students in 5 clusters was carried out with epoch 1000 and Kohonen Parameters 0.01.

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