



Bipolar Approach in Recognition of Gorga Batak Patterns with the Hebbian Method

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ABSTRACT

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The recognition of shapes or patterns in Intelligent Artificial is a method that is developing very rapidly and is continuously being developed to this day. The need for information contained in a pattern or form is very useful to be developed and applied properly to the health or culture sector, by using a system that is embedded with a capability or feature in pattern recognition. This model can be applied both to face pattern recognition, patterns. Likewise in this discussion about the pattern recognition of the Gorga Batak using artificial neural networks, namely the Hebbian method. With two patterns as knowledge or learning base and then tested. The input pattern will be checked for the similarity of the two learning base patterns, whether it is recognized as the Gorga "Simeol - eol" pattern or as the Gorga "Sitompi" pattern. By using 25 input variables and bias 1 with an initial weight value of 0, the Gorga "Someol-eol" and "Sitompi" patterns were initialized to a grayscale image and then extracted to a bipolar image with values of 1 and -1. The Gorga "Simeol - eol" pattern has a target of 1 and the Gorga "Sitompi" pattern has a target of -1, the function $f(\text{net})$ is 1 if $Y \geq 0$ and -1 if $Y < 0$. From the process carried out, it is found that the Gorga "Simeol - eol" pattern is obtained the value of $Y = 12$ and for the Gorga "Sitompi" pattern $Y = -12$, and inputted to the function $f(\text{net})$, the result is the same as the target 1 for the Gorga "Simeol - eol" pattern and -1 for the Gorga "Sitompi" pattern.

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1. Introduction

As research on digital image processing continues to grow [1][2]. Likewise, the quality of sharpness and refinement of images increases for better image or pattern recognition processes [3]. "Gorga" is an important thing to be preserved. Because this is very supportive of the characteristics of one of the tribal Batak cultures [4][5].

Almost every Batak traditional house called "Sopo" has "Gorga" carvings as decoration, which gives aesthetic and magical impression when looking at it [6]. "Gorga" carvings are characterized by their curves and basic shapes and colors. For the Batak people themselves, these carvings have their own symbolic meaning depending on the type and placement because not every type of "Gorga" carving can be placed in every house carelessly. The choice of ornament type has been determined based on the customary position of the house owner among the local community [7]. Apart from the classification of customary positions, Gorga" also indicates the level of economic stability of a person.

The reason for the need to preserve the "Gorga" Batak is due to many factors including, the increasingly eroded Batak culture with the arrival of the new culture so that many young people leave and migrate to a new culture to feel contemporary youth [8]. Plus the lack of knowledge to recognize the "Gorga" Batak because the teachings of the previous elders were not passed down by the youth, so that many "Gorga" were lost and difficult to find again.



The author's reason for adopting the Hebbian method in this research is because in this method learns about patterns so it is very appropriate to be used in research of "Gorga" Batak pattern recognition[9]. By implementing Artificial Neural Networks on computers. Artificial Neural Networks are a branch of the field of artificial intelligence[10]. Modeling with Artificial Neural Networks is the learning and adjustment of an object. One model of Neural Network network is Hebbian[11]. The hebbian network model is a learning method with supervision in a neural network system. Hebbian can be used to identify the "Gorga Someol – col" and "Gorga Sitompi" patterns[12].

2. Method

2.1. Artificial Neural Network

The field of Artificial Neural Networks[1] is one of the artificial representations of the ability of the human brain which always simulates the learning process in the human brain[13]. artificial here is used because this neural network is implemented using a computer program that is able to complete a number of calculation processes during the learning process[14].

The term artificial neural networks or called neural networks[15] is addressed to a collection of various mathematical approaches and algorithms that use the concept of computation in parallel as occurs in the brain[16], unlike a microprocessor consisting of millions of transistors. The human brain is made up of several networks of more than 110,000,000,000 brain cells or neurons. Each neuron corresponds to about 100,000 other neurons[17]. Neurons are the backbone of the brain's work. These brain cells have five important components, namely: synapses[18], dendrites, soma (cell bodies)[19], axons, and electro-chemical pulses as message delivery signals. Electrochemical pulses from related neurons enter through the dendrites through the synapses to the soma[16].

2.2. Hebbian Network

The Hebbian rule is the earliest and simplest training rule for Artificial Neural Networks in general. In this Hebb rule, the training that occurs is by modifying the synapses strength (weight). If both nerves are "active" (both negative or positive) at the same time, the neuron weight will increase or increase. Conversely, if both nerves are "active" (one is negative or positive), the weight of the neuron will decrease or weaken[20].

To solve the problem, in each repetition cycle, the weight and bias are changed based on the multiplication of all input x_i directly connected to the output unit y , then the change in the weight value is carried out based on the equation[20].

$$w_i(new) = w_i(old) + x_i y \dots \dots \dots (1)$$

And here is the Habbian network architecture

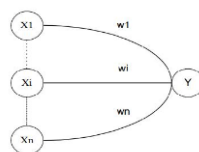


Figure 1. Habbian network architecture

The Habbian training algorithm with input s and unit target t is as follows:

1. Initialize all weights = $w_i = 0$, ($i = 1, 2, 3, \dots, n$)
2. For all input vector s and target unit t , do:
 - a. Set activation for $x_i = s_i$ ($i = 1, 2, 3, \dots, n$)
 - b. Set activation unit output $y = t$
 - c. Fix the weights by satisfying the equation

$$w_i(new) = w_i(old) + \Delta w \quad (i = 1, 2, 3, \dots, n) \dots \dots \dots (2)$$

$$\Delta w = x_i y \dots \dots \dots (3)$$

- d. Correct the bias according to the equation $b(new) = b(old) = t$

Note that bias fixes are treated the same as weights.



Some problems that must be taken seriously or things that must be considered in using this Hebbian algorithm. Among them are determining the input value or representation of the input value as well as the output value for the activation function in the form of threshold. Representations that can be processed in determining patterns are those in bipolar form (value -1 or 1) in either input or output form, while values in binary form (value 0 or 1) are unable to solve problems in recognizing patterns, both in values. input or output.

2.3. Activation Function

The activity function is a bipolar sigmoid that has a range of values [-1,1] and is defined as:

$$f(x) = \frac{2}{1 + \exp(\sigma x)} - 1$$

With

$$f'(x) = \frac{\sigma}{2} [1 + f(x)][1 - f(x)]$$

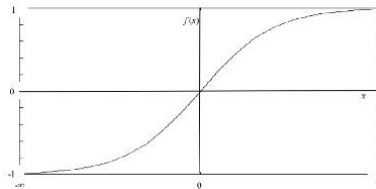


Figure 2 Bipolar sigmoid activation function

3. Result and Discussion

Patterns which are assumed to be Figure 3 (Gorga Simeol - eol) and Figure 4 (Gorga Sitompi). This image is the original image or RGB image shown in Figure 3 and Figure 4 below:

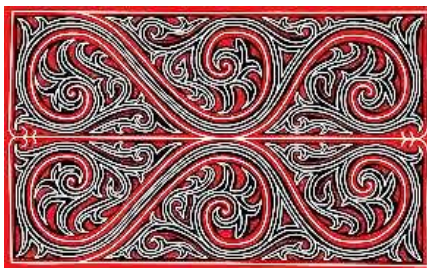


Figure 3. Gorga Simeol – eol



Figure 4. Gorga Sitompi

After obtaining the original image, Figure 3 and Figure 4 are processed into a grayscale image shown in Figure 5 grayscale “gorga Simeol-Eol” and Figure 6 Grayscale “gorga Sitompi”.

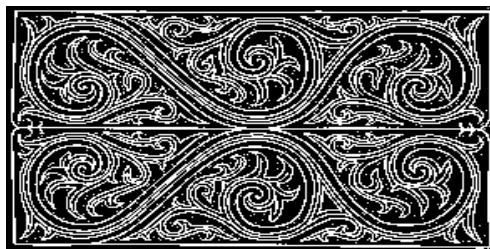


Figure 5 Grayscale Gorga Simeol – eol

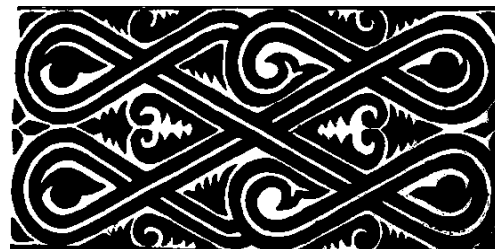


Figure 6. Grayscale Gorga Sitompi

After obtaining a grayscale image like Figure 5 and Figure 6 above, then extracted to a bipolar image (-1 1), where Habbian uses the value received as input or output is bipolar (-1 1). By using the input as much as 25 points from each. The pattern of the “Gorga” can be seen in Figure 7 Bipolar “Gorga Simeol-Eol” and Figure 8 Bipola “Gorga Sitompi” below.

1	-1	1	-1	1
1	1	-1	1	1
-1	-1	1	-1	-1
1	1	-1	1	1
1	-1	1	-1	1

figure 7. Bipolar Gorga Simeol – eol

1	-1	1	-1	1
-1	1	-1	1	-1
1	-1	1	-1	1
-1	1	-1	1	-1
1	-1	1	-1	1

Gambar 8. Bipolar Gorga Sitompi.

Image of “Gorga Simeol – eol” pattern and “Gorga Sitompi” pattern image after extraction to bipolar is shown in the picture above, namely in Figure 7 and Figure 8

a. Making weight patterns of artificial neural networks

The first stage is calculating the weight renewal of the “Gorga Simeol – Eol” pattern and the “Gorga Simeol – Eol” pattern so as to form a network pattern. Represent in the form of input variables x1, x2 ... x25.

Pola	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13
Simeol – eol	1	-1	1	-1	1	1	1	-1	1	1	-1	-1	1
Sitompi	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1

X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	t
-1	-1	1	1	-1	1	1	1	-1	1	-1	1	1
-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1

While the change in weight (Δw_i) and bias after input patterns 1 and 2 are given

Pola	Δw_1	Δw_2	Δw_3	Δw_4	Δw_5	Δw_6	Δw_7	Δw_8	Δw_9	Δw_{10}	Δw_{11}	Δw_{12}	Δw_{13}
Simeol – eol	1	-1	1	-1	1	1	1	-1	1	1	-1	-1	1
Sitompi	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1

Δw_{14}	Δw_{15}	Δw_{16}	Δw_{17}	Δw_{18}	Δw_{19}	Δw_{20}	Δw_{21}	Δw_{22}	Δw_{23}	Δw_{24}	Δw_{25}	Δb
-1	-1	1	1	-1	1	1	1	-1	1	-1	1	1
1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	-1

Furthermore, the network weight calculation is carried out, the weight of each variable x on the “Gorga Simeol – eol” pattern + the weight of the “Gorga Sitompi” pattern so that the results are:

Pola

$$\text{Net} = \{1(0)+(-1)(0)+(1)(0)+(-1)(0)+(1)(0)\} + \{(1)(2)+1(0)+(-1)(0)+1(0)+(1)(2)\} + \{(-1)(-2)+(-1)(0)+1(0)+(-1)(0)+(-1)(-2)\} + \{(1)(2)+(1)(0)+(-1)(0)+1(0)+(1)(2)\} + \{1(0)+(-1)(0)+(1)(0)+(-1)(0)+1(0)\} = 12 \text{ then } f(\text{net}) = 1$$

$$\text{Net} = \{1(0)+(-1)(0)+(1)(0)+(-1)(0)+(1)(0)\} + \{(-1)(2)+1(0)+(-1)(0)+1(0)+(-1)(2)\} + \{(1)(-2)+(-1)(0)+1(0)+(-1)(0)+(1)(-2)\} + \{(-1)(2)+(1)(0)+(-1)(0)+1(0)+(-1)(2)\} + \{1(0)+(-1)(0)+(1)(0)+(-1)(0)+1(0)\} = -12 \text{ then } f(\text{net}) = -1$$



The results of the calculation with the value of $Y = 12$, then using the bipolar sigmoid activation function, then $f(\text{net}) = 1$. The pattern of the “Gorga Semeol-eol” is in accordance with the target value, meaning that the pattern is recognized by the network. Then with the same process for the “Gorga Sitompi” pattern the Y result is -12 so that $f(\text{net}) = -1$ according to the “Gorga Sitompi” target is -1 then it is recognized by the network.

4. Conclusion

With this research, the input data or input is in the form of binary and binary output and then input values are entered in the form of binary and bipolar output. Habb is able to recognize a given pattern using a bipolar input and a bipolar output, using an input like this. Habb can work with the existing rules on Habb. By using this Habb rule to recognize patterns, excellent results are obtained where this Habb can recognize patterns of Batak characters including “Gorga Semeol-eol”, “Gorga Sitompi”, “Gorga Sitompi” using bipolar input and bipolar output.

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