Perceptron Genetic to Recognize Opening Strategy Ruy Lopez

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Abstract. The application of Perceptron method is not effective for coding on hardware based systems because it is not real time learning. With Genetic algorithm approach in calculating and searching the best weight (fitness value) system will do learning only one iteration. And the results of this analysis were tested in the case of the introduction of the opening pattern of chess Ruy Lopez. The Analysis with Perceptron Model with Algorithm Approach Genetics from group Artificial Neural Network for open Ruy Lopez. The data is processed with base open chess, with step eight a position white Pion from end open chess. Using perceptron method have many input and one output process many weight and refraction until output equal goal. Data trained and test with software Matlab and system can recognize the chess opening Ruy Lopez or Not open Ruy Lopez with Real time.

Keywords: Perceptron, Genetic Algorithm, Ruy Lopez

1. Introduction

1.1. Problem Background

The use of perceptron methods on this system is not effective, the learning process is longer and not real time into a smart system. One with the Neurall Network approach and the Genetic Algorithm approach can to prediction a case and more quickly learning or more real time. And in the training, genetic algorithm (GA) can be used to determine the initial weight of Multi Layer Perceptron. ([1] Ming Zhu and Lipo Wang.2010) Genetic algorithms can be used to optimize the weight, topology or neural network parameters ([4] Stephen Ashmore and Michael Gashler.2015). The proposed exponential multilayer perceptron is proportional to a linear network of similar size. ([2] Exponential-Weight Multilayer Perceptron.2017).Especially for predicting and oxygen needs in ponds as material testing. The approach taken to make the waterwheel by the method of Neural Network. (Lie Jasa.2016 Method).

And the results of this analysis were tested in the case of the introduction of the opening pattern of chess Ruy Lopez. Because the knowledge and practice should be supported chessplayer base which is a collection of chess programs. Based on this, it is necessary to research a system that can recognize patterns based on the positions of chess opening end of a pawn using Perceptron with algorithm genetic. The algorithm use iterate over and over again to find out the possibility of the existing pattern so that the system can recognize patterns chess opening characterized by equal all network output with the
desired output targets. Which is expected to improve the performance of existing chess programs and increase knowledge of the chess players preparing for it in every game. And so writer is interested to lift want to examine with the title "Analysis with Perceptron Model with Algorithm Approach Genetic for Open Ruy Lopez.”.

2. Information Technology

2.1. Technology Computer

The method discovered by Rosenblatt (1962 and Minsky-Papert (1969) is part of an Artificial Neural Network (ANN), which has characteristics similar to the neural network biology. This network as a generalization of mathematical models of neural network biology, assuming that, information occurs in neurons and transmitted between neurons. Neuron has a weight that will amplify signal, and to determine the input, each neuron is using activation functions to imposed on the amount of input received. the magnitude of this output is then compared with a boundary threshold. And this perceptron algorithm in the method are:

- Initialize all weights and bias.
- Set Learning rate.
- Set threshold value.
- Set activation input.
- Compute response to the output unit.
- Put it in the activation function.
- Compare the value of the network output Y with goal. If not the same then changed weight and bias. Do iteration changes constantly and if you already have an output equal to the goal and iteration is stopped. (T.Sutojo, S.Si., M.Kom.2011).

And the term Genetic Algorithm was first proposed by John Holland in 1975 in his book Adaptation in Natural and Artificial Systems. One application is the path planning on mobile robot so that move efficiently to the destination. Therefore, evolution programming techniques, based on genetic algorithm, apply to many optimization problems, such as functional optics with linear and non-linear constraints, traveling salesman problems and scheduling, partitioning and control issues.

Genetic Algorithm is an adaptive method, starting with a set (represented by chromosomes) called population. Solutions from one population are taken and used to form a new population. This is driven by expectations, that the new population will be better than the old. The solution chosen to form a new solution (heredity) is in accordance with fitness. If it fits, then their chance to reproduce will be more. In theory, Gnome has several genes, and a collection of more than 1 gname becomes a population. Genetic Algorithm is a heuristic method developed based on genetic principles and the process of scientific selection of the theory of Darwinian Evolution Genetic Algorithm is a search method based on the process of natural evolution (Wolfgang Ertel.2011), namely the formation of a random population consisting of individuals with properties that depend on the genes -gen in the chromosome. The computation process that occurs in this algorithm is analogous to a process that may be known as a population. The initial population in the Genetic Algorithm was randomly generated by Genetic Algorithm operators for generations. In each generation, the chromosomes will undergo an evolutionary process using a measuring instrument that uses the so-called fitness function. The chromosomes formed from previous generations of chromosomes are called offspring. As well as parents. Crossovers. In GA, known operators can alter genes in chromosomes, this operator is called a mutation operator (mutation). The Basic Structure of the Genetic Algorithm consists of several steps: a) Initialization of population

- Population evaluation
- Population selection to be known genetic operator
- The process of crossing certain chromosome pairs.
- The process of mutation of a particular chromosome.
• Evaluation of the new population.
• Repeat from step 3 if the stop condition has not been met.

Coding is useful to decode gen so the value does not exceed for predetermined range and also becomes the value of the variable to be searched for as a solution to the problem. If the value of the encoded $x$ variable is changed into $rb$, $ra$, $ierb$ = lower boundary, $ra$ = upper boundary, then the way to override the values of the above variables until they are in the new range $[rb, ra]$ is called Decoding [Encoding].

Real Number Encoding:  
$x = rb + (ra - rb)g.$

Discrete Encoding Decimal:  
$x = rb + (ra - rb)(g \times 10^{1} + 10^{-2} + \ldots + 10^{-N})$

Binary Encoding:
$x = rb + (ra - rb)(g \times 2^{-1} + g \times 2^{-2} + \ldots + g \times 2^{-N})$

And the opening, an early stage of the game of chess. In the opening round, chess players must try as soon as possible to master the central plot and develop chess pieces so ready to attack, set up defenses and has a good vision for the game. Type of opening so are manifold, among which:

• The Game of open, such as Spanish Defence, Defence 4 Horse Defense of Russia, Games Philidor. This game is very sharp, and players must be vigilant step by step to make no mistakes.
• Games of Closed such as Opening Gambit Minister, Slavic Defense, Tarrasch Defense. Games that happens very quiet, setting the attack and pertahanan gradually.
• Games of Half-Open as Defense caro Khan, Alekhin, defense Sicilia, playing was calm, but can turn out to be sharp and quick.
• The game Half Closed namely Nimzo Indian Defence, the Indian Gaming king, Benoni Defense, Defense of the Netherlands, Ruy Lopez.
• The game Wings as the Indian Game turning upside down, Retri system, opening Inggris..Dan opening can be expected normally in the step-8 $s / d$ 15, and after it was entered in the middle innings. (BeyMagethi, 2007: 7-9).

By understanding the basic theories and perceptron with algorithm genetic methods then chess opening as a base to approach in this study. Furthermore, the theory will be applied using a variety of referral sources that have been modified to be studied. So identify the problem to determined the pattern based of Ruy Lopez opening on the position of white pawn at the end of the opening (step 15) by the method of Perceptron.

2.2. Formulation of Problem

• How is Perceptron method with Genetic Algorithm approach to find the best fitness value at best weight and bias fast compared to usual Perceptron method?
• The results of this analysis were tested in the case of the introduction of the opening pattern of chess Ruy Lopez with Perceptron Model with Algorithm Approach Genetics?

2.3. Purpose Theoretical

• As an essential and expanding contribution to the study of computer science in Perceptron methods that can be used as a reference for development different instances in the future.
• Provide an important contribution and expand the study of computer science that involves the chessing.
• Adding a new concept that can be used as reference material for further research for the development of computer science.
2.4. Practical Uses

- The results can be used as their contributions to the development of computer science to enhance software related to chess opening.
- The results of this study can be used as a benchmark the performance of the computer to determine the pattern of chess opening by the end position of the chess pieces.
- The results of the research can promote the development of chess, especially in Indonesia and improve the quality of chess players.

3. Results And Discussion

The variables in this study consisted of independent variables and one dependent variable. The independent variables are the input pattern \((x_1, x_2)\) and the dependent variable is the output \((Y)\).

3.1. The research design

The research design is a design experiment with using the input vector \(8 \times 8 = 63\) components, according to the regional chessboard 8x8, 8 columns and 8 rows. The figures fill the pattern, namely: the number 1 marked, white pawn chess pawn position and the number 0 in the pattern that marked positions other than the pawns / white pawns or empty areas.

3.2. Research Model

The model used in this study are the Perceptron with algorithm genetic. This method has a network architecture that consists of several units and a bias input that has an output unit. And the activation function is a binary function or bipolar, with a possible value of -1.0 or 1. For a price determined threshold \(\theta\): \(ff(\text{net}) = 1\) if \(\text{net} > \theta\), \(ff(\text{net}) = 0\) if \(-\theta < \text{net} < \theta\), \(ff(\text{net}) = 1\) if \(\text{net} < -\theta\).

4. Material And Methods

4.1. Data Analysis Technique

The algorithm make perceptron training for introduction of several patterns at once is as follows;

- Indicate each input pattern as a vector whose elements are 1, -1 and 0
- Give the target value \(t_j = 1\) if the pattern resembles the desired opening. Otherwise, provide a target value, \(t_j = -1\) \((j = 1,2,2, ..., m)\),
- Give initiation weights, bias, rate of comprehension and threshold.
- Make perceptron training process for each unit of output, namely: to calculate the output response of the \(j\)-th; \(\text{net}_j = \sum x_i.w_i + b_j\), \(f(\text{net}) = 1\) if \(\text{net} > \theta\), \(f(\text{net}) = 0\) if \(-\theta < \text{net} < \theta\), and \(f(\text{net}) = -1\) if \(\text{net} < -\theta\). And fix weighting pattern contains an error output that is not the same as the (target), the equation; new \(W_{ji} = w_{ji}(\text{old}) + \alpha t_j.x_i, B_j = b_j(\text{old}) + \alpha t_j\) and Perform steps continuously until \(t_j = y_j\); \(j = 1, .. m. (T.Sutojo,S.Si.,M.Kom (2011))\).

4.2. Chessing

Conditions of chessing

The game was held on a board consisting of 8 rows and 8 rows box or plot black and white with alternately. The game starts with 16 pieces on each side, which are arranged specifically lined up on each side of the chess board face to face. One piece can occupy only one plot. At the forefront of each row - there are 8 pawns, followed behind the two forts, two horses, two elephants, one minister and one king.

Before the match, player chose chess pieces that will used. Holders white berries begin the first step, which is followed by black holder interchangeably. The game objective is to achieve a checkmate
position. This may happen when the king is threatened and could not escape to another plot. Game not always ended in defeat, because it could happen anyway or mussels series of events in which both sides are no longer able to continue the match because it cannot achieve checkmate. In the chess game winning party usually get a value of 1, the loser 0, while the draw is 0.5.

4.3. Mechanical Chess Games

To be able to master how to play chess well, full of variety and the dynamics there are steps that need to be considered and lived by chess players. Chess players both novice level, as well as an advanced degree or an expert. Technique playing, is divided into three acts namely: the initial round (opening), round them idle, final round.

- Preliminary Round (Preamble).
- Early rounds is the initial stage of the game of chess.
- Round Mid
- It is estimated that after the chess players stepped between 8 to 15 steps, it can be said that the game went in the middle rounds.
- End Game The final Game can be started at step 20, could step into the 50th but also less than 10. In this round required precision and accuracy in determining step, so as not to make a blunder to be fatal. (Bey Mageth, How Understanding Chess Games Games Opening Ceremony: 1:11).

4.4. Computer chess opening with Fritz 6

Fritz is a computer chess program that always uses the theory of the opening. Hence, if you play without opening theory, then the next step will experience a lot of emphasis. Fritz 6 been aware opening move as much as 10 billion. Therefore, if making strides opening new ones, then Fritz 6 will say: "I have ten million moves and this guy comes up with something new!" (I already know 10 billion steps and this guy comes up with something the new "). It shows us, bring Fritz 6 already know all the steps of opening and determine if we get out of theory.

4.5. Definition of Neural Network

Before discussing the method Perceptron Artificial, it helps us to study on Artificial Neural Networks is part of the artificial intelligence. Neural Network is an information processing system that has characteristics similar to biological neural networks. Artificial Neural Networks as a generalization of mathematical models of biological neural networks with assuming that, process happened many neurons. Signal information transmitted between neurons Between neurons have weights that will strengthen signal. And to specify the input, each neuron using activation functions to imposed on the amount of input received. The magnitude of this output is then compared with a threshold. (Pitowarno. 2004).

4.6. Perceptron

Perceptron network model was found by frank Ronbalatt late 1950s . He was a psychologist . This technique is a simple modeling of the retina of the human eye. Perceptron single layer are can be regarded as one of the artificial neural network techniques are simple . This technique only have an input layer and an output unit . Training algorithm is used to train the network with a case or patterns until the network managed to recognize the pattern. Each output generated by the network was not consistent with the targets then the weight is changed It is continuously performed until no more changed to weight. The last weight acquired during the training artificial neural network that will be used (Pitowarno. 2004).
4.7. Algorithm Genetic

Coding is useful to decode gen so the value does not exceed for predetermined range and also becomes the value of the variable to be searched for as a solution to the problem. If the value of the encoded $x$ variable is changed into $rb$, $ra$, $ierb =$ lower boundary, $ra =$ upper boundary, then the way to override the values of the above variables until they are in the new range $[rb, ra]$ is called Decoding [Encoding]. Real Number Encoding:

\[ x=rb+(ra-rb)g. \]

Discrete Encoding Decimal: \( x=rb+(ra-rb)(gx10^{+10^{-2}}+\ldots+10^{-N}) \)

Binary Encoding:

\[ x=rb+(ra-rb)(gx2^{-1}+gx2^{-2}+\ldots+gx2^{-N}) \]

The application of Perceptron method is not effective for coding on hardware based systems because it is not realtime learning. With Genetic algorithm approach in calculating and searching the best weight (fitness value) system will do learning only 1 iteration only. And it is realtime.

4.8. Results And Discussion

![Figure 1. The Open Ruy Lopez (Morphy Defence)](image1)

![Figure 2. The Open Ruy Lopez (Berlin Defence)](image2)
Figure 3. Input matrix 8x8 The Open Ruy Lopez (Berlin Defence)

Figure 4. User interface

Figure 5. Training with bias and weight

Figure 6. Graphics Software training results by using Matlab.
5. Conclusion

- The system was created by Method Perceptron with Genetic algorithm approach to recognize pattern RuyLopez opening and not the Ruy Lopez. And so it is real time.
- Data trained and test with software Mathlab and system can recognize the chess opening Ruy Lopez or Not open Ruy Lopez with Real time.

References

[1] Strukov Farnood Merrikh Bayat, Xinjie Guo dan Dmitri Perceptron Multilayer Exponential,(ECE Department.Universitas California Santa Barbara CA 93106-9560, AS E-mail: farnoodmb@ece.ucsb.edu).

[2] Andrii Shalaginov.Evolutionary Optimization of On-line Multilayer Perceptron for Similarity-Based Access Control.Norwegian Information Security Laboratory Center for Cyber- and Information Security Norwegian University of Science and Technology andrii.shalaginov@ccis.no).

[3] Stephen Ashmore dan Michael Gashler.2015. Perceptron Multi-Layer dengan Alignment Bipartite Terusan.Arkansas: Departemen Ilmu Komputer dan Teknik Komputer.Universitas Arkansas.Fayetteville, Arkansas

[4] Mehran Amiri a, Abdollah Ardehish b,c, Mohammad Hossein Fazel Zarandi (2016).Fuzzy probabilistic expert system for occupational hazard assessmenti construction.

[5] Iran:Journalhomepa (Svetlana Filicheva, Alexey Zaikin, Oleg Kanakov.2016. Dynamical Decision making in a Genetic Perceptron.Physica D: Nonlinear Phenomena).

[6] Yi-chung Hu.2008. Nonadditive grey single-layer perceptron with Choquet integral for pattern classification problems using Genetic algorithms. Neurocomputing, Volume 72, Issues 1–3, December 2008, Pages 331-340).

[7] J.J.DGroote,D.M.L.Barbato.2008. Generalization of finite size Boolean perceptrons with genetic algorithms. Neurocomputing, Volume 71, Issues 16–18, October 2008, Pages 3650-3655.

[8] T.Sutojo,E.Mulyato,V.Suhartono.2010.Kecerdasan Buatan.Yogyakarta: Andi.

[9] Rajasekaran, Sdan G.A. Vijayalakshmi Pai. 2003, Neural Network, Fuzzy.

[10] Majethi,Bey.(2007). Bagaimana Memahami Catur Permainan Pembukaan. Bandung: Pionir Jaya Publishing.

[11] Didik Wahyudi/Imam Sucadyo.1996. Pertahanan Spanyol Variant Marshal dan Hindia Menteri. Jakarta: Titik Terang. Publishing.

[12] Mico Pardosi.2000. Teori Pembukaan Catur. Surabaya: Indah Publishing.

[13] Guanida Abdia Away.2010. The Shortcut of Matlab Programming. Bandung; Informatika Bandung Publishing.