Complexity Calculation for Student Activity Evaluation Using Feed Forward Back Propagation Algorithm

by Nurul Hidayat

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Nurul Hidayat, Retantyo Wardoyo

Abstract— **Complexity is a part of computer science that deals with the use of algorithms in a particular application, such as group decision making in this paper. The complexity of the algorithm is divided into two, namely the complexity of time and space complexity. The time complexity is measured by the number of computational steps required to run the algorithm as a function of some data n (input size). The method used is artificial-backpropagation neural network. Backpropagation method. The approach method used is structured and the method of development using waterfall model.**

Index Terms— Complexity, Back Propagation, PJJ.

I. INTRODUCTION

The algorithm is an effective method expressed as a finite range of well-defined instructions for computing a function. Starting from a start and initial input (possibly empty) conditions, these instructions describe a computation that, when executed, is processed through a finite set of well-defined set of conditions, which in turn produces "output" and stops in the final state. The transition from one condition to the next does not have to be deterministic; Some algorithms, known as randomization algorithms, use random input [1].

Algorithms can be described with many notations, including natural language, pseudokode, flowchart, drachon chart, programming language or control table (processed by translator). The expression of natural language against more inclined and ambiguous algorithms, and rarely used for complex and technical algorithms [2]. Pseudokodes, flowcharts, drachons, and control tables are structured ways of describing algorithms that prevent many confusions on natural language statements. The programming language is intended to express the algorithm in a form that can be executed by the computer, but is often used as a way to define or document algorithms.

There are many different kinds of representational possibilities and one can express a Turing machine program as a sequence of machine tables (see further on condition-limited machines, Tables transition conditions and control tables), a flowcharts and drachon charts (see further in the condition diagram), or as a form of machine code or basic assembly code known as "fourfold collection" (see further on Turing machine) [3] .

The algorithm can be classified by the amount of time required to complete compared to its input size [4,5,6]. There are different varieties: some algorithms are completed in linear time relative to the input size, some are completed in an exponential amount of time or more labor, and some stop. In addition, some problems can have different algorithms with different complexities, while other problems may not have algorithms or unknown algorithms that are efficient. There are also mappings from several algorithms to other problems. Therefore, it is more suitable to classify the problem itself rather than the algorithm into the same classes based on the complexity of the best possible algorithm for it [7,8,9].

Using generalized algorithm definitions that loosen the shared need that the output of an algorithm running a function must be determined after a number of steps [10,11]. He defines the super-recursive class of algorithms as "an algorithm class which allows to calculate functions that can not be calculated by any Turing machine". This is closely related to the study of the hyperkomputation method.

Along with the rapid growth of World Wide Web technology, web-based education system has been used as an important media to support the activities of learners and lecturers at an educational institution, one of which is to open the communication channel as wide as possible the collaborative system between students and lecturers on one eye Lectures as one of its entities. Basically, in the application of e-Learning systems learners can take web-based classes to improve their knowledge at any time and at any time and from the faculty or instructor side can easily create their online classes and monitor student performance.

An advancement in information and communication technology brings about a change in human life. The role of Information and Communication Technology (ICT) is increasingly felt in various sectors, especially in education. The role of ICT in education is expected to improve the quality of education as one of the pillars of education. Improving the quality of education becomes a priority with awareness That the success of a nation in the future depends on the quality of education.

Therefore, the Ministry of Education and Culture of the Republic of Indonesia very seriously places the pillars of education through its mission known as 5 K, namely Availability, Affordability, QUALITY and Relevance (Quality and Relevance), Equity and certainty (equity and certainty) . The origin of learning is one aspect of education that must be available, affordable, high quality, relevant to

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***Nurul Hidayat**, Doctoral Students of Computer Science, UGM Jogjakarta, Indonesia.*
***Retantyo Wardoyo**, Lecturer of Computer Science, UGM, Jogjakarta, Indonesia.*

the needs of the community, and accessible to all, without discrimination on the basis of sex, age, religion, race and guaranteed certainty in its access [11,12, 13].

At present, the attainment of these goals can be done with just one word: technology. The rapid development of information and communication technology; They impact on the ease of social networking, and gain access to information, and interact directly indefinitely space and time [14,15,16,17].

II. Literature Review

2.1 The Complexity of Algorithms

The complexity of an algorithm is a measure of how much computation the algorithm needs to get the desired result. The algorithm that can get the desired results in a short time has a low complexity, while algorithms that take a long time to obtain these results have a high complexity. Usually the algorithm complexity is expressed asymptotically with big-O notation. If the time complexity for executing an algorithm is expressed by T (n), and satisfies $T(n) \leq C(f(n))$ for $n \geq n0$, then the complexity can be expressed by $T(n) = O(f(n))$.

One measure of cost in the execution of an algorithm is the length of time it takes. The measurement of the time required to execute an algorithm is called the time complexity of the algorithm. Two different algorithms can be used to solve the same problem and may, have a very different time complexity. The time complexity of the best algorithm to solve the problem is called the time complexity of a problem. There are two classifications of problems, as follows :

1. The problem solved (decidable / solvable problem) problems that include this classification are all types of problems that have a solution algorithm, although sometimes not practical. In terms of computing, the problems in this classification can be divided into three categories, namely:
2. Problems Tractable (easy in terms of computing). A problem is said to be tractable, if the problem can be solved by an efficient algorithm. For example, the problem of determining the largest number between n numbers, determining the shortest path between two vertices in a graph, and so forth.
3. Intractable problems (difficult in terms of computing). A problem is said to be intractable, if there is no efficient algorithm to solve the problem.
4. NP-Complete Problem (NP stands for Non-Deterministic Polynomial). A problem is said to be NP-Complete if the problem has been successfully proven to be included in an intractable problem. For example, graph coloring problems.
5. The undecidable / unsolvable problem of the problems included in this classification are all problems that do not have the solution aloritma, meaning that the calculation can not be done, or the answer can not be obtained within a limited time. For example, unbounded tiling problems.

2.2 Back Propagation

This backpropagation method was first introduced by Paul Werbos in 1974, then reiterated by David Parker in 1982 and then popularized by Rumelhart and McCelland in 1986. In the BackPropagation Algorithm, network architecture uses multiple layered networks. Broadly speaking the training process on artificial neural networks is known for several types of training, namely Supervised Training, Unsupervised Training, Fixed-Weight Nets. BackPropagation training method known as Generalize Delta Rule (GDR) is a supervised training where for each input pattern there is a target output pair for each input pattern. It is actually a gradient descent method to minimize the total square error in the output of the network calculation. The basic idea can be described with a simple relationship pattern: if the output gives results that are not in accordance with the target that is not desired, then the weights will be corrected so that the damage can be minimized and then the network response is expected to be closer to the appropriate price. In general, the objective of artificial neural networks in the training process is to obtain balancing between the network's ability to correctly respond to input patterns during training (it can be said of the ability to remember) and the ability to provide a proper assessment of a similar pattern of other entries. So from the training process will be formed a weighting price that will be used as a digging factor of other input patterns. In this method, there are three stages in the training process, namely: advanced feeding process from training input pattern, calculation and back propagation of error and weight value adjustment.

At this stage of the training is a step how a neural network is practiced, namely: advanced feed process from training input pattern, calculation, and back propagation of errors that occur from weighted value adjustment. At this stage of the training is a step how a neural network is practiced, namely by changing the weight of the connection, both the connection weight between the input layer and the hidden layer or between the hidden layer and output layer, if there is more than one hidden layer then there is also a weighting between Hidden layer itself. While solving new problems will be done if the training process is completed, the phase is the process of usage / testing of course by using weights that have resulted from the training process that has been done..

III. Backpropagation Complexity

In this section we calculate the time complexity of the Back Propagation algorithm. Complexity calculations are performed at several stages of the Back Propagation algorithm. The program pieces and complexity calculations of the Back Propagation algorithm are as follows:

Step 1. Normalization and Weighting

Mahasiswa	Aktif	Non Aktif
X : 1	1	0
	0	1
X : n		

1 : aktif
0 : Non Aktif

S = status (mahasiswa, status)

```
Line
 1    for i = 1 to 5,
 2      for s = 1 to 2,
 3        if mahasiswa (s) ==1,
 4          Mhs = Aktif;
 5        else
 6          Mhs = non aktif;
 7         end;
 8         s=s+1;
 9      end;
10      i=i+1;
11    end;
```

Calculation of complexity at this stage is as follows :
Line 3 dan 7 -> O(1)
Line 4 sampai 6 -> O(1)
Line 8 -> O(1)
Line 2 -> 2.O(1) -> O(2)
Line 9 -> O(1)
Line10 -> O(1)
Line 1 -> 5.O(2) -> O(10)
Line 11 -> O(1)

Maka hasil komplesitas tahap 1 adalah O(10)

Step 2. Student Activities

```
Line
 1    mahasiswa = 0;
 2    score = 0;
 3    aktifitas = 0;
 4    for i = 1 to 5,
 5      for j= 1 to 3,
 6        if aktifitas (j) == 1,
 7            score= score + 1;
 8        else if aktifitas (j) == 2
 9            score= score + 1;
10         else if aktifitas (j) == 3
11            score= score + 1;
12        else
13            score= 0;
14        end;
15        score = score +1
16      end;
17      if (score) >0,
18        status = " Aktif "
19      else
20      status = "mhs non aktif";
21      end;
22    end;
```

Calculation of complexity at this stage is as follows:
Line 1 -> O(1)
Line 2 -> O(1)
Line 3 -> O(1)
Line 6 dan 14 -> O(1)
Line 7 sampai 13 -> O(1)
Line 15 -> O(1)
Line 5 ->3.O(1) -> O(3)
Line 16 -> O(1)
Line 17 dan 21 -> O(1)
Line 18 sampai 20 -> O(1)
Line 22 -> O(1)
Line 4 -> 5.O(3) -> O(15)

Then the result of phase complexity 2 is O (15)

Backpropagation is one of the development of Single Layer Neural Network architecture. This architecture consists of input layer, hidden layer and output layer, and each layer consists of one or more aritificial neurons. The common name of this architecture is the Multilayer neural network.

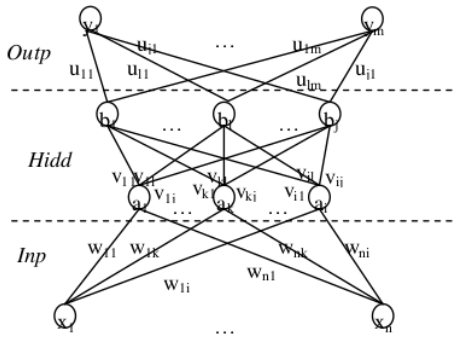

Fig 2.2. : Arsitektur Multilayer Neural Network

By using this type of architecture, the training method used is Backpropagation which is usually referred to as feedforward networks

IV. Conclusion

Based on research that has been done, the calculation time complexity of the algorithm generated is O (15)

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