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A new method for scheduling workflow in cloud computing using the neural network runtime prediction mechanism

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Abstract
Cloud computing is a new measure for the development of enterprise applications that can effectively facilitate the implementation of workflow in the business process management system. Workflow technology in business processes is able to manage the new needs of companies and improve their productivity satisfactorily. Transferring workflows to the cloud computing environment enables organizations to use a variety of cloud services to facilitate their workflow. Workflow scheduling is one of the key issues in managing workflow execution. In this study, the neural network will be used for the problem of scheduling workflow in cloud networks. Most of the work done in the past has been using evolutionary algorithms. If these algorithms have a lot of computational complexity, therefore The neural network algorithm has been used and the results have been compared with the genetic algorithm. The results show the superiority of using this algorithm in scheduling the workflow in the cloud.

Keywords: Cloud Network, Neural Network, Workflows.

Introduction
Today, with the help of cloud computing, advanced services can be obtained only using the Internet; Users can use large computer networks consisting of thousands of small and large computers and thousands of software with just one bank card and leasing other people's resources. One of the issues in cloud computing is the scheduling of tasks or load distribution, which can reduce costs for users and provide more resources for rent to providers by dividing tasks between different computers (Naghibzadeh 2016).
Complex applications are usually represented using workflows. A workflow program is usually represented as a directional graph without rotation, in which each computational task is represented by a node and each data or control dependence is represented by an arc between related tasks. These tasks should be mapped to existing resources to optimize one or more performance metrics (Deldari, 2016). This is called workflow scheduling, which is one of the NP-Complete issues. The purpose of workflow scheduling can be cost and time

optimization, availability, reliability, productivity, load balancing and so on.

Research method

In general, the scheduling problem is illustrated in Figure 1:

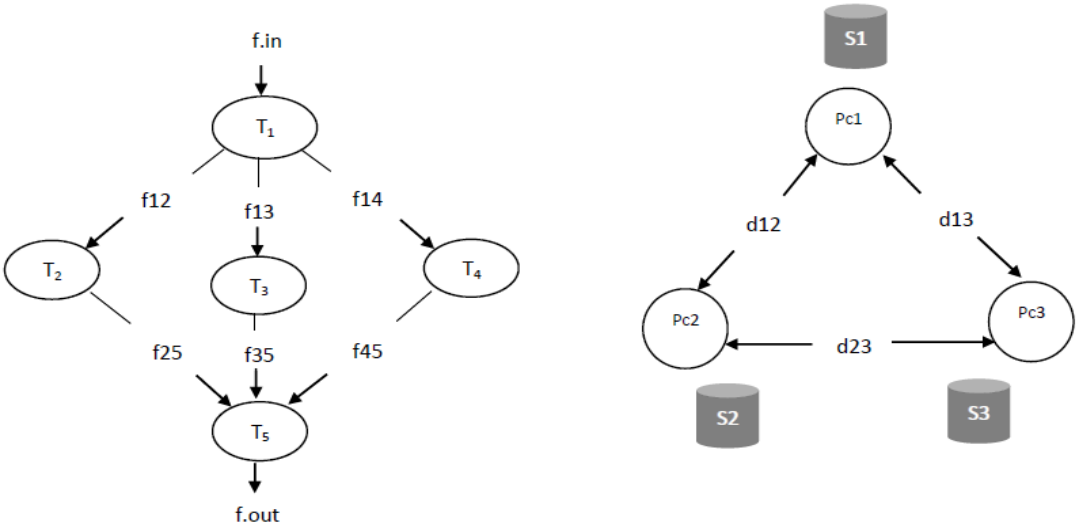

Figure 1, sample workflow

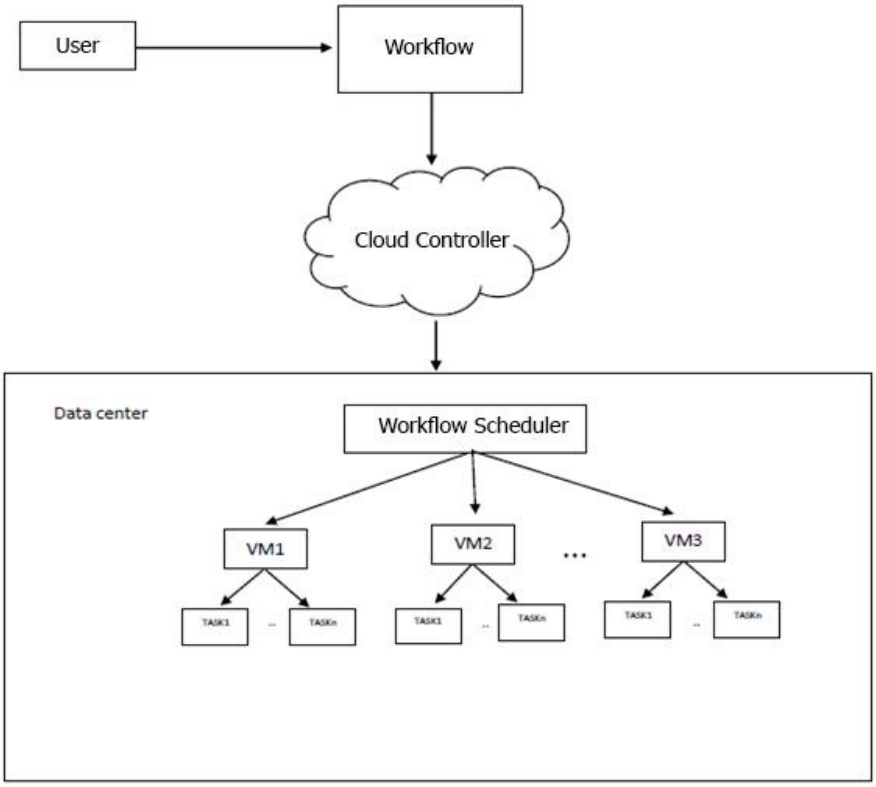

figure 2, the scheduling problem in general

As shown in Figure 2, a set of tasks is the input of the proposed algorithm that enters the model and divides the model of these tasks and performs them to different sources.

The proposed model in this research is the use of neural network algorithm. The formulas used in this chapter are shown in Table 1:

Table 1 , Expression of formulas

Computing power of remaining resources	*P=Speed_of_CPU*CPU_percentage*
Cost of resources	$RB = RC * TL$
Used capacity	$MS = TL/p$

Computational power for each resource is the standard for resource selection. In the computational power algorithm, each resource is used as a standard for selecting the desired resource. The product of CPU speed and CPU id is multiplied by computational power. Also, to initialize the values required in the scheduling algorithm, the position of each resource in the cloud system is used and those values will be set with local and global updates. Therefore, according to the updated information, the system can assign tasks to the appropriate source, which is the process of division of tasks using this combination is In

Figure 3, as shown, in the first step, the initialization algorithm will be performed. This concept means how many workflows and resources this algorithm has. In the second stage, matrices are created along the number of workflows in which resources are randomly assigned to them. In the third stage, the remaining computing power of each resource, which is described in general, will be calculated per entry. Each part of the workflow is scheduled and assigning a part of the workflow to a source. Of course, the remaining computing power of each processor must be updated, and if the work is completed, the algorithm goes to the next step, otherwise this process continues.

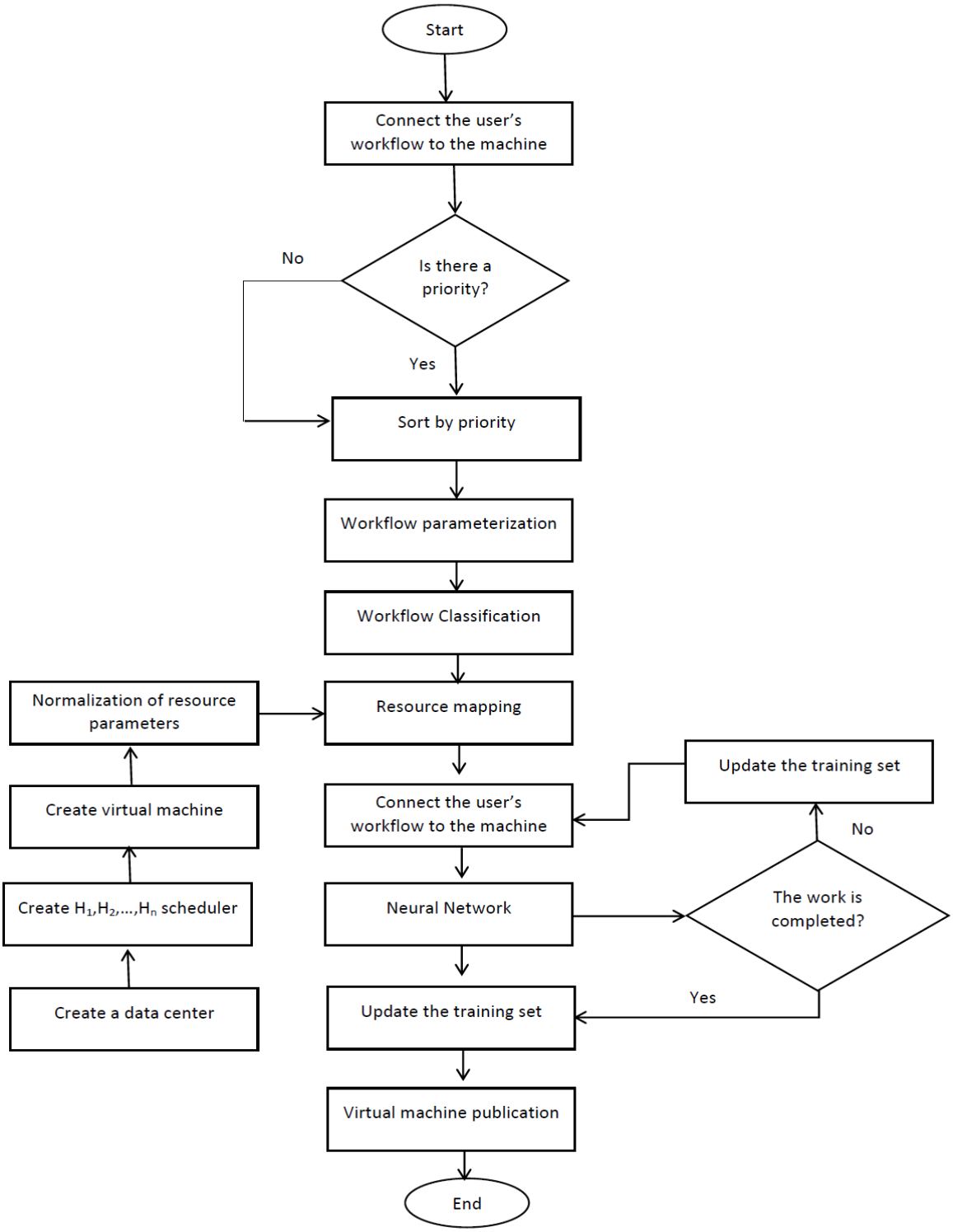

Figure 3, Flowchart of the proposed trend

In the first step, the parameters are initialized according to Table 1 and the simulation will start. In the second stage, tasks are randomly assigned to resources. In the third step, the model algorithm will be created. The remaining computing power will be calculated according to the following formula:

1) P = Speed-of-CPU * CPU-percentage

CPU-percentage is equal to the amount of CPU currently occupied and cannot be used. In this algorithm, the execution cost is also calculated and the execution cost depends on the cost of resources in each MI (million instructions) and the length of each workflow in MI. The cost of resources is calculated as follows:

2) RB = RC ∗ TL

In this formula, RB is the resource budget, RC is the resource cost per MI and TL is the length of work in the MI.

Make span (calculation time / runtime) depends on two factors: resource capacity (power) and workflow length calculated in MI as follows:

3) MS = TL / p

In this process, after calculating the remaining computing power of each of these processors, an array is created to select the best source. MS creates a matrix that selects the best output to select the first source to perform a task. At this point it is clear that the algorithm has started with an intelligence of the remaining computing power.

In the proposed method, 50 users submit their tasks to the schedule at the same time, and there are 100 providers who can execute the submitted tasks.

At each scheduling interval (100 seconds); Network Scheduler Schedules 100 to 200 jobs sent randomly by users. All jobs are submitted on time. Alpha is a constant coefficient that will be used in the calculation. Figure 4 shows the neural network representation:

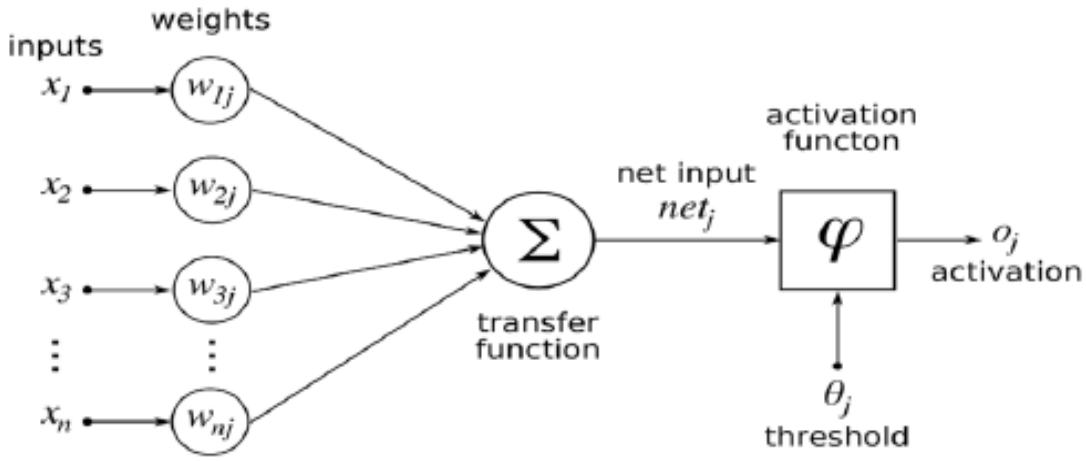

Figure 4, showing the neural network

Each source has a different number of available processors in the range of 4 to 12 with an average of 8 processors. As shown in Table 2:

Table 2: Simulation parameters

PARAMETER	NUMBER
Users	50
Resources	100
Execution time	Random between 2 to 100 units of time
Maximum replication of the algorithm	100
Alfa	20
Gravitational constant	100*exp(-alfa*(iter/maxiter))

Implement the proposed method

The type of neural network used in this study is as follows:

1 - Feed neural networks

2 - Multilayer Perceptron Networks (MLP) and Post-Diffusion Algorithm (BP)

3- The network will be simulated and workflows, users and resources will be determined.

5 - Using the Levenberg -Marquardt (ML) learning algorithm in the middle layer (slow layer middle) due to the acceleration of work and high accuracy in scheduling

6 - In this research, the technique of early stopping is used to control the training phase.

7 - Normalize the data using sigmoid functions in the range [1 and 0] to prevent excessive weight shrinkage.

Findings

Neural network algorithm

In computer science, artificial neural network is a computational method that optimizes a problem with a self-learning mode to improve a model according to a given quality criterion. This algorithm will be repeated in the model construction in the training phase until a powerful model is obtained.

In this research, first, for the superiority of this algorithm over meta-heuristic and evolutionary algorithms, comparison operations will be performed with these algorithms.

Correct comparison of a hybrid simulation requires performing this operation with its simple methods and similar to it, so in this study, the proposed method is implemented and compared with evolutionary algorithms.

Comparison of algorithms

In this section, due to the selection of the neural network algorithm as the superior algorithm is discussed. This algorithm is implemented in the field of cloud resource scheduling and their results are specified. These results indicate the accuracy of the proposed algorithm compared to other algorithms.

Figure 5 shows the execution time of tasks by different algorithms during different tasks. In this diagram, the superiority of the proposed method is clear and the ant colony algorithm is in the worst condition. While the proposed algorithm has shown the best performance for different tasks. This diagram also shows the superiority of the proposed method over the algorithm itself.

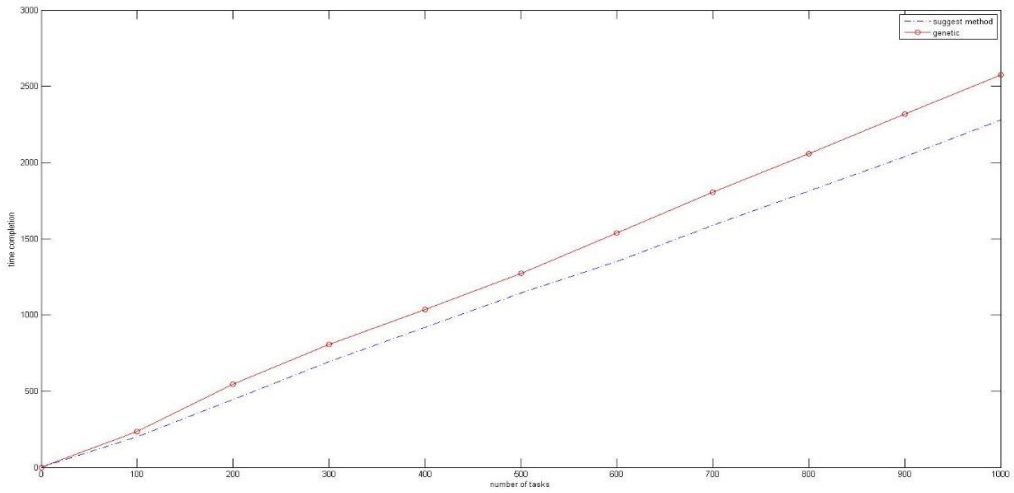

Figure 5: Execution time by different algorithms

Figure 6 shows the success of completion of tasks by different algorithms during different workflows. In this case, the important issue is how well the proposed scheduler can properly manage the resources to allocate the workflow, and as it turns out, the proposed algorithm performs better in this operation than the others.

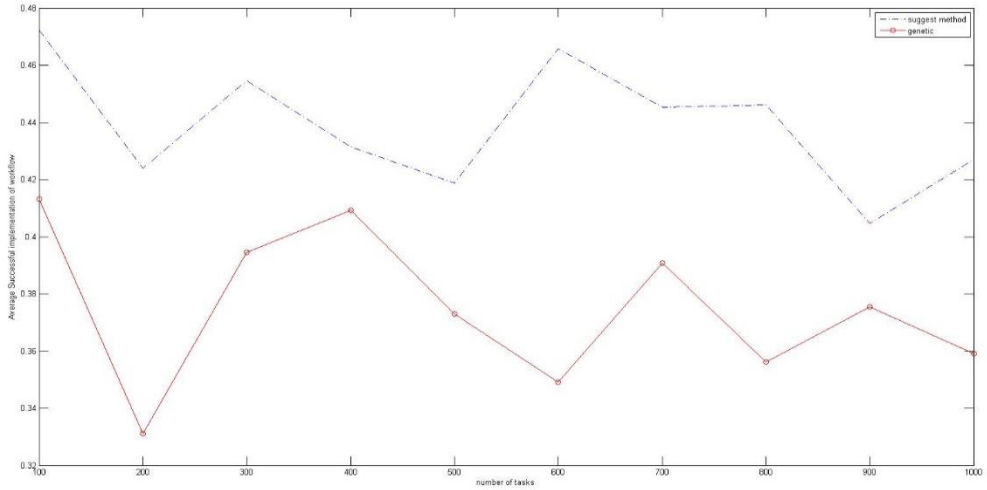

Figure 6: Successful completion of workflow by different algorithms

Weaknesses of the genetic algorithm require long processing time, which makes it difficult to search locally. In the ant colony method, each ant is not able to find a solution on its own, and with the cooperation of other ants and following the pheromone, an optimal solution can be achieved, thus slowing down the rate of convergence. To improve the mentioned disadvantages and create an optimal solving various optimization problems. Therefore, based on the results, it is clear that the proposed algorithm has better results

Comparison

In this research, two experiments are performed. The first test examines the rate at which things are done. The second test examines the cost of doing the work.

In Experiment 1, work performance rates are discussed. The result is shown in Figure 3-4. In this experiment, the number of sources is considered to be 100. Observing the results, we conclude that the response of the neural network algorithm in this issue was appropriate.

Experiment 1: Number of successful tasks

In this part of the research, the number of works done will be calculated. This image shows the superiority of the proposed method.

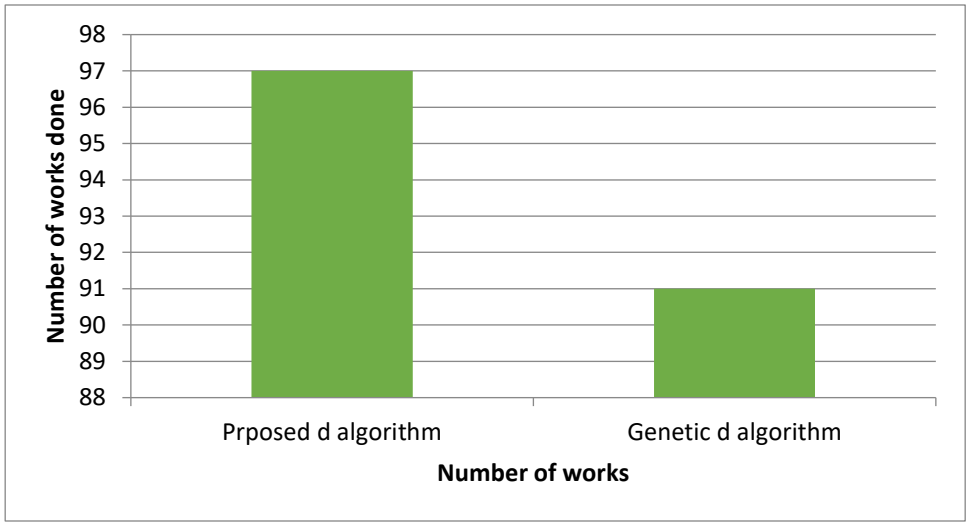

Figure 7: Comparison of performance rates

The second experiment: the cost of doing things

In this part of the research, the execution time of each task will be calculated. As depicted in this image, the time to perform the tasks is specified in the diagram, and this image shows the superiority of the proposed method.

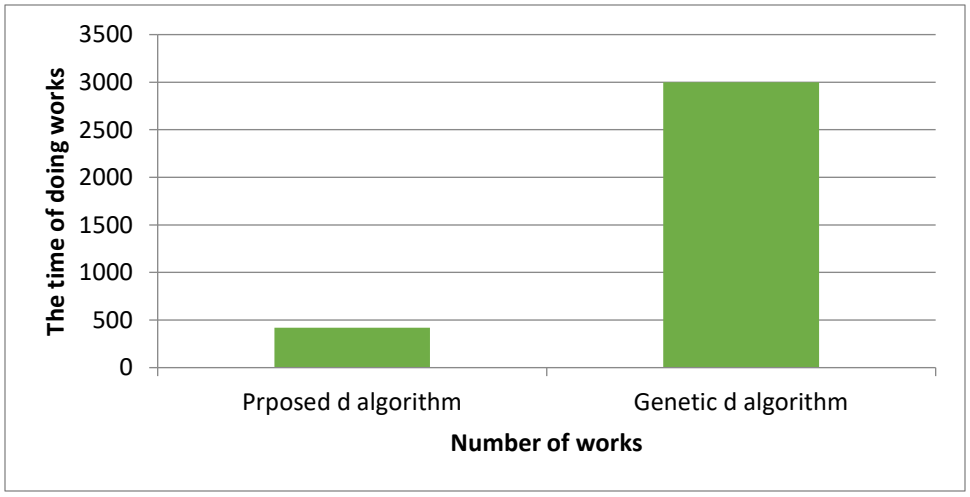

Figure 8: Execution time

Discussion and conclusion

Scientific issues require high computational power and storage space due to their high complexity. Cloud is an environment in which a geographically balanced set of software and hardware is shared and made available to remote users. One of the goals of Cloud Network is to manage resources for processing user or customer applications so that it leads to high quality services, lower costs and more flexibility.

The desire of companies and organizations such as Amazon and Google to use and service cloud computing shows that the future of cloud computing is very bright and there is much room for improvement. By using cloud computing, organizations can reap the benefits of reducing costs and increasing productivity and multiple choices. Therefore, in order to realize these benefits, the system speed must be increased and a proper schedule must be created for this action. These types of problems are known as optimal problems. To solve such problems, optimization algorithms are used to reduce response time. In this project, the neural network algorithm is used to solve the scheduling problem in the cloud computing system.

Therefore, scheduling user tasks for processing by appropriate resources available in the cloud network, has been raised as a key issue in achieving high performance in cloud network computing systems.

Workflow scheduling is one of the most important challenges of the cloud network. The tasks received by users need to be efficiently distributed between resources to reduce response time to users and get things done faster. In this research, the objective function of latency was used.

By implementing the scheduling algorithms in the previous chapter, it can be concluded that the proposed algorithm works better than other ones.

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