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Application of Cukoo Algorithm to Improve Economic Scheduling In Grid Computing

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Abstract

In this article, Cukoo algorithm was used to improve the economic scheduling in grid computing. Different economic calculation methods is evaluated given the synchronization importance of time and cost criteria. Using TCI algorithms, a new algorithm was proposed based on Cukoo algorithm. Evaluation the implementation process of this algorithm needs to new algorithm based on the previous proposal that has the ability to regard prerequisite tasks to deliver optimum results. To compare and evaluate the capabilities of the proposed method, we need a simulator that can be used for many different tasks in the DAG to provide the model to deal with the proposed algorithm. The results of our proposed method compared to TCI method has a huge amount of optimality. Also, it was shown that the population growth in the process of review, increases the speed to achieve optimal value and the higher repetitions will reduce the time to reach optimal results.

Keywords: **algorithm, TCI method, Cukoo method, time, cost, Cukoo algorithm, grid computing**

Introduction

Increasing knowledge of human progress and achieve new results includes various requirements. For example, heavy calculations in order to solve problems in different fields of science and technology is one of the most important in this regard. In managing such a complex environment, common approaches could not be used to manage resource that try to optimize efficiency in the system. Grid is a new technology that uses communication and computer networking infrastructure as well as maximum concepts and possibilities of distributed systems to access a variety of resources for remote and disparate computing resources that can be connected to a wide spectrum. In the simplest sense, grid computing is a distributed computing that has a higher level of development. (Buyaa, 2002)In grid computing, the source is an entity with Reusabilityto meet a demand. (Yeo et al., 2004) Sources used in the grid can be storage devices, databases, software, grid software licenses which could be shared by grid oruse them in a remotely, coordinated and safe way. These resources belong to different organizations that have their ownpolicies and management models and cost for variously for different users. Computational Grid is a hardware and software infrastructure that provide reliable, sustainable, inclusive and affordable access to the computational capabilities others. (Foster, 2002)In scheduling Computational Grids, time parameter should be regarded in addition to the cost of resources. Economic approach provides a fair basis for successful management of heterogeneity. For example, a bartering-based model which is determined based on supply and demand and the economic value. (Buyaa, 2002) Dynamic and heterogeneous Computational Grids resources, complexity, time constraints, budgets andetc.are properties of Computational Grids. Computational Grids is a method to process large data even supercomputers are unable to do it, so by the accumulation of small computers, large processors are appeared to have the ability to perform these calculations. Computational Grids historygoes back to 1996 and Legion, Condor and Globus projects. (Rashid et al., 2002)

Computational Grids approach motivation in the beginning was large-scale applications that more resources could be placed in a computer. Computational Grids have some protocols to solve large-scale problems in multi-user and multi-source distributed environment which provide lowcost,

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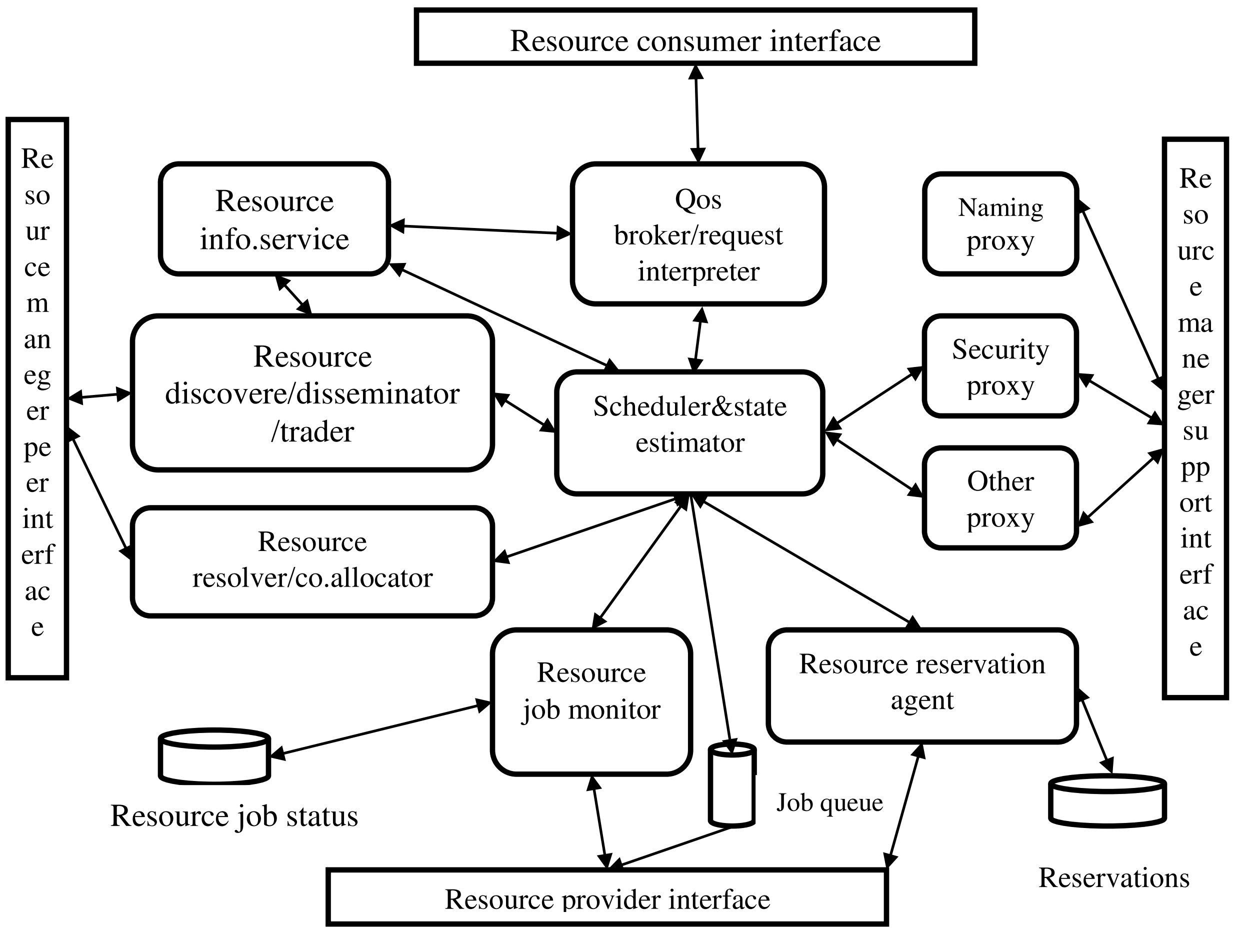

Figure 1: The abstract model of resource management system

- ***Step 1**: read* the *DAG G<V,E>, and M,C,T,D Matrixes;*
- ***Step 2**:Leveling the DAG;*
- ***Step 3:** for* all tasks *Vk* at each level *Li* do
- *begin*
- compute *ACC(Vk),DTC(Vk) and RPT* (*Vk*);
- *rank(Vk) = ACC(Vk) + DTC(Vk) + RPT* (*Vk*);
- //tie, if any, is broken based on *ACC* value, the task with minimum
- *ACC* value receives the higher priority followed by the task with
- //next minimum *ACC* value and so on;
- *end;*
- ***Step 4:*** construct a priority queue using ranks;
- ***Step 5:** while* there are unscheduled task *Vk* in the queue *do*
- *MachineSelection(Vk)*

Figure 2: TCIPseudo-code Algorithm

consistent and effective accessibilitywith high computing power or sharing resources dynamically and virtualization to solve this problem through hardware and software structure. (Yang, 2010) (Buyaa, 2000)Main goals to design Grid system include increasing application performance, data access, and increase and improve services.In the real world, Parameter Web applications using computational grids have concluded, molecular modeling for drug design (Buyaa, 2002) and diagnosis of X-ray radiography noted. (Smallen, 2000) Exploitation of resources without the use of parallelism processors, access to additional resources, balancing the use of resources can be considered the capabilities of Computational Grids. (Buyaa, 2002) Figure 1 shows the abstract model of resource management system.Fields which was investigatedin this regardcan be noted. In 1986, using stochastic learning automata as a method for scheduling tasks in distributed systems is suggested. (Mirchandaney, 1986)Reinforcement learning is usedto manage resource allocation aim of load balancing and increasing the efficiency of the system. (Galstyan, 2004) Saeed Ghanbari using learning automata able to schedule tasks to other algorithms in heterogeneous environments toimproveload balancing. (Ghanbari, 2004) Nader Aria Barzan proposed new methods based on learning automata to select educational content with the economic objectives of the bargaining model. (Aria Barzan, 2004)Also Learning Automata to transfer tasks to grid resources is usedwith the aim of optimizing desired cost functions (separately). (Vnktarmana, 1999) TCI (Time and Cost Improvement) is one of the algorithms that examine the resource allocation from perspective of time and cost. In this method, DAG model is used to show the dependence of things together. (Foster, 2002) TCI algorithm is a heuristic algorithm, which has a fierce procedures. This algorithm is triedto optimize the cost and time. The algorithm is composed of three phases including sort of implementation, prioritize the implementation of tasks, assign resources to tasks to run. Figure 2 shows TCIpseudo-code algorithms. Algorithms whichcalculateseconomic have a lot of aspects, so that economic calculation algorithms have a variety of models. Most economic calculation algorithms have examined optimization problem more from the perspective of cost, time, while in most cases the grid system users considers optimization from both time and cost perspective. In the meantime TCI Algorithms optimizes the time and cost, taking into account issues such as prerequisite and dependency between works.In fact, using this algorithm gives users the ability to decide on the amount of time needed to run in addition to consider the cost to run the work.Cuckoo optimization algorithm (COA) is one of the newest and most powerful evolutionary optimization methods that have already been introduced. After introducing the basic evolutionary optimization methods such as genetic algorithms and simulated Annealing algorithms, a lot of research was done on evolutionary optimization methods that were inspired by nature, which numerous applications of these methods to solve complex problems of different optimization can be found in the literature. (Figure 3)

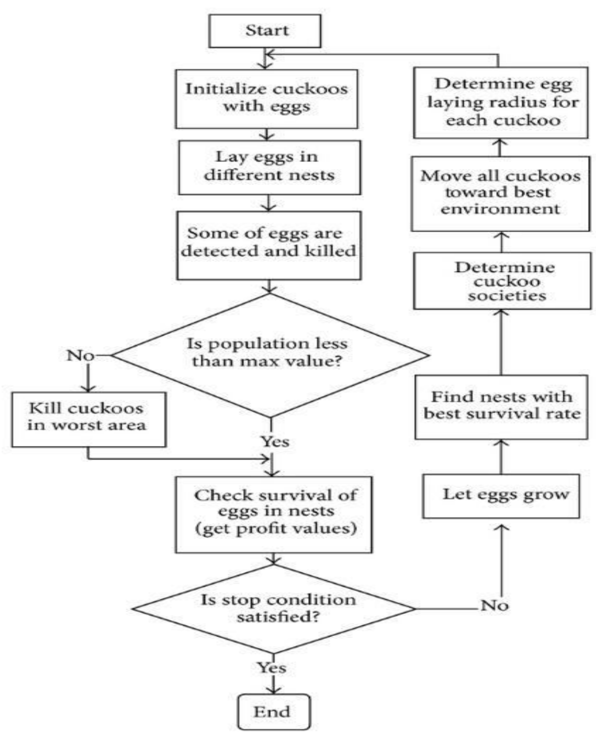

Figure 3: Flowchart of Cuckooalgorithm

Objective function $f(\mathbf{x}), \quad \mathbf{x} = (x_1, x_2, \ldots, x_d);$
Generate an initial population of n host nests;
While (t<MaxGeneration) or (stop criterion)
  Get a cuckoo randomly (say, i) and replace its solution by performing Lévy flights;
  Evaluate its quality/fitness F_i
    [For maximization, $F_i \propto f(\mathbf{x}_i)$];
  Choose a nest among n (say, j) randomly;
  if ($F_i > F_j$),
    Replace j by the new solution;
  end if
  A fraction (p_a) of the worse nests are abandoned and new ones are built;
  Keep the best solutions/nests;
  Rank the solutions/nests and find the current best;
  Pass the current best solutions to the next generation;
end while

Figure 4: CuckooPseudo-code Algorithm

Figure 4 shows the Cuckoo pseudo-code Algorithm. Cuckoo algorithm is anOptimization Algorithm that will maximize the benefits function such as Cuckoo Optimization algorithm to solve complex nonlinear optimization problems with reliability and high accuracy. Faster convergence, higher speed, higher accuracy are benefits of cuckooOptimization algorithm.

Results and Discussion

Table 1: fixed parameters used in the proposed Cukooalgorithm

Constant value	Parameter	Row
0.5	CC	1
0.5	CT	2

Table 1 shows a list of parameters used to calculate fitness. Also there are several parameters in the proposed algorithm, which affect the generation of accelerated evolution. But these parameters are not constant and changein the evolution of these parameters based on the values of the generation. In Table 2, parameters together with a formula that would alter these parameters is shown.

Table 2: non-fixed parameters used in the CUKOOproposed algorithm

Parameter formula	Parameter	Row
$Max(Time\_POP)$	Z_t^{Max}	1
$Min(Time\_POP)$	Z_t^{Min}	2
$Max(Cost\_POP)$	Z_C^{Min}	3
$Min(Cost\_POP)$	Z_C^{Max}	4
$1/(Z_t^{Max} - Z_t^{Min})$	W_t	5
$1/(Z_C^{Max} - Z_C^{Min})$	W_c	6

In Table 1 and Table 2 shows the constant and variable parameters in implementing the program. In Table 3, other parameters affect the proposed algorithm is shown that tests were carried out for each of these parameters is shown.

Table 3: parameters affecting Cukoo algorithm proposed in the first experiment

50	45	40	35	30	25	20	15	10	Number of work
50	45	40	35	30	25	20	15	10	Number of Cukoo
10	10	10	10	10	10	10	10	10	Number of repetition in Cukoo Algorithm

Test results shown in the diagram from the results of 20 replicates that of the average of the values obtained. Figure 5 shows the estimated costs for the implementation of programs between the proposed algorithm and TCIalgorithm. It should be mentioned that the test for a number of DAG models using the simulator generates and then this run the model to get the best time and the best cost to run them and TCI algorithm is proposed. To do this, we can raise the level of accuracy of the results was repeated at 20. Repeat this process for each DAG using a simulation model has been replicated. Published due to different sources of power generation and runtime for each of the works produced, amount of difference between the two algorithms that compare the proposed algorithm can explain the exact amount.

In fact, every time the simulator for a certain number of jobs produced DAG model, in addition to the amount of time required to perform each of the tasks to run on each of the products. Meanwhile amount proposed for use of the resource for each time period for each source products. In this case,the high frequency it is possible that a source with higher power and the next iteration of its power greatly reduced and also the issue of resource prices and the impact of the results will be great.

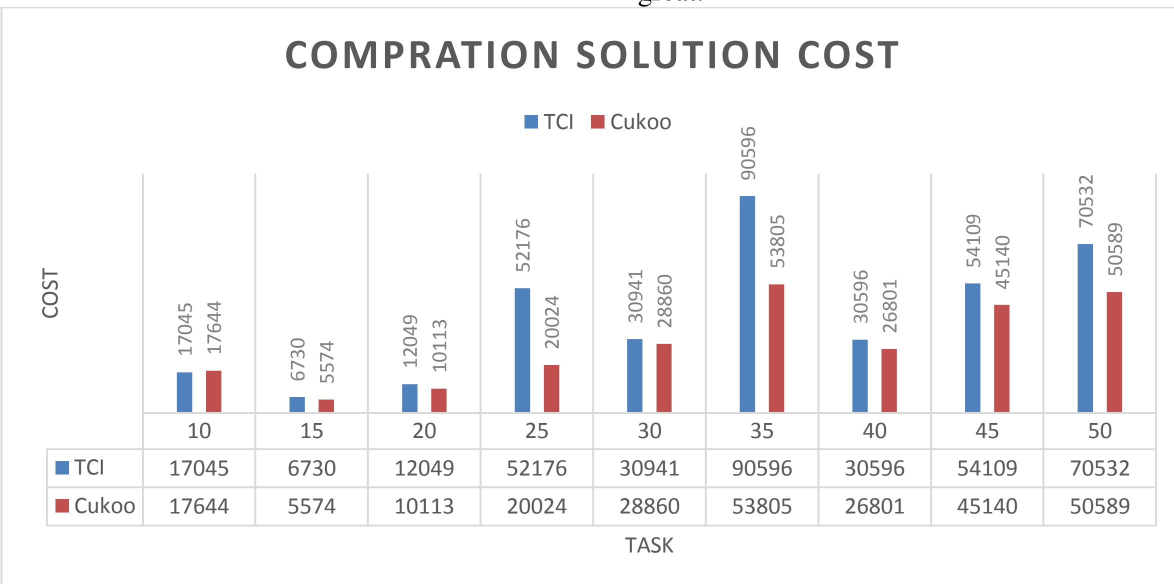

Figure 5- the resulting cost to perform the works in the CUKOO proposed algorithm, and the TCI algorithm in 20 repeated at first experiment

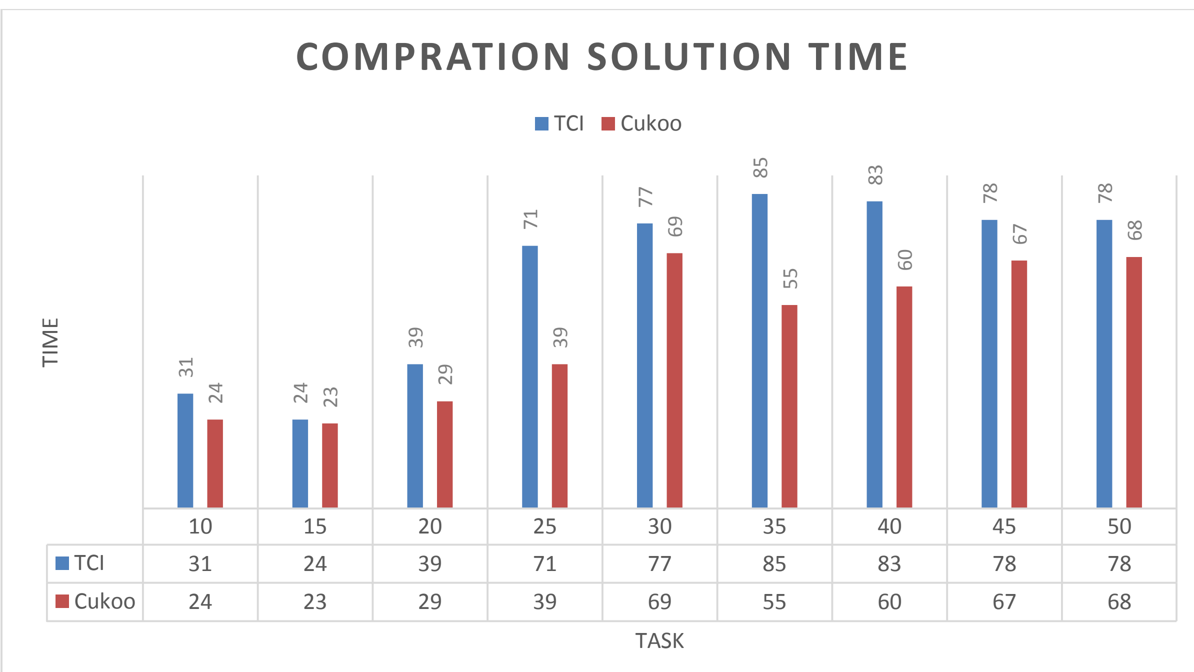

Figure 6: the time to perform the works in the CUKOO proposed algorithm, and TCIalgorithm in 20 repeated at the first experiment

As can be seen in Figure 5, when the number over 30 of tasks works are modeled by simulator, after completion of the algorithms on the model of a solution to contribute to the implementation of programs, the average cost of TCI achieved nearly 32,000 in 20 iterations for the algorithm, and is 2900 for the proposed algorithm.This comparisonis also investigated for the number of different tasks and in total shows the ability of proposed algorithm to produce a solution that showcost value obtained for the implementation of the solution to TCI algorithm to.According to Figure 6, when the number of tasks on 45 is modelled by simulator, after completion of the algorithms on the model of a solution to contribute to the implementation of programs that the mean time in 20 iterations are 78 for the TCIalgorithm, and 67 for proposed algorithm. This compares is also investigatedto the number of different tasks, in total, the proposed algorithm can be used to produce a solution that the amount of time taken to implement those solutions TCI algorithm.Results shown in Figure 5 and 6 on the basis of the values obtained in Table 3. The values in Table 3 is based on the amount of work per 1 bird addedin the number of birds. For example, we have 30 works for number of birds as 30. Table 4 displays parameters affecting Cukoo proposed algorithm. In a second experiment as the first test for each of the number of jobs has been repeated 20 times the performance of algorithms. The mean value of the results is used to display charts. In this tests determine the number of birds and the number of repetitions Cukoo algorithm in the proposed method than the first experiment in which the number of birds were examined. At first results of this procedure in Figure 7 and 8 is investigated.Figure 7 in total showsability of the algorithm to get the best cost solutions. In the diagram, there are 2 fine point and it cost values obtained in the number of 50, 40, showsobtained for the more cost of the proposed method compared to TCI. To investigate this we have to investigate figure 7 in the Figure 8.Figure 8 represents the minimum amount of time required to calculate in the value of the work.As noted in Figure 7 there are two things that cost the proposed method is more than the cost in TCI. Compare the time to run the same number of tasks in Figure 8. The result is, that best value obtained for the costs not less than the amount obtained in the TCI, because the time and cost optimality In addition to the amount of time is also impressive and for the same amount of time given for 40 proposed method is 47, and TCImethod is 84, which has a difference of 17 points. This difference of 50, the unit of time is equal to 5. Thus proposed algorithm can be argued that in some cases the output results in a measure of time or cost more than it was capable of TCI and other criteria with slight differences more than the value of the TCI method.

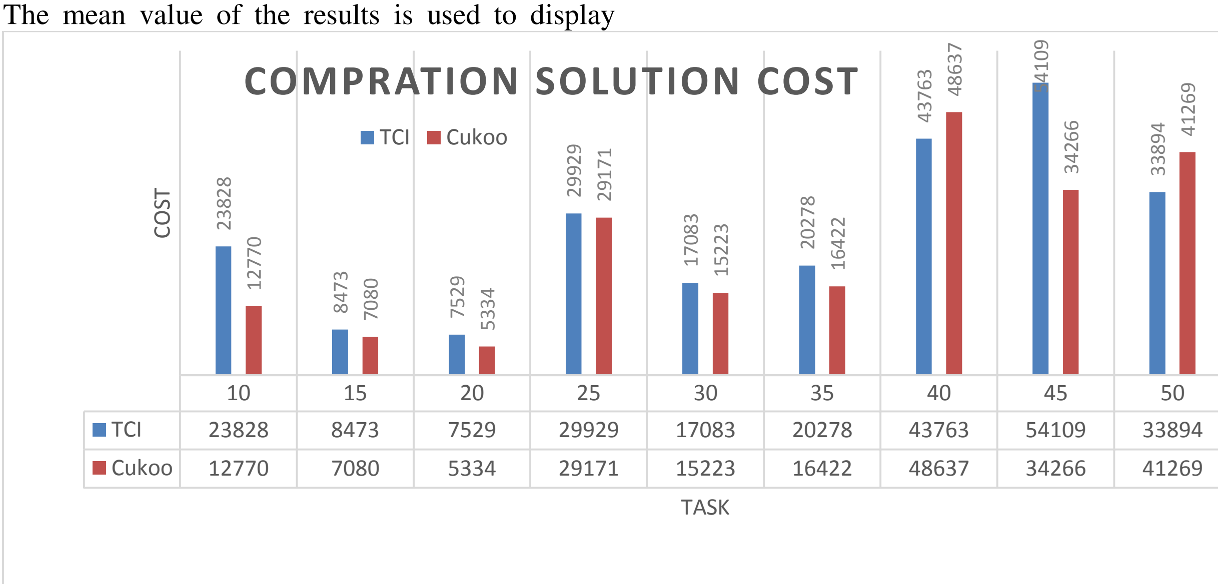

Figure 7: cost of the work to implement the Cukoo proposed algorithms and TCI algorithms repeated at 20 second test

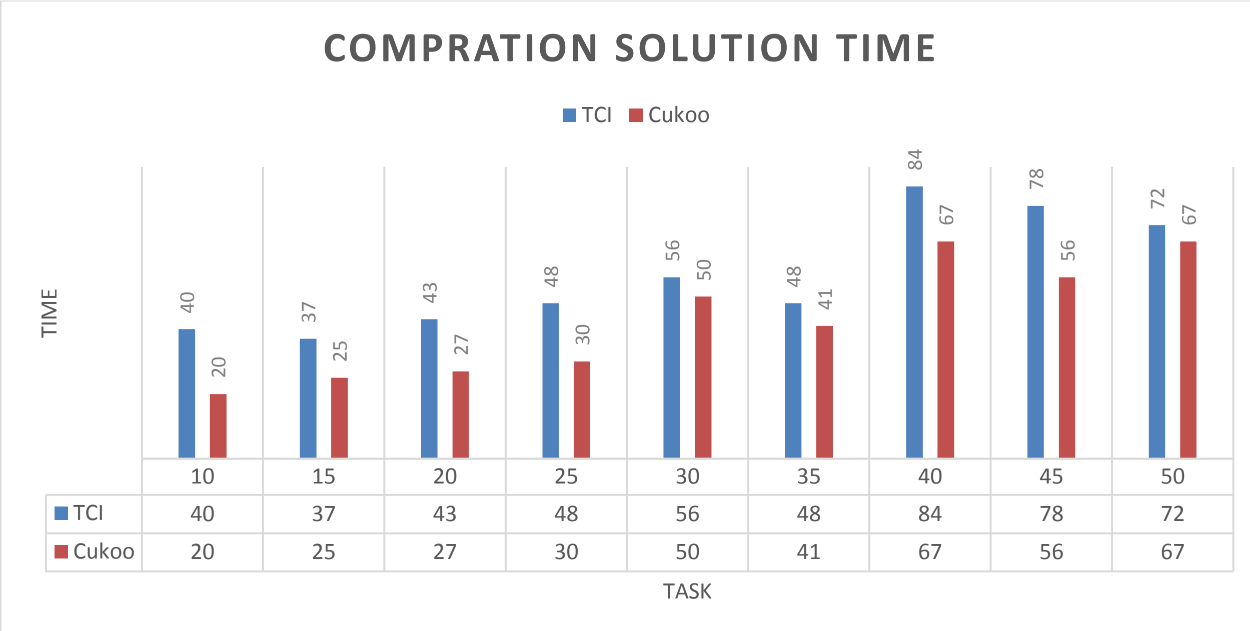

Figure 8: the time to perform the works in Cukoo proposed algorithm, and TCIalgorithm, repeated at 20 second test

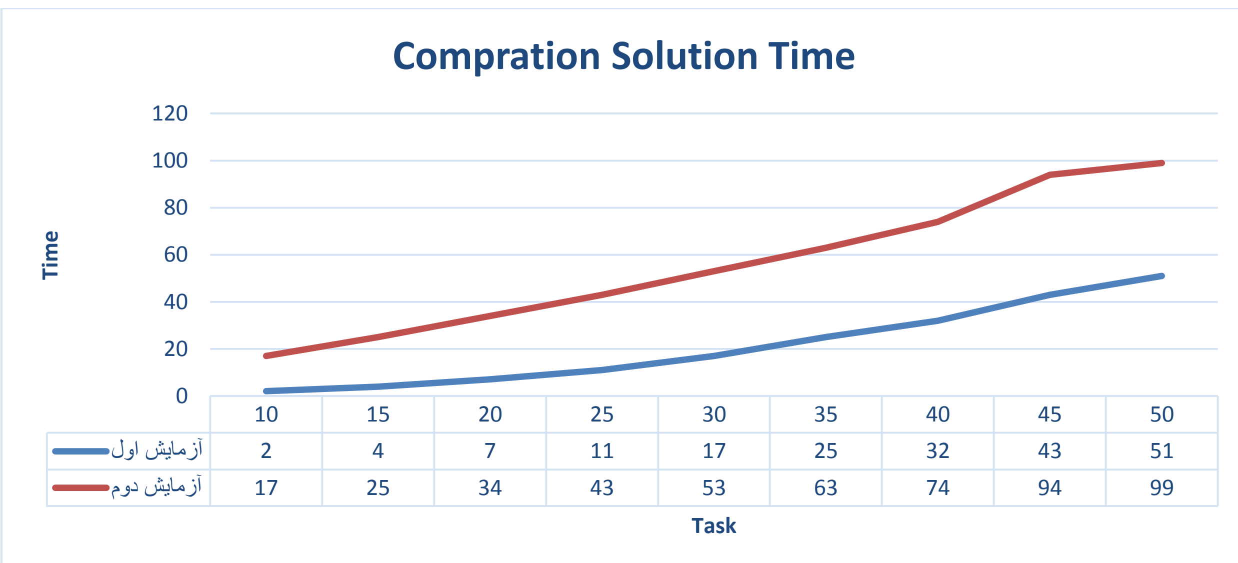

Figure 9: the time to perform the works in Cukoo proposed algorithm, and TCIalgorithm, repeated at 20 second test

After the implementation of the proposed algorithm is expressed in both the first test and the second test will be discussed. Amounts necessary for the implementation of this test are shown in Tables 3 and 4. Thus in Figure 9 can compare the results of these two tests.As can be seen in Figure 9 to depict the performance of tests with the conditions set forth in Tables 3 and 4 has been investigated. In the first experiment for 1 bird in any given population. In a second experiment, only 10 birds are in the population. The second test is allowed that continue repeating the algorithm CUKOO to 100 times, but the first test was this number of repetitions to 10 repetitions. Before the deal Figure 9, initially in the form of 10 and 11 to the results of the tests in two modes for the algorithm described above.

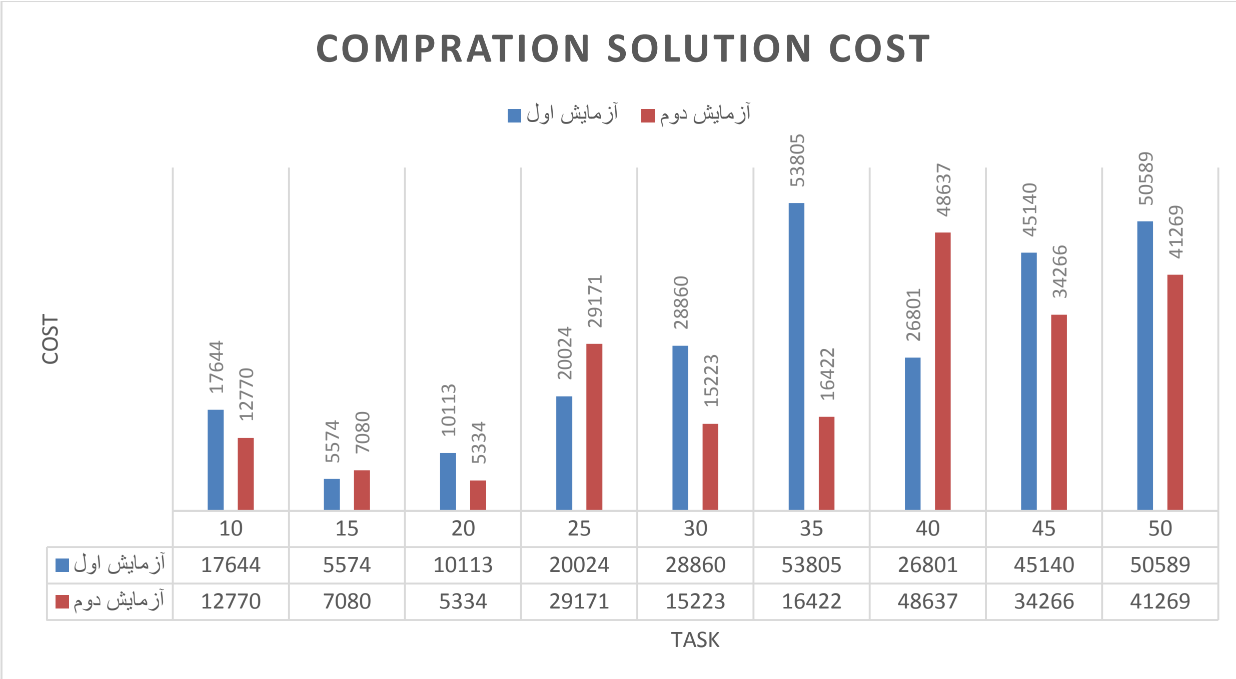

Figure 10: the resulting costs to run things in Cukoo proposed algorithm in 2 test by 20 repetition

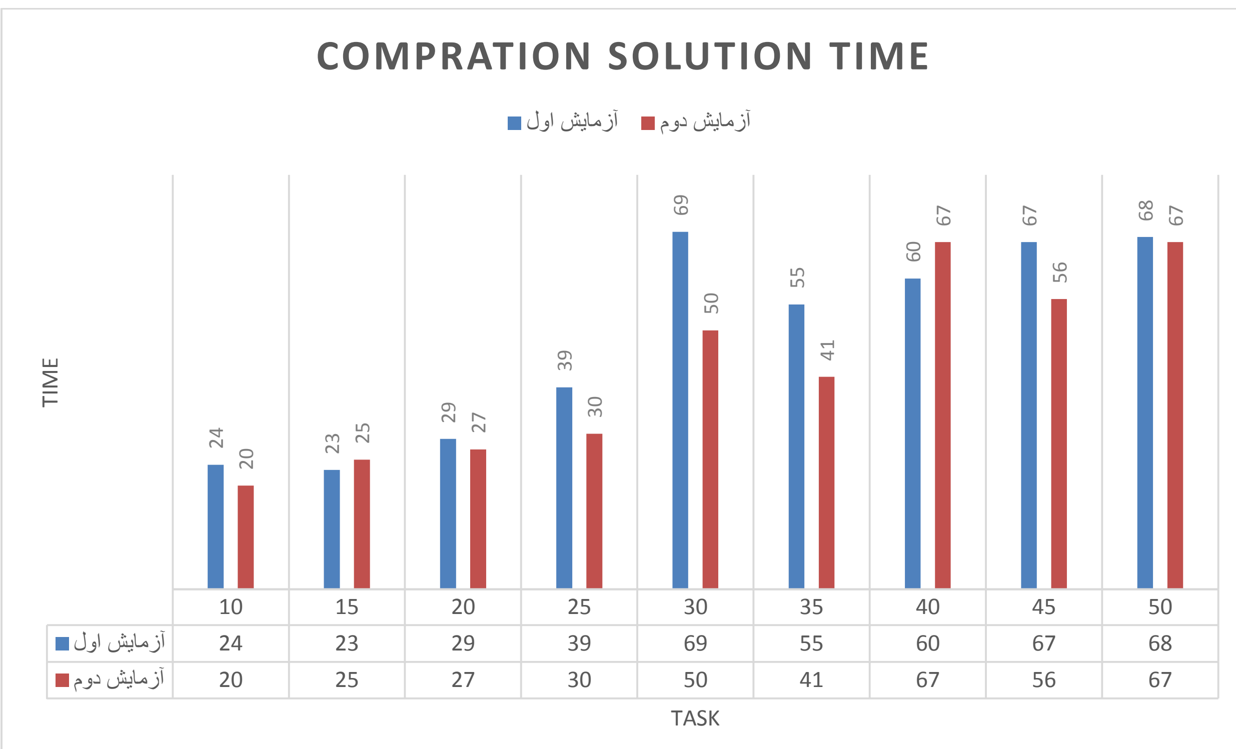

Figure 11: the time to perform the works in proposed Cukoo algorithm in 2 test and 20 repetition

At reviews two forms 10 and 11 clearly seen that the results of the second experiment better results than the first experiment is both time and cost criteria. Thus it can be stated that the increase in the number of repetitions Cukoo algorithm is proposed to improve results. Following, figure 9 will be investigated.Figure 9 shows that the second test execution time than the first test, this has been that result of optimality is higher. So we can explain the impact of the number of repetitions in the proposed method. That whatever proposed method has a higher value is the amount of repetition algorithm Cukoo added computation time and at the same time improves the optimality results. On the other hand number of birds in the population will reduce that time and proposed algorithm in less time to reach results. This is only if optimality results from the second test is less optimality, but also one is better than the TCI has optimality. In order to evaluate the improvement of optimality with the performance of other tests proposed algorithm was designed.

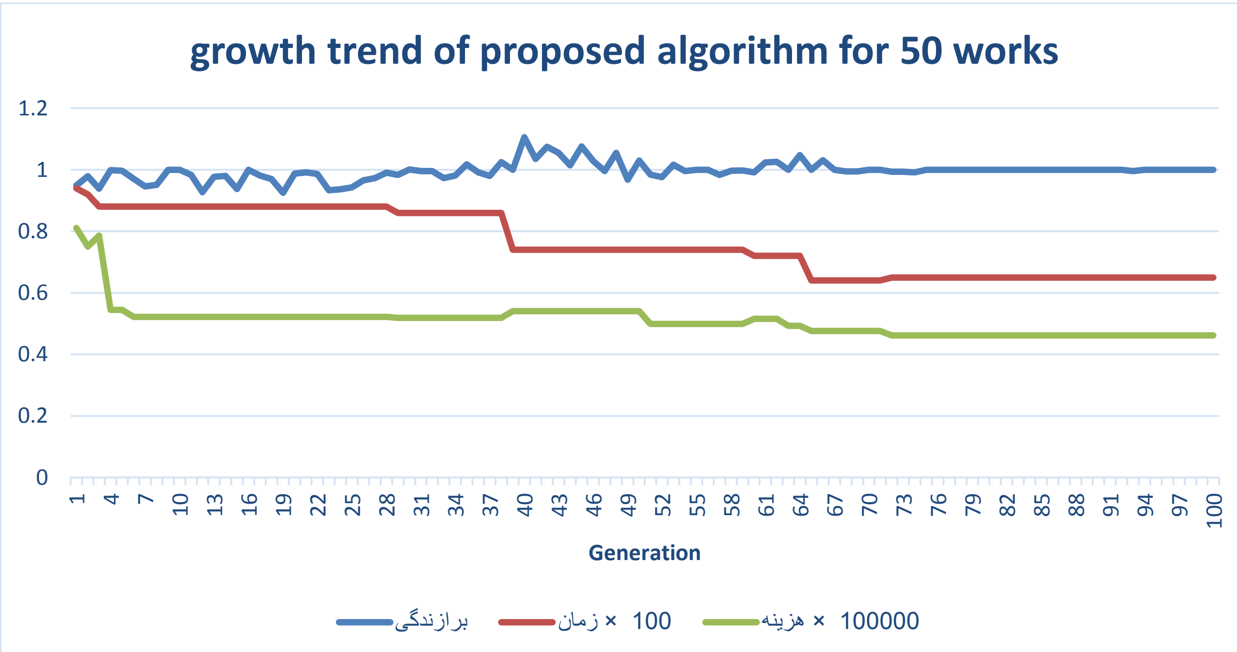

Figure 12: the time to perform the works in Cukoo algorithm proposed in 2 test and 20 repetition

Figure 12 displays the time to perform the works in Cukoo proposed algorithm in two tests with 20 repetitions. In this way the time required to show results for the best bird in each iteration of the algorithm shown Cukoo amount must be multiplied to 100 and for the cost must be multiplied to 100,000. The best proposed method has achieved much in the 73 repetitions, and then left without progress. Means for 50 employment, with 1,000 birds and 73 repeat optimum is achieved. So run time can be reduced by reducing the number of repetitions. Of course program proposed method provided for other end is placed where the condition has been argued, that if the situation did not change the algorithm to finish the fitness for 30 generations and that is visible in Figure 12. On 93 repeated with a change in the fitness that has continued this process is repeated up to 100 repetitions. But nearly 73 generations, the amount of time required to perform 50 work and the estimated cost of implementing these sources have been identified.In reviewing two proposed algorithms and other important parameters that must be addressed TCI algorithm execution is time of the program. Considering that TCI algorithms and a linear algorithm proposed algorithm is an evolutionary algorithm, certainly the amount of time performing in TCI algorithm to algorithm will be implemented in less time. This issue clearly shown in Figure 13.

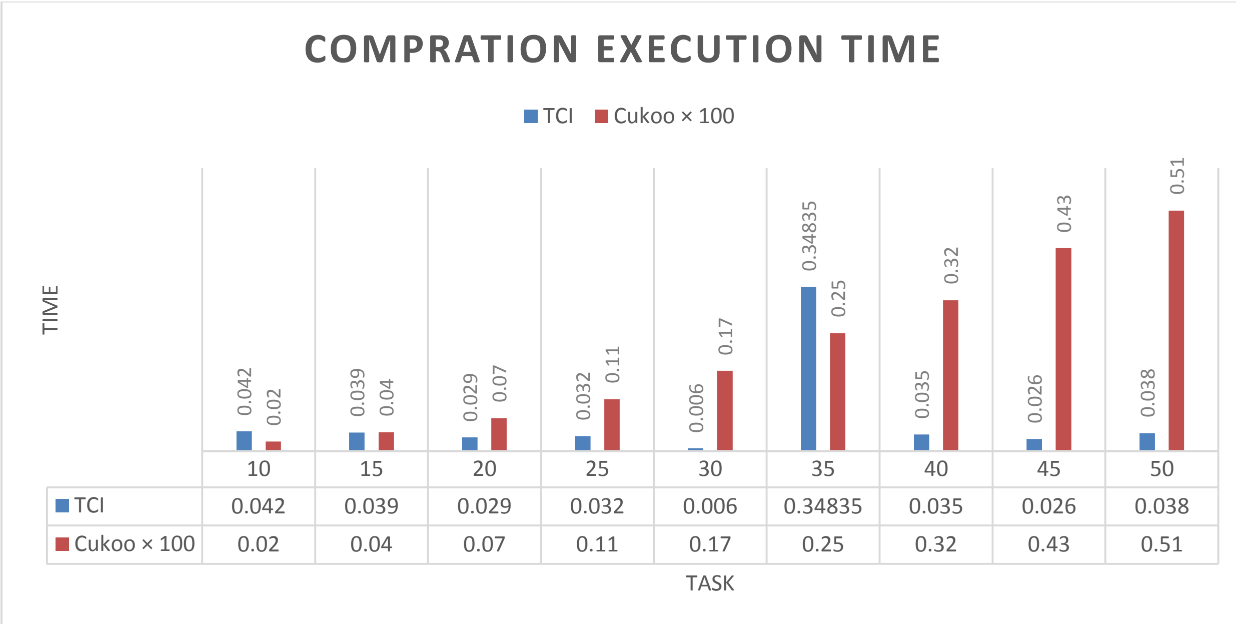

Figure 13: the execution time taken to get a solution for task execution

As shown in Figure 13 this time is minimal, but the main thing is that if a system of economic calculation results and run more efficiently, here our proposed method gives better performance, but if the scenario is different and the policy center and for that time schedule is important, in this mode TCI with linear performance and algorithm can provide results in a fraction of a second, but no guarantee that give the best value. As shown in Figure 5 and 6, amount of difference between the results obtained by increasing the number of jobs in our proposed method is better than that of TCI added.

Conclusion

The results of our proposed method has a huge amount of optimality compared TCI. Also showed that the number of speeding the process is achieving optimal value and the number of occurrences exceeds what makes time to reach optimal results added but results obtained in this case than in the case with many birds in one generation will be better. The only advantage of TCI is high speed answer.Of course, the answers have a lot of different answers from our proposed algorithm and by adding the amount of this difference between the numbers of jobs added. In fact needs of our algorithm to schedule tasks to run more different focus, which can be achieved in less time and expense to implement.

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