Load Balancing in Multi Cloud Computing Environment with Genetic Algorithm

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Load Balancing in Multi Cloud Computing Environment with Genetic Algorithm

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Abstract. Cloud is a pool of resources that is available on pay per use model. It provides services to the user which is increasing rapidly. Load balancing is an issue because it cannot handle so many requests at a time. It is also known as NP complete problem. In traditional system the functions consist of various parameter values to maximise it in order to achieve best optimal individualsolutions. Challenge is when there are many parameters of solutionsin the system space. Another challenge is to optimize the function which is much more complex. In this paper, various techniques to handle load balancing virtually (VM) as well as physically (nodes) using genetic algorithm is discussed.

1.Introduction

Organization makes use of cloud at high level. As the user request increase rapidly, there is need to response to the request quickly. Load balancing is one of the major issue in cloud computing. The nature of cloud is distributed so it becomes a crucial task to divide the work load in efficient manner. There were many solutions proposed in traditional system for balancing load in cloud. The solutions included certain algorithm such as round robin, opportunistic load balancing algorithm, Max min load balancing algorithm, Min Min load balancing algorithm, honeybee foraging load balancing algorithm. The algorithms that are traditional have one or the other drawbacks which becomes inefficient to handle the load in cloud computing. The main aim of handling the load balancing is to improve the efficiency as well performance of the system. The resources should be utilized to the better extent. The QoS metric should remain same whenever the number of users increases. The service provided by cloud should remain unaffected despite an increase of the user. The response time should be less while providing the service. The system should also be fault tolerant so that whenever one node fails the system should be able to switch to another node or alternate path to distribute the load. Whenever some failure occurs, the system should not get disturbed due to one-point failure. By observing the challenges of traditional algorithm, genetic algorithm is one such algorithm that is used to overcome the challenges that is faced while distributing the load in cloud.

To improve the performance, combination of genetic algorithm and ant colony optimization algorithm is taken into consideration. The ant colony is one of the task scheduling algorithm in load balancing for cloud computing. It searches for the best and shortest efficient path and also reduce the make span for distributing the work load. This algorithm makes uses positive response and act like the real ant colony to find the food and search each other with the help of pheromone which they leave while travelling. The algorithm solves the virtualization placement problem which is occur in cloud computing. Genetic algorithm is famous for searching huge spaces, and also finding the optimal integration of things. This algorithm does not look for the best solution rather it looks for the better and robust result which is compared to fitness criteria. So, while calculating the fitness value it looks for global instead of dividing the local optimal search. Genetic algorithm is purely based on Darwin's principle of natural selection. In short the genetic algorithm uses search and optimized technique to work accordingly. Genetic algorithm is processed in three stage. The first step includes the selection of

population to improve the survival of the fit. Duplication is carried out with the large fitness and drops the less fitness value. Second stage includes crossover solution in better components to better structure in combination to give even better structures. Crossover again combines the element of better chromosomes with different genes. Third stage does the additional work with the previous work just by adding few probabilities. Mutation chose random component of every component. The steps are repeated in genetic algorithm, where every structure deals with the solution at hand. The generation is evolved by carrying out these operations, thereby improving the structure in current population. So this algorithm differs from the traditional algorithm in many ways such as they search parallel in every population. Genetic algorithm has chromosomes concept which gives potential results. The combination of ant colony and genetic algorithm gives efficient result.

2. Literature survey

Kanwarpreet Kaur[1] et al. proposed an effective load balancing algorithm by making use of hybridisation of ant colony optimization technique, ant colony min max technique and genetic algorithm. They developed this effective technique to minimize the cost of migration of VM and maintain the SLA (Service Level Agreement) which is a QoS factor. The migration is done using Ant Colony Optimization (ACO) scheduling algorithm. This ultimately calculates the number of iteration of virtual machines from host applications.Mayur S Pilvare[2] et al. came up with the technique that deals with the starvation problem in load balancing. As genetic algorithm (GA) randomly selects the processors and then applies the genetic algorithm, the fittest processors get the chance and the VM which has lower priority starves. To overcome this problem they used genetic algorithm with the logarithmic least square matrix technique. Through this, priority is assigned to VM to increase the response time of the system and to achieve better load balancing.

Ronak R Patel[3] et al. have proposed an Improved GA by using partial population reduction method (PPRM). This method identifies the healthy chromosome, groups the resources, applies a tournament selection and generates the new population. After this process, GA is applied on the new population and finds a fitness value. Selection, crossover and mutation with toggling of binary bits is carried out. Thus, it helps to increase the response time which leads to better performance of the system and maintains consistency.Aya A. Salah Farrag[4] et al. have surveyed on intelligent cloud algorithm to balance the load and proposed AntLion Optimizer (ALO) to provide better results in balancing the load in cloud. GA follows set of filtration and removes less important solution supporting to add new population obtained from crossover and mutation. This gives more important solutions. ALO handles large problem space.

Hussain A Makasarwala[5] et al.have surveyed on evolutionary GA for generating a solution. Basic GA having terms called population, chromosome, gene and fitness function. It is following three operations such as selection, crossover and mutation. They have considered priority based initial evaluation. By this idea, they achieved better average response time and increases cloudlets with permutation encoding.Vinza V Suthan[6] et al.have proposed Cloud based mostly Storage and dynamic Multimedia Load Balancing (CSdynMLB) method to balance the load of server cluster. In multimedia system, When client requests server via resource manager, additional RAM capacity, CPU and storage space is required for communication between the client and the clustered server. It helps to reduce overhead, moving time and improves the performance.

Santanu Dam[7] et al. have proposed hybrid genetic algorithm and gravitational emulation local search (GA-GEL) algorithm for VM load balance in cloud. They have introduced Job Unit Vector (JUV) and Processing Unit Vector (PUV) terms to obtain fitness function. Result shown with Cloud Analyst simulation tool that differs with different number of data centers. Similar priority is applied to all the requests and ensures better QoS, high interoperability and scalability.Liang Hong [8]

et al. have proposed Genetic Ant Colony Algorithm-Virtual Machine Placement (GACA-VMP) approach to resolve VMP problems using improved ACA. Through this approach, they have selected a feasible path in two steps. First analyse the pheromone whenever ant walks and next evaluates pheromone optimization to balance the VM load. This obtained to efficiently select the physical server and increases the performance.

Wang Li [9] et al. presented the Multi Population Genetic Algorithm (MPGA) instead of genetic algorithm to solve the problem of task scheduling in cloud computing environment to avoid premature convergence. For scheduling min min and max min algorithm is used. A direct encoding scheme is adopted by the author. Brief comparison is done between Time and Cost Genetic Algorithm (TCGA) and Simulated Annealing Genetic Algorithm (SAGA) to evaluate the performance of MPGA. The following result handles the task effectively without any drawbacks.

Keke Gai [10] et al. proposed the novel approach to solve the problem of allocation of data in cloud based heterogeneous memories. The proposed model i.e. Cloud Aware Heterogeneous Cloud Memory Model (CACHM) gives the high performance through heterogeneous cloud memories. Genetic algorithm is used to reduce the overall cost with the help of merging the data capabilities with various datasets. For this whole process a new algorithm which is Dynamic Data Allocation Advance is merged with genetic algorithm. This ultimately scales up the memory capability in cloud environment.

William A. Greene [11] has proposed a routine for scheduling GA. In addition to GA, it accommodates the enqueues task periodically, balances processors load and schedules as per time interval allocated to machines. Thus, it gives balanced schedules with less cost and better performance. Ali Bentaleb [12] et al. presented the web based composition technique which consist of genetic algorithm in Cloud Saas to reduce the breakage of Service Level Agreement (SLA). The proposed system works with the Saas to deal with cloud provider and consumer in several Cloud computing environment. This results in client security and reduces complexity in the system.

Yonghua Xiong [13] et al. proposed the Johnson's-rule- based genetic algorithm for data-centres scheduling in cloud environment. It solves the problem of two stage scheduling, where it is able to give the optimize solution in allotted time. The main motive of this algorithm was to drop the idle time of the given two machines by adjusting the time. The GA implemented in this paper works with the mechanisms, such as reproduction, crossover and mutation. The combination of Johnson's and GA algorithm is given as JRGA to work with multiprocessor scheduling.Zhao Li [14] et al. has proposed Link Load Balancing based on Improved Genetic Algorithm (LLBIGA) to balance the network load. This algorithm speeds to minimize link delay and has high fitness value of population. Depending on constraints like link bandwidth, latency, utilization and delay, it finds global optimal solution.

Neeraj Kumar Sharma [15] et al. presented the Hybrid Genetic Cat Swarm Optimization (HGACSO) algorithm to make the system energy efficient and to avoid the wastage of resources. The migration of Virtual Machines (VM) is done using the above algorithm which reduces the energy consumption. This technique drops out 50 per cent chromosomes with less fittest value and makes use of Cat Swarm Optimization (CSO) to the fittest value. The crossover and mutation mechanism is applied on Cats and are arranged in descending order w.r.t their fitness value.

3.Methodology

Load Balancing can be handled by various mechanisms and algorithm. In this paper, we present the integrated genetic and ant colony algorithm for virtual machines placement problem. Existing Algorithm GACA-VMP targeted on scheduling policy of cloud data center which ultimately solves the root problem. This tries to make available large number of VM and serves these resources as service in homogenous cloud environment. The proposed work enhances the scheduling policy of heterogeneous cloud environment (Figure 1).

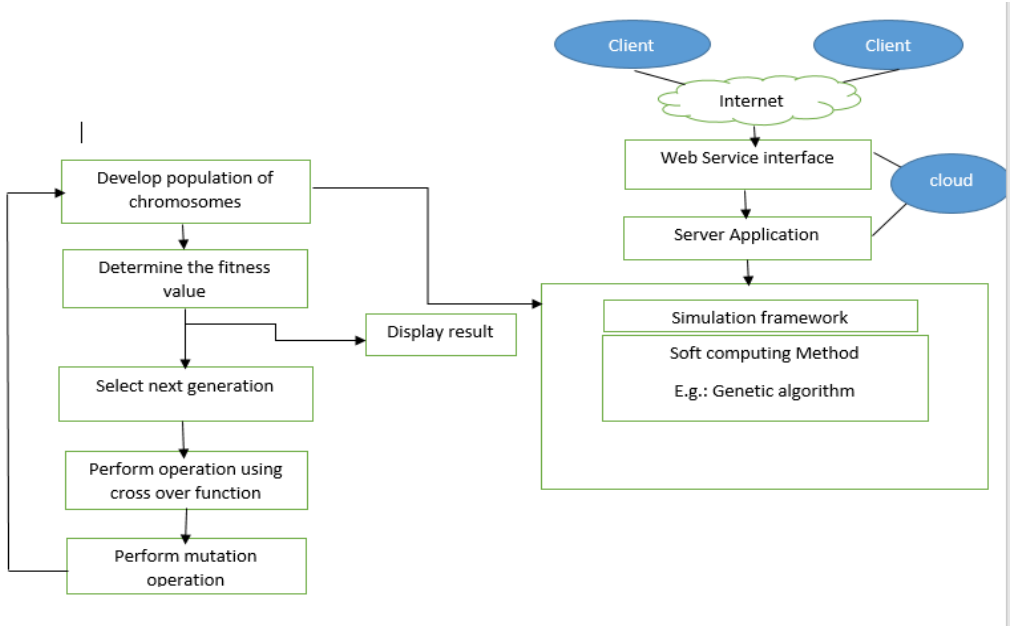

Fig .1. Genetic algorithm in Cloud

Algorithm: Genetic algorithm

1. Initialize the population by taking random generation
2. Equate every candidate solution
3. While termination condition not true do
   Choose the individual for next generation
   Take combination of parents
   Mutate the resulting offspring
   Evaluate every candidate solution
4. End

4. Results

The iteration points are plotted in the graph. The best optimized value using mathematical equationis 13.0031.

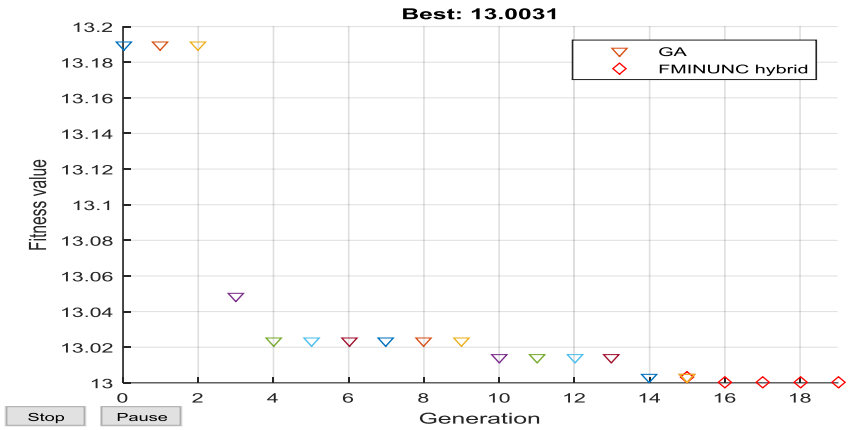

Fig .2. The fitness graph using mathematical equation

Following graph in Fig 3 shows the optimization output using MATLAB Genetic Algorithm toolbox. The best optimized value obtained is 13.0005.

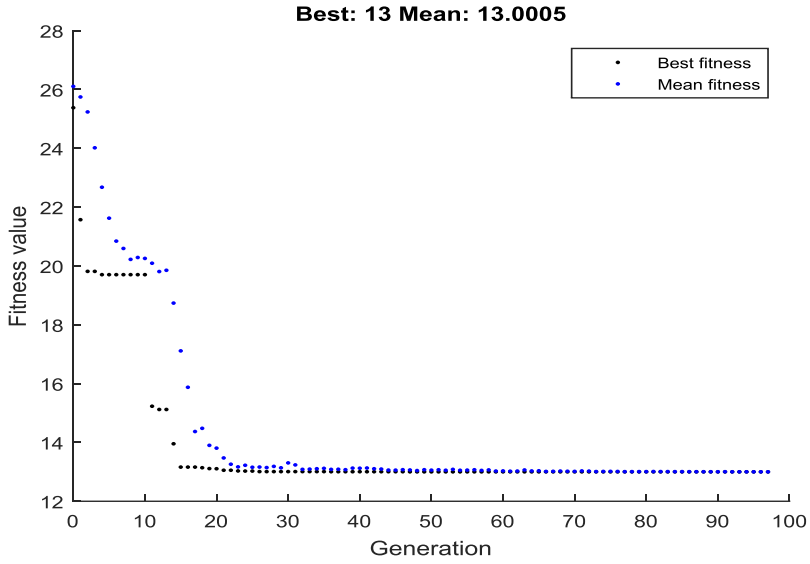

Fig 3. The fitness graph using GA tool box

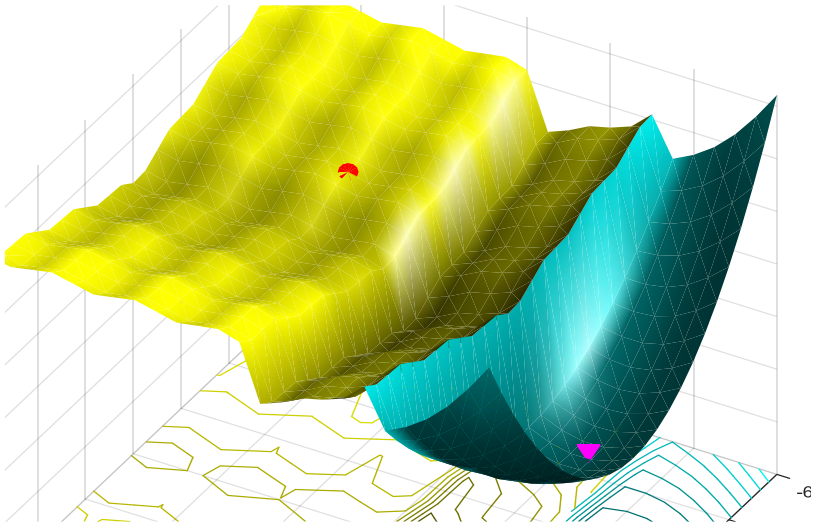

Fig 4. 3D Graph

Toolbox procedure:

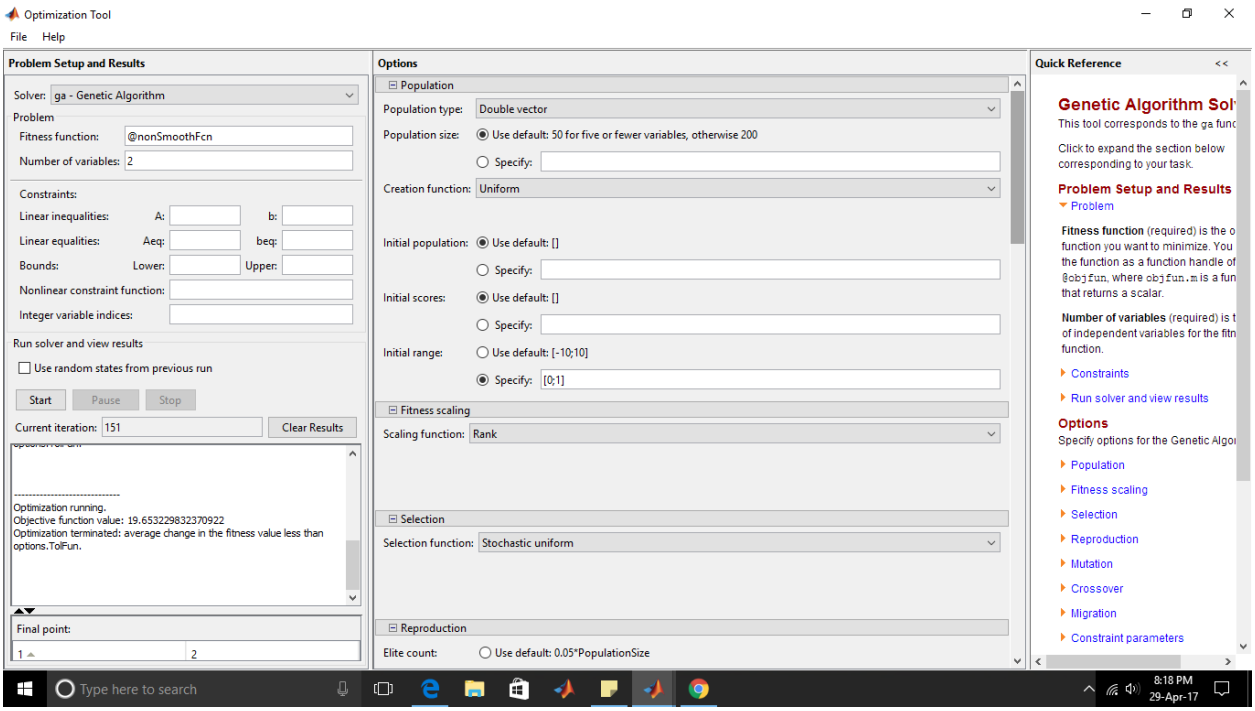

Fig 5. Showing problem setup

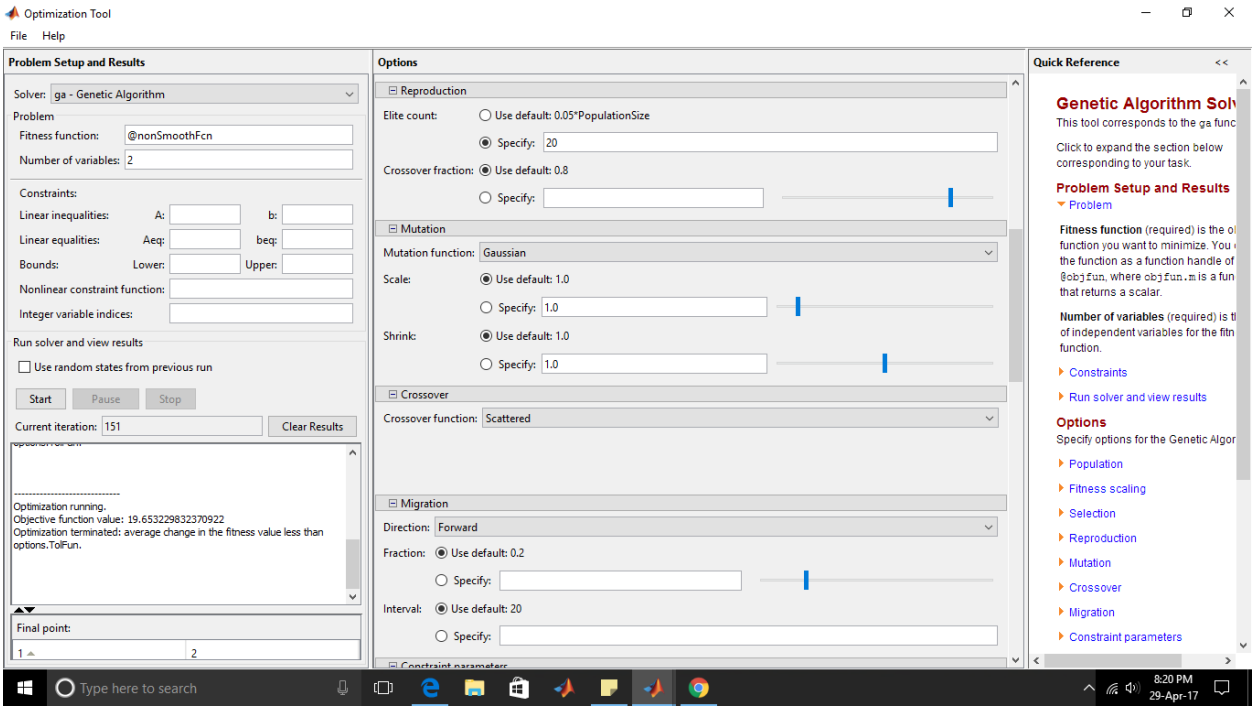

Fig 6. Options of Reproductions

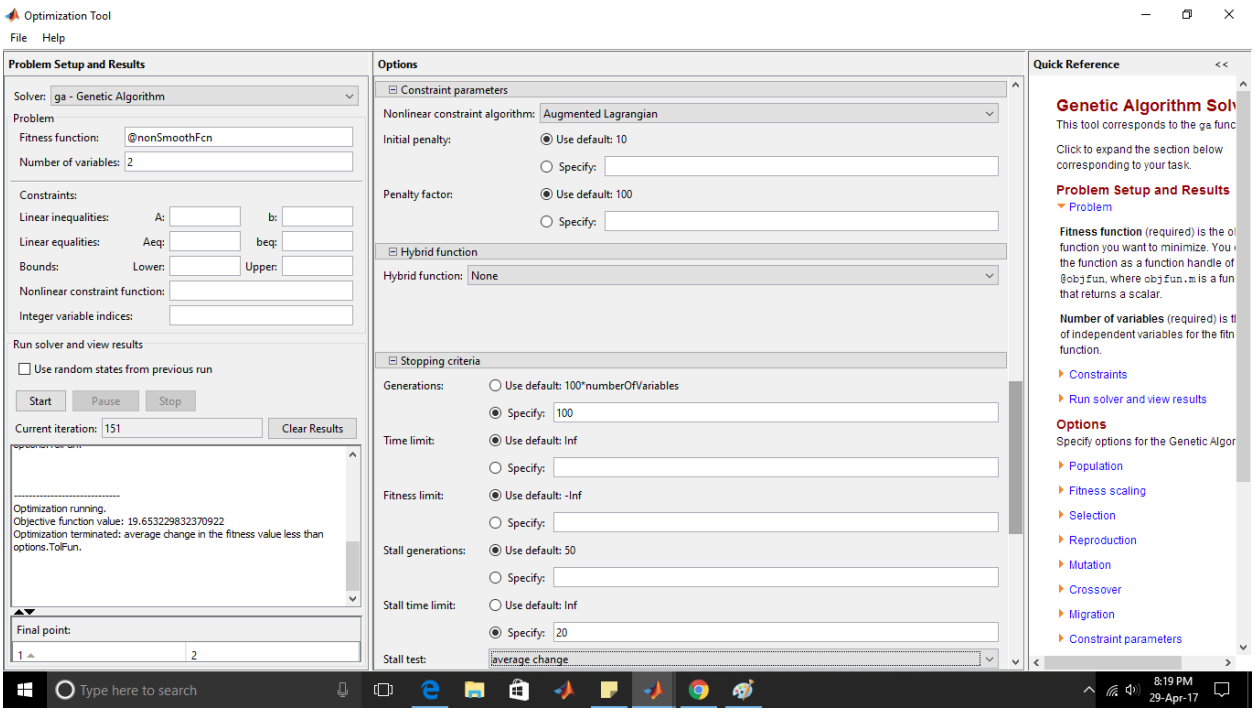

Fig 7. Options for stopping criteria

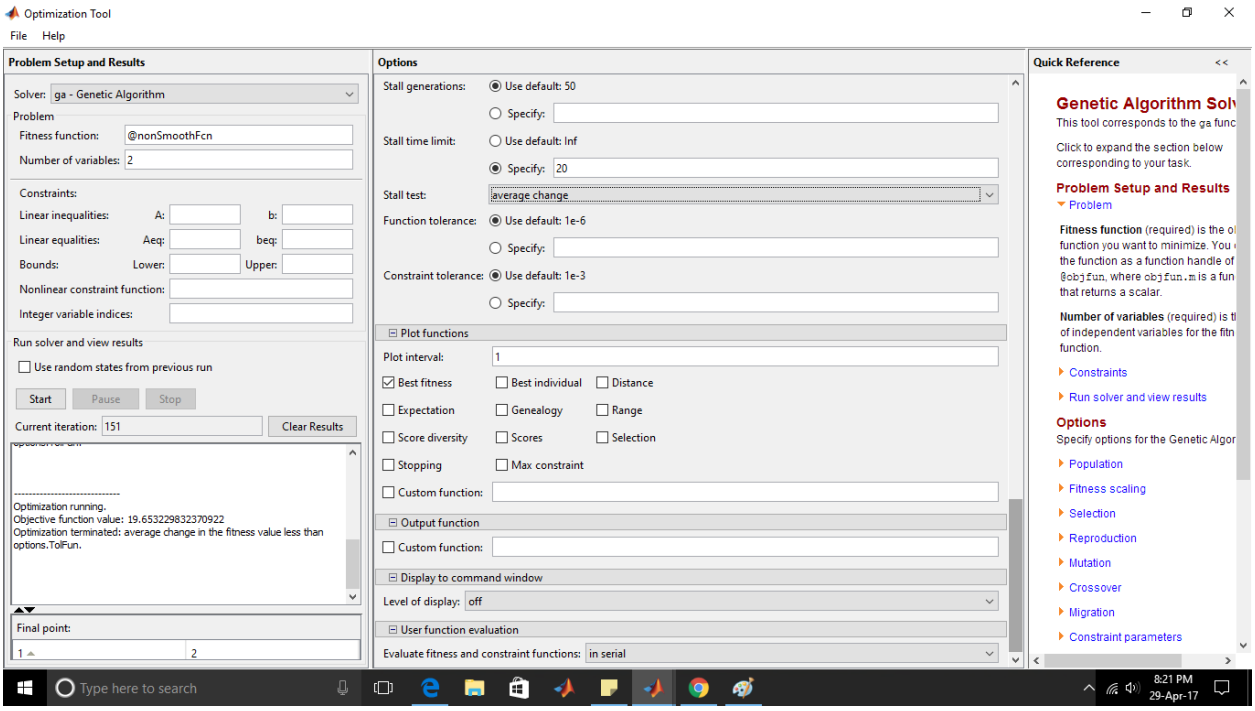

Fig 8. Options for Plot Function

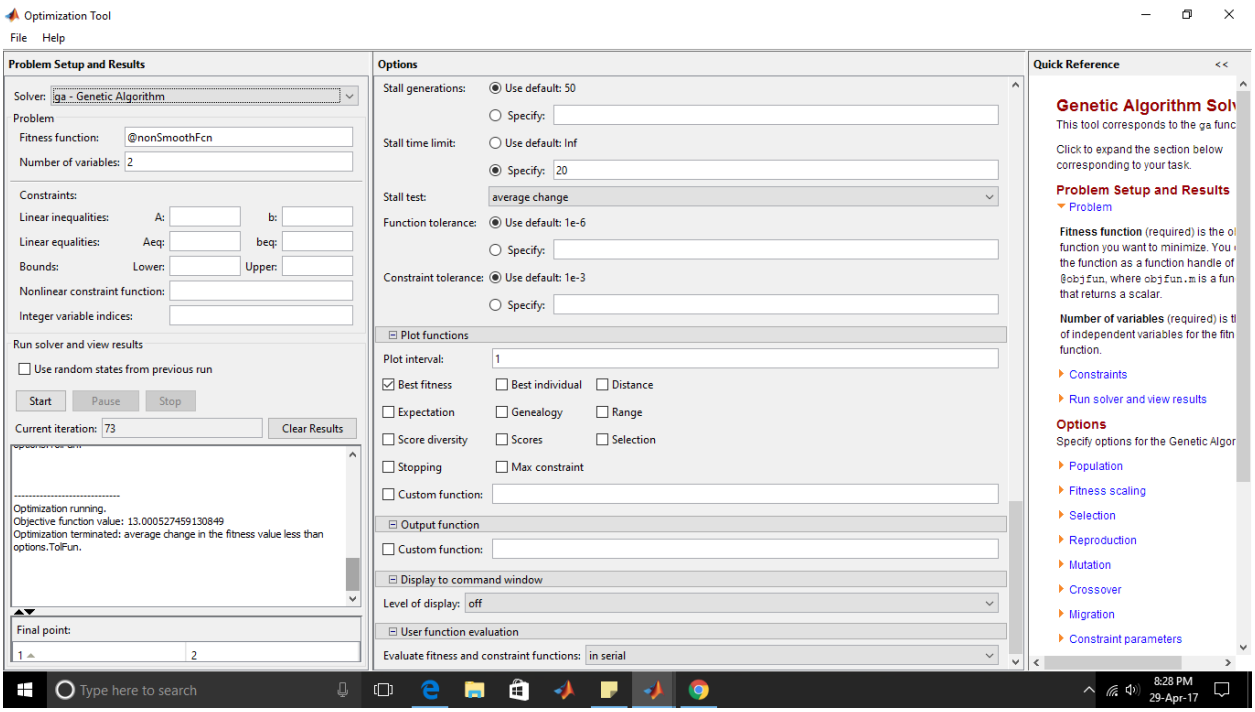

Fig 9. optimized fitness funtion value for GA

5.Conclusion

The main issue faced by cloud computing is load balancing which is avoided by most algorithms presently. Genetic Algorithm is one of the dynamic and centralised load balancing technique which uses its operatios such as population, chromosomes, mutation, with some additionaly featured condition. The problem statement defined in the paper presents the result analysis using matlab with genetic algorithm in cloud computing. Thus the analysis carried out concludes that genetic algorithm minimises the response time.

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