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Implementation of Genetic Algorithm for Solving De Jong Test Function on Cloud Environment and Compare Its Performance with Local Host Environment

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Abstract — **In this day, Cloud Computing has gained large attention not only from IT specialists but also from many clients. It is global network (internet)-based computing, where shared resources, software and information are provided to computers and other devices on-demand, like the electricity bill. Firstly Cost can be reduced and the technology is also known as green saver or power technology. Secondly, the dynamic and flexible scalability of cloud computing. The third is that cloud computing is platform independent means any internet supported system can be used to access cloud environment. In our paper, we will discuss the utility of the cloud computing for scientific computing. Google App Engine (GAE) is adopted because it is open source or free and good software development Kit is available. Simple Genetic Algorithm are implemented on the GAE for solving the minimization of De Jong Test Function and for measuring the performance of cloud for showing that how cloud is the better choice than desktop.**

Key Words — **Cloud Computing, De Jong test function, Genetic Algorithm, Google App Engine.**

1. INTRODUCTION

Cloud computing is one of the greatest new buzzwords on the next generation of computing. It has drawn large attention not only from IT analyst or specialists but also from several clients. It is internet-based computing, where shared resources, software and information are provided to computers and other devices on-demand, like the electricity grid.[1] we want to measure the performance of Google App Engine, one of the world's most established cloud service provider by using the De Jong test function minimization problem implementing the Genetic Algorithm. More importantly, the ability to dynamically reallocate resources using virtualization technologies can help mitigate the need for additional investment in infrastructure to meet sudden spikes in demand by temporarily diverting existing resources from low-priority business applications to high priority business applications. [1]

A. Definitions of Cloud Computing

A cloud computing platform dynamically provisions, configures, reconfigures, and deprivations servers as needed. Servers in the cloud can be physical machines or virtual machines. Advanced clouds typically include other computing resources such as storage area networks, network equipment, firewall and other security devices. Cloud computing also describes applications that are extended to be accessible through the Internet. These cloud applications use large data centers and powerful servers that host Web applications and Web services. Anyone with a suitable Internet connection and a standard browser can access a cloud application. There is a lot of concept about cloud computing have been given already this is another convenient idea about cloud computing buzzword. A large-scale distributed computing paradigm that is driven by economies of scale, in which a pool of abstracted virtualized, dynamically-scalable, managed computing power, storage, platforms, and services are delivered on demand to external customers over the Internet. [2]

Finally Cloud computing is sum of software as a service and utility computing. For Example Coca-Cola uses the Azure for low maintenance cost in cloud. Acquisition is achieved by using digital camera and webcam. Then image scaling and filtering technique is performed. Then image segmentation is performed. [2]

B. Five Essential Cloud Computing Characteristics

1. On-demand self-service
2. Broad network access
3. Resource pooling (Location independence)
4. Rapid elasticity
5. Measured service

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C. Cloud Service Models

1. **CLOUD SOFTWARE AS A SERVICE:** USE CLOUD SERVICE PROVIDER'S APPLICATIONS OVER A GLOBAL NETWORK (INTERNET)

2. **CLOUD PLATFORM AS A SERVICE:** DEPLOYING DEVELOPER'S APPLICATIONS TO A CLOUD AND ALSO ALLOW TO MANAGE THIS APPLICATION IN DEVELOPER SIDE

3. **CLOUD INFRASTRUCTURE AS A SERVICE:** RENT PROCESSING COMPUTING RESOURCES, STORAGE, NETWORK CAPACITY, AND OTHER FUNDAMENTAL COMPUTING RESOURCES LIKE DATA STORE, AMAZON EC2 SERVICE CAN BE CONSIDERED AS GREAT EXAMPLE.

D. Cloud Deployment Model

1. **PRIVATE CLOUD:** SPECIFIC ENTERPRISE OWNED

2. **COMMUNITY CLOUD:** SHARED RESOURCES FOR SPECIFIC ORGANIZATION OR GROUPS

3. **PUBLIC CLOUD**: SOLD TO THE PUBLIC, MEGA-SCALE INFRASTRUCTURE

4. **HYBRID CLOUD**: MIXED OF TWO OR MORE CLOUDS

2. WHAT IS GOOGLE APP ENGINE?

Google App Engine is a Python-based runtime platform that provides web application hosting, data storage and high-speed networking by running on top of Google's massive infra-structure. In particular, Google App Engine is designed to host applications with many simultaneous users. [3, 8] GAE considered as a platform as a service. Developers can use the preview release of the GAE API and serve applications free of charge or obligation, with some restrictions:

- They're limited to 5 million page views per month (bandwidth and CPU usage).
- They can consume only 500 MB of persistent storage.

The restrictions aren't bad considering the upside:

- Development takes place in the end users' local environment, and OS X, Linux, and Windows are all supported.
- Google App Engine provides efficient dynamic web application execution, even under load or with heavy data usage, thanks to built-in scaling and load balancing.

The persistent storage system supports transactions, queries, and sorting-mail support uses the Gmail API for authentication and e-mail support. [8]

3. GENETIC ALGORITHM

Genetic Algorithms (GAs) are adaptive heuristic search algorithm based on the evolutionary ideas of natural selection and genetics. It is a rapidly growing area of artificial intelligence. Genetic algorithms belong to lot of best characteristics that decides it's a good option when someone needs to solve very complicated problems or NP hard problems. The simplicity and robustness of the algorithm has made it popular among developers. [6]

A basic flowchart of a genetic algorithm has been given here

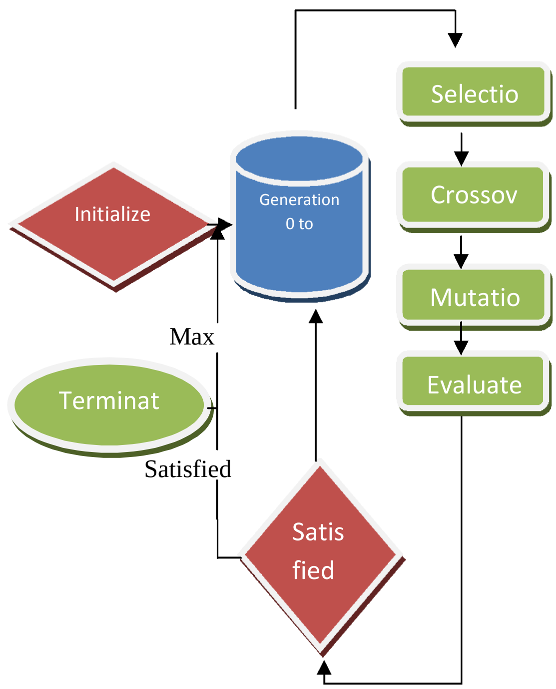

Figure 3.1: A basic flowchart of a Genetic Algorithm. [10]

4. DE JONG TEST FUNCTION

De jong test functions for testing evolutionary algorithms with. These test functions are continuous and are considered by many to be a minimum standard performance comparison for evolutionary algorithms [7], which genetic algorithms are a part of. The test suite has become a classic set and contains a set of 5 mathematical functions that isolate the common difficulties found in many optimization problems (Goldberg, 1989).We have chosen De Jong test functions because they are well tested,

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so we can compare our result to others. Because of the different characteristics that De Jong's functions has are we able to test our hypotheses over a large set of mathematical functions

A. Test function 1 for sphere

This three-dimensional function is a simple, non-linear, convex, symmetric function that poses very little difficulty for most optimization methods. The sphere is intended to be a performance measure of the general efficiency of an algorithm.

$f1 = \sum_{i=0}^{3} x_i^2, xi = [-5.12, 5.12]$............ [7]

B. Test function 2 or Rosenbrock's Saddle

This two-dimensional function is a standard test function in optimization literature and was first proposed by Rosenbrock in 1960 (Jong, 1975). The function is smooth, unimodal and can be quite difficult for algorithms that are unable to identify promising search directions with little information. The difficulty lies in transiting a sharp, narrow ridge that runs along the top of the saddle in the shape of a parabola.

C. Test function 3 for step

This five-dimensional function that is discontinues, consists of many flat plateaus with uniform, steep ridges. This function poses considerable difficulty for algorithms that require gradient information to determine a search direction and it is easy for ordinary optimization algorithms to get stuck on one of the flat plateaus.

D. Test function 4 or Quadratic

This 30-dimensional function includes a random noise variable that ensures the function never evaluates to exactly the same value for the same solution vector. Thus, the quadratic function tests an algorithm's ability to locate the global optimum for a simple unimodal function that is padded heavily with Gaussian noise.

E. Test function 5 or Shekel's Foxholes

This two-dimensional function contains many (i.e., 25) foxholes of varying depth surrounded by a relatively flat surface. Many algorithms will become stuck in the first foxhole they fall into.

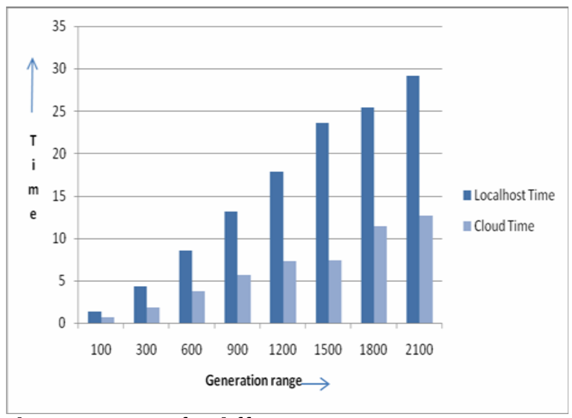
5. Experimental Results

The following mentioned table shows the result of local host and cloud environment (Google App Engine) computational speed individually for different generation and population size. Here in first case the X axis is the generation and y axis is consider to represent computational time. In second case X axis is the population size and y axis is remain for representing computational time. We can see the figure for sphere function computational speed for local host and Google app engine. Here is the table for showing the computational speed on both environments for different generation.

Generation	**Local Host Environment (time in sec)**	**Cloud Environment (time in sec)**
100	**1.390**	**0.703**
300	**4.359**	**1.821**
600	**8.500**	**3.711**
900	**13.125**	**5.614**
1200	**17.795**	**7.323**
1500	**23.562**	**9.427**
1800	**25.375**	**11.415**
2100	**29.172**	**12.685**

Table 5.1: Comparison between Cloud performance and Desktop performance according to generation.

Here is the figure for showing the computational speed on



both environments for different generation

Figure 5.1: Population VS Time graph for sphere function (C= 0.8, M= 0.002, Generations=500)

Here is the table for showing the computational speed on both environments for different population.

Population	**Local Host Environment (time in sec)**	**Cloud Environment (time in sec)**
100	**6.828**	**3.085**
150	**10.234**	**4.548**
200	**14.422**	**6.593**
250	**18.404**	**7.992**
300	**21.438**	**9.124**
350	**25.250**	**10.296**
400	**30.781**	**12.369**
450	**35.141**	**14.413**

Table 5.2: Comparison between Cloud performance and Desktop performance according to population.

Here is the table for showing the computational speed on both environments for different population.

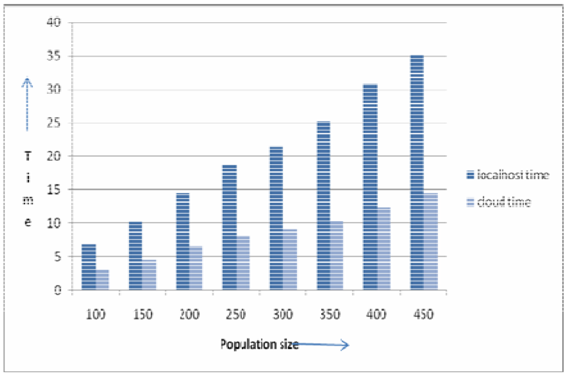


Figure 5.2: Population VS Time graph for sphere function (C= 0.8, M= 0.002, population=100)

6. Conclusion

Cloud computing is one of the foundations of the next generation of computing. A way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software. Certain applications, usually those already geared towards a web environment lend themselves very well to the cloud computing environment. For these applications, the advantages of the environment are a huge advancement over the features and pricing available just a few years ago. On the other hand, there are applications which aren't quite as fitting of a match to the cloud environment as others. The processing power and instant response required by demanding locally running applications are not yet ready to be replaced by an application in the cloud. Ultimately, we come back to the original question. Can cloud computing ever replace traditional desktop computing? I believe that the answer is yes. The biggest obstacle, internet connectivity, is already bordering on universally available in the world among populous areas when including cellular access. As technology continues to progress and devices converge, the move to the cloud will continue to expand. The transition will likely not take place in the immediate future, but as technology progresses, the traditional desktop computing environment will become as outdated as the mainframe. Finally I want to give information, that is Google, IBM, Amazon, Microsoft and others are investing billion, billion dollar for developing cloud based application.

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