

Cloud Testing Papers Review and Proposed Approach

Swapnali Shrikhande

Graduate Masters Student, Department of Computer Science, California State University, Sacramento, California, US

ABSTRACT: With increasing adoption of cloud over physical data centers and servers, cloud computing has become an inseparable part of computer technologies. These cloud services are made available to the public by tech companies who charge its user for subscribing to a part of their virtual space. These cloud service providers have an additional responsibility of providing a secure, failure resistant, reliable and robust network of virtual computing resources. Testing of application hosted on cloud platforms hence becomes a necessity. The cloud providers are only responsible for reliability of computing resources. The mere layering of cloud infrastructure services introduces additional layer of uncertainty in testing applications hosted on cloud. Any performance issues in applications hosted on cloud could be due to errors in application or network or virtual machine or the cloud architecture itself. It is important to acknowledge these complexities and derive methodologies for testing cloud applications. In order to account for uncertainty factor multiple variables of the network and cloud must be monitored and measured. In this paper we have presented the multiple parameters that should be measured and means to measure them to derive testing of cloud infrastructure and its applications. Along with this we have suggested how these results can be utilized by cloud admins to design distribution and allocation of cloud computing resources.

KEYWORDS: Cloud Computing, Cloud testing, Performance, Cloud uncertainty

I. INTRODUCTION

Cloud Computing is one of the most quickly adopted computer technologies. The cloud service providers offer cloud containers, security, storage services and analytics platforms to its users based on plans subscribed to. They also have the responsibility of providing reliable and robust computing resources. Cloud constitutes of layers of virtualization which differs as per organizations in terms of their application requirement, availability of physical computing resources, data storage requirement and performance. The cloud resources are stored and executed remotely on virtual machines which all adds to the applications' performance factors. Cloud providers ensure that the performance of these virtual machines is maximised, and they are well tested. Customers are given the options of increased performance of virtual cloud computing resources at the expense of additional costs. Although it does not guarantee the testing and performance of software applications running in cloud containers. Also, the performance of virtual resources on cloud is unpredictable because of its dependence on internet and layers of virtual resources with high level of dependence on the virtual layer below it. There are a few methodologies proposed for measurement of testing and performance parameters of software applications hosted on cloud. These measurements can be gathered from each layer of the virtual computing platforms. Tests that are required for accurately measure performance of cloud application are:

1. Load and performance testing
2. Functional testing
3. Latency testing
4. Browser performance testing
5. Compatibility testing
6. Stress testing

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 8, August 2019

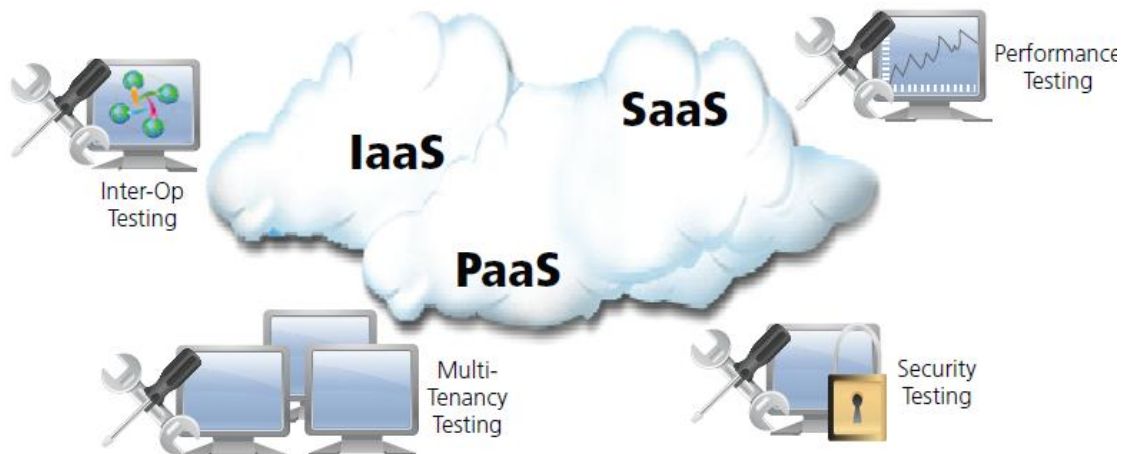


Fig 1. Cloud testing across different cloud services [1]

As cloud services are completely dependent on internet for execution makes the cloud applications complicated to test and trace point and reason of failures. Other threats include failure in actual physical machines on which the virtual machines execute. To understand the methods for testing in cloud applications we review two papers here:

1. Testing cloud applications under cloud-uncertainty performance effects [2]
 - Abhijeet Shrivastava, Lori Pollock, Mary Lou Soffa, Sen He, Sunzhou Huang, Wei Wang, Ningjing Tian
2. Performance Testing Web Applications on the Cloud [3]
 - Joydeep Mukherjee, Diwakar Krishnamurthy, Mea Wang

Paper 1 introduces Cloud Application Performance Tester (CAPT) tool, whereas Paper 2 presents techniques used for testing by classifying cloud applications as small, medium and large running on Amazon Web Services (AWS) Elastic Cloud Compute (EC2) instance.

This paper presents review of these two papers and suggests analytics approach based on them to improve cloud application performance, and how to leverage these metrics in re-designing cloud architecture of the company for optimized performance. The rest of the paper is organised as follows: Section II will be review of the two papers mentioned above. Section III presents our machine learning analytics approach based on methodologies proposed in previous section. Section IV presents conclusion of our findings.

II. REVIEWED PAPERS

- **In [2]:** This paper proposes various parameters that are direct measures for indicating performance of cloud application. Its major contribution is developing tool called Cloud Application Performance Tester (CAPT) that implements a black box like container for testing cloud applications. This performance measurement is done in three steps:
 - a. Characterization tests
 - b. Performance tests of the application
 - c. Test oracle to determine if application meets virtual

Authors of the paper tested this approach on amazon web services (AWS). The applications tested were classified as small, medium and large with respect to the breadth of the network to be tested.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 8, Issue 8, August 2019

	t2.small	t2.medium	t2.xlarge
ground truth tests	\$54.10	\$109.13	\$436.53
CAPT total costs	\$22.75	\$38.51	\$137.79
CAPT cost reduction	58.0%	64.7%	68.4%

[2]

The findings were recorded as above. Clearly testing with CAPT proved to be cost effective than testing without any tools. As a result, this led to a cost reduction of 68.4% for large systems and 58.0% for small systems.

However, this approach comes with a couple of inherent shortcomings. Firstly, the paper considers data processing and CPU processing time as same. Also, the paper has no mention of scenarios where multiple or layers of virtual machines are involved.

- **In [3]:** In this approach, the authors accounted for CPU, CPU cores, memory and disk units of the virtual machines tested. These parameters were tested against Elastic Compute Cloud (EC2) instances. This leads to a precise measurement of the actual processing involved. The following results were recorded on small, medium and large instances:

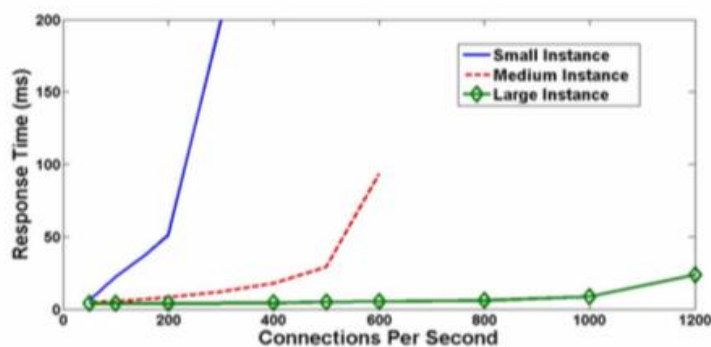


Fig. 2. Performance of EC2 instances

[3]

The instances were monitored every hour of the day for one week. As seen, large instance is best both in terms of response time and throughput. Thus, the paper further draws conclusion that small instances are highly variable depending on time of the day, whereas performance of large systems is stable as compared to medium and small instances.

Certainly, this paper considers external factors for cloud performance measurement. However, the test was only monitored for weeklong duration and needs to be conducted on heavy workloads.

III. PROPOSED APPROACH

Paper [2] and [3] were very helpful in our understanding of the cloud testing approaches. The two papers complement each other well. Paper [3] proposes multiple parameters that are direct measures for indicating the performance of a cloud application. However, it considers a flat structure, whereas cloud infrastructures are built bottom-up on top of some already existing infrastructure. Hence, measuring the underlying infrastructure first and then adding up the values for the layer ensures that no all cloud parameters

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 8, Issue 8, August 2019

are taken into consideration. Also, the small, medium and large infrastructure can be executed over a period and saved as historical data to derive patterns using machine learning (ML).

- Paper1 [2] proposes a tool for testing the cloud performance but only considers CPU processing measures as its prime testing determinant.
- Proposed solution:
 - Gather direct measures of performance as in paper 2, first for underlying infrastructure.
 - Repeat the above step until the most top layer is built.
 - Run the data through supervised machine learning algorithms.
 - Generate test-suite performance parameters.

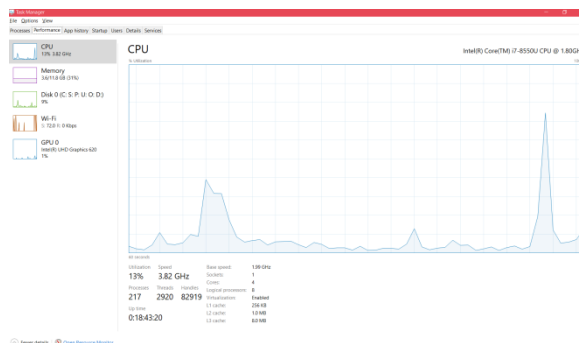
A. Description of Proposed Approach:

Step 1: Gather direct measures of performance as in paper 2, first for underlying infrastructure

- Segregate systems as small, medium and large.
- Collectl [4] can be used in each VM instance to monitor CPU utilization.
- Iperf [5] is used to monitor network bandwidth.
- Infrastructure information of region, number of subnets, operating system, web server and database server.

Step 2: Repeat the above step until the most top layer is built.

- Starting from actual physical machine, measure its performance parameters through Task Manager.



- For openstack [7] we can use osprofiler [6] to trace our results, AWS will provide its services for paid versions. These plugins must be explicitly enabled.
- Store this data collected in historical database.

Step 3: Run the data through supervised machine learning algorithms.

- Employ supervised learning algorithms [8] on this historical dataset which includes both input and output to further predict the output.
- This is the black box machine learning (ML) suite that generates result file that indicates regions in same ordifferent region of low latency and performance for each layer of infrastructure.

Step 4: Generate test-suite performance parameters

- The expected output values are test-parameters for an inevitably uncertain cloud infrastructure platform.
- Use CAPT [2] tool actual testing.

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Vol. 8, Issue 8, August 2019

IV. CONCLUSION AND FUTURE WORK

The revised approach provides following features:

- Irrespective of the type of application hosted and cloud platform used this approach will generate a cloud test-suite
- This implementation will measure unpredictability test parameters within range
- This will provide test parameters for entire cloud's functional, non-functional and performance test cases with respect to infrastructure.

The following add-on can be considered for future work:

- Adding design suggestions sheet as an output along with CAPT tool performance results.
- Due to heavy cloud data there is a possibility of the historical data being populated very quickly and there needs to be a technique to cap that.
- The performance should be further improved by exploring other algorithms in Machine learning which gives the best outcomes for the performance testing by generating better set of test suits.

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