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Framework for Analyzing and Testing Cloud based Applications

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Abstract- Software testing is the process of assessing the functionality and correctness of a program through execution and/or analysis [1]. Testing is a challenging activity for many software engineering projects and is one of the five main technical activity areas of the software engineering lifecycle that still poses substantial challenges, especially for large-scale systems. Because testing can be such a difficult, expensive, and labour-intensive process, there is always high demand for better testing support. Cloud Testing is the method of software testing based on cloud computing technology and is provided using Web Access to Cloud Testing Services or Using Virtual Machine Technology in which Cloud testing service providers provide the IP of the virtual machine; clients connect the virtual machine through remote desktop and other ways.

Keywords- Cloud Computing, Cloud Testing, Software Testing.

I. INTRODUCTION

Software testing is an integral and important phase of the software development process. Testing requires expensive dedicated infrastructure and resources that were only used sporadically which scrutinizes the application's performance, reliability, speed, security and functionality. Since, business applications are growing in complexity, it is somewhat difficult for organizations to build and maintain in-house testing facilities that imitate real-time environments. This is where cloud testing has emerged as a fresh approach to testing where cloud computing environments are leveraged to simulate real-world user traffic by significantly decreasing costs [2]. It is defined as a software testing using Cloud Computing and was introduced by Tieto in year 2009 in Denmark. According to Wikipedia, "cloud testing is a form of software testing in which Web applications leverage Cloud computing environments ("cloud") seek to simulate Real-world user traffic as a means of load testing and stress testing web sites. Unit testing activities are another area where on-demand software testing service can be utilized. Symbolic execution concept has been migrated to cloud environment, which facilitates automatic test case generation for unit tests [3] [4] [5].

II. CLOUD TESTING TYPES

A. *Functional Testing*: Applications deployed in the cloud can be tested for the expected features and the functionalities by matching them with the document collected from the user, if present they are ready to use otherwise customization process is needed.

B. *Multi-tenancy*: It is sharing of resource by more than one tenant. It is the responsibility of the service providers to build effective network infrastructures and data architectures that are computationally efficient to support multi-tenancy.

C. *Performance Testing*: The fast-paced deployment and the ease of deployment of cloud applications force the testers to test features like Response time, maxload and Scalability.

D. *Security*: The primary testing parameters in security testing are Data integrity, security standards. Since cloud computing is at an infant stage not too many standards are developed and available. Security also plays a major role in multi-tenancy where authentication, data access matters.

E. *Compatibility*: .Testers are required to test the applications deployed in the cloud with different browser types, operating systems etc.

F. *Negative Testing*: Self Healing – We want applications deployed in the cloud has to get back functioning without human intervention when disaster occurs. We have to test all the layers in applications deployed in the cloud.

G. *Conformance to Standards*: Since applications deployed in the cloud are being used by many applications and cannot be restricted to limited usage different organizations have their own compliance standards in terms of data, applications, retention etc.

H. *Upgrade and Disaster Recovery*: Applications must be tested for upgrades and how the application deployed in the cloud recovers if some disaster occurs, like What recovery procedure is followed.

I. *Latency*: Now we are purely dependent on the internet, latency plays crucial role, because of the geographical zones. Latency is more specific to an application deployed on the cloud.

J. *Endurance*: Ensure High Mean time before Failure – we do not want our applications deployed in cloud to break down or face some issues, so we test cloud applications for Endurance [6].

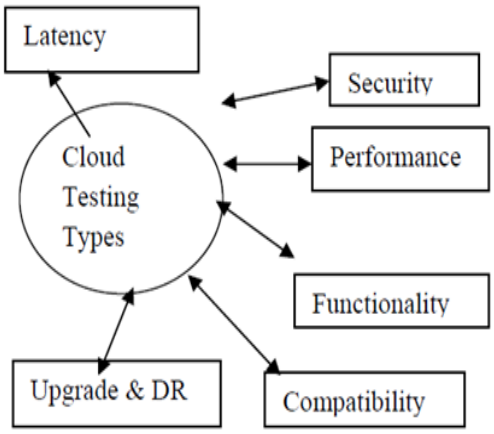

Figure 1. Types of Cloud Testing[6]

III. CHARACTERISTICS OF APPLICATIONS

Not all applications are suitable for testing in the cloud. For some, the cost of migration may outweigh the amortized benefits. Characteristics of an application that can make it feasible for its testing process to migrate to the cloud include:

A. Test Case Independence

When test cases are migrated from their current environment to the cloud, the speedup will often be achieved through concurrent execution of the test cases. Concurrent execution is only possible if the test cases (or collection of test cases) are independent from one another.

B. *Known Operational Environment*

A well-known theory is that automated testing aids in reducing the execution time for test cases. It is true in terms of test execution that running automated regression suite ensures that any modification made to a system works correctly. The unfortunate truth is that most people tend to forget that test automation requires software engineering as well [8]. The operational environment for a test case also includes all libraries, components, and other programs that the application under test requires. Sometimes the application's dependencies are not clear; they are implicit in the original testing and/or development environment. In such cases another form of dependency analysis must take place. Like the test case ordering analysis, this form of analysis can also be quite complicated, requiring a combination of static and dynamic code analysis techniques. Automated testing process requires three components: the test code, the application under test, and the libraries and other dependencies that the test cases require to execute.

C. Programmatic Interface

One assumption underling the migration of testing to the cloud is that the testing will be done in an automated manner. Test automation is more efficient when the application under test has programmatic interfaces. It is true that record-and playback tools can be used to automate activities such as GUI testing even when the application does not have a defined programmatic interface. However, this would limit the type of testing that can be performed in the cloud and thus reduce the potential benefits of the migration [7].

IV. FORMS OF CLOUD-BASED SOFTWARE TESTING

There are four different forms of cloud-based software testing. Each of them has different focuses and objectives.

A. *Testing a SaaS in a cloud* – It assures the quality of a SaaS in a cloud based on its functional and non-functional service requirements.

B. *Testing of a cloud* – It validates the quality of a cloud from an external view based on the provided cloud specified capabilities and service features. Cloud and SaaS vendors as well as end users are interested in carrying on this type of testing.

C. *Testing inside a cloud* - It checks the quality of a cloud from an internal view based on the internal infrastructures of a cloud and specified cloud capabilities. Only cloud vendors can perform this type of testing since they have accesses to internal infrastructures.

D. *Testing over clouds* – It tests cloud-based service applications over clouds, including private, public, and hybrid clouds based on system level application service requirements and specifications. This usually is performed by the cloud-based application system providers [8]

V. ADVANTAGES OF USING CLOUD COMPUTING IN TESTING

A. *Less management work*: As the user in borrowing the service/ platform/ infrastructure from the cloud service provider, there is no need to deploy employees in managerial work for code deployment,data space, test servers etc. hence the operating of the project becomes less complex and containing less man power and work practice.

B. *Cost effective*: when a user borrows any service/platform/ infrastructure from the cloud, it is contracted for particular period of time. In other users user is paying only for the period for which he is using the cloud services. Hence the overall cost reduces because user does not need to buy the infrastructure or platform. So testing with cloud is cost effective also.

C. *Independent work environment*: As testing is performing for the application which are on cloud, there is less dependency of office setup or team setup because user can access the application under test through internet. Location base issues also eliminates with cloud assistance [9] .

D. Improve the Testing Efficiency: Using cloud testing, we can reduce the time to build a test environment greatly, such as machine and network preparation, the operating system installation, software installation of various testing tools.

E. Performance Testing is More Realistic: Performance test on the cloud testing platform, you can open more clients, and the test itself is the external net application rather than the inter-enterprise internet simulation which covers more realistic scenario. If you can find and deal with the unexpected traffic peaks, it will make the test software get great function improvement.

F. Changes in the external environment: With the progress of cloud computing technology, the companies will provide software products and services through the network (cloud), we can only "rent" rather than "buy" to use these testing software, that is, only cloud testing.[6]

VI. CHALLENGES IN CLOUD TESTING

A. *On-demand test environment construction*: How to set up a testing environment systematically (or automatically) for on-demand testing services in a cloud? Although the current cloud technologies support automatic provision of required computing resources for each SaaS (or application) in a cloud, there are no supporting solutions to assist engineers to set up a required test environment in a cloud using a cost-effective way.

B. *Testing security and measurement in clouds:* Security testing has becoming a hot research subject with many open questions in current software testing community. Since security becomes a major concern inside clouds and security services become a necessary part in modern SaaS and cloud technology, engineers must deal the issues and challenges in security validation and quality assurance for SaaS and clouds.

C. *Integration testing in clouds***:** Although we have seen numerous published research papers addressing software integration testing issues and strategies, not much research results have been applied in the real engineering practice. One of the major reasons is the existing software and components are developed without enabling technology and solution to support and facilitate systematic software integration. In a cloud infrastructure, engineers must deal with integration of different SaaS and applications in/over clouds in a black-box view based on their provided APIs and connectivity protocols.

D. *Regression testing issues and challenges:* Supporting on-demand software validation in clouds must address the regression testing issues and challenges caused by software changes and bug-fixing. However, most existing research in software regression testing pays most attention to re-test a specific software version in a preconfigured test environment. The multi-tenancy feature of clouds may cause the difficulty to apply the existing research work in cloud testing, specially for on-demand software regression testing service whenever software changes. In addition, we also lack of dynamic software validation methods and solutions to address the dynamic features of SaaS and clouds, for example automatic provisioned/de-provisioned features [10].

VII. NEW FEATURES IN CLOUD TESTING

There are four new requirements and features in cloud testing.

A. *Cloud-based testing environment*: This refers to use a selected cloud infrastructure as a base to form a test bed equipped with different and scalable computing resources, system infrastructures, and licensed tools, which are allocated using static/ dynamic requests.

B. *Service-level-agreements (SLAs)*: In cloud computing, all clouds, SaaS, and applications usually provide diverse services to their end users and customers with well-defined service-level-agreement. Naturally, these agreements will

become a part of testing and quality assurance requirements, such as system reliability, availability, security, and performance agreements.

C. *Price models and service billing*: Since utility computing is one of basic concepts and features in cloud computing, so price models and utility billing becomes basic parts and service for testing as a service. In other words, required computing resources and infrastructures (including tools), and testing task services will be charged based on pre-defined cost models.

D. *Large-scale cloud-based data and traffic simulation*: Applying and simulating large-scale online user accesses and traffic data (or messages) in connectivity interfaces is necessary in cloud testing, particularly in system-level function validation and performance testing.

E. *Testing as a Service (TaaS)***:** This is an innovative concept, and it refers to providing static/ dynamic on-demand testing services in/on/over clouds for the third-parties at any time and all time (365/7/24). Primary objectives is to reduce the IT budget and to focus their core businesses by outsource software testing tasks to a third party using TaaS service model. The execution can be performed either on client site or remotely from the outsourced providers [11].

VIII. CLOUD TESTING LIFE CYCLE

Conventional testing requires expensive dedicated infrastructure and resources that are only used sporadically. The growing complexity of business applications, it is harder to build and maintain in-house testing facilities that mimic real-time environments. Cloud computing has opened up new opportunities for software testing, which provides unlimited resources with scalability, flexibility and availability of distributed testing environment. It reduces the execution time of testing of large applications and lead to cost-effective solutions. Testing is not a single activity but a series of planned tasks. Cloud Testing is defined as Testing as a Service. Cloud Testing Life Cycle includes the following steps:

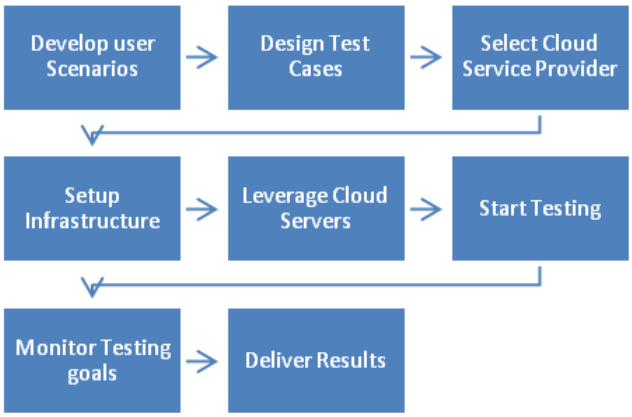

Figure 2. Cloud Testing Life Cycle

IX. CONCLUSION

Cloud testing is becoming a hot research topic in cloud computing and software engineering community. As the advance of cloud technology and testing as services, more research work must be done to address the open issues and challenges in cloud testing and TaaS. More innovative testing techniques and solutions, and QoS standards are needed to support on-demand testing services in a scalable cloud infrastructure. Cloud computing provides large business and technical benefits to software testing. As it becomes more common practice and availing a myriad of cloud solutions, services and applications, we observed that organizations seem to be on the lookout for ways to enhance the testing process. There is an anticipation of an increase in testing solutions in the cloud, providing flexibility and cost benefits. We believe cloud computing promises a lot of potential for testing. Major technology vendors such as HP, Intel and Yahoo are presently collaborating to create huge cloud „test beds" consisting of many thousands of processors working together as centers" of excellence in Cloud Computing [12]. Current test tool offerings by the likes of HP and IBM are ideal for non functional and automated testing in a cloud environment [13].

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