



**CSCI 5409 Advanced Topics in Cloud
Computing**

**Assignment-1
Report**

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Submitted By

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Q-1: Summary [2]

Cloud Computing is a model for enabling convenient, elastic, multi-tenant, measured on-demand network access to a shared pool of configurable computing resources. Migration to cloud involves moving from dedicated hardware to a virtualized platform which is safer and cheaper. There are three cloud service delivery models namely Software as a Service (SaaS), Infrastructure as a Service (IaaS), Platform as a Service (PaaS). SaaS is a model in which software or application is provided as a service via web interfaces or mobile devices. PaaS provides platform to build and run applications. In IaaS, basic infrastructure including storage, servers will be provided. According to reports IaaS is expected to dominate the market at a rapid pace. The crucial reason for the exponential growth of cloud is its features like universal access, fault tolerance, virtualization and low cost.

Small and medium enterprises tend to adopt cloud computing as the infrastructure cost is minimal whereas large enterprises are reluctant to migrate as they face many obstacles while moving to cloud and that might damage their reputation if there are any service interruptions. The four cloud deployment models are private cloud which provides infrastructure to a single enterprise for their exclusive use, community cloud which provides infrastructure to a group of enterprises with common requirements, public cloud which provides services to common public, and hybrid cloud which takes advantages and disadvantages of all the above models to provide optimal solutions.

The major public cloud vendors are AWS, Azure and Google Cloud in which AWS dominates the market with 47.1% share while Azure holds 10%. Cloud is not an optimal solution for all the applications, factors including security concerns, regulation compliance, data exposures, scaling, cost of usage, growth rate, workload, storage capacity must be considered before choosing a cloud service. The applications for which cloud computing will be very helpful are neural networks which are time consuming and difficult to implement with local hardware configurations, cryptocurrency mining, big data analytics, software defined wide area networking.

When it comes to cloud service providers, AWS has 10 times more compute capacity than the aggregate of all other major competitors. AWS offers single-tenant compute and xen-virtualized multi-tenant compute with additional IaaS, PaaS services, docker container services, object storage, batch computing services, event-driven serverless computing and extensive third-party software. Microsoft Azure provides a range of cloud services, including those for compute, storage, analytics and networking. Users can develop and scale new applications or run existing applications in public cloud including neural network clusters and Internet of things. The virtual machine performances of both Azure and AWS are similar and both offer monitoring services. These cloud service providers follow two types of charging models, subscription model which involves monthly or annual fee for the cloud services usage and perpetual license which involves one-time software purchase and an annual maintenance fee.

Many large enterprises are building their own private cloud due to security and service interruption concerns. There are many open-source cloud computing projects like OpenStack, OpenNebula, Eucalyptus. OpenStack is aimed at providing IaaS and to construct, monitor and manage public and private clouds. It provides an open and flexible framework to be used by enterprises as their underlying technology to support business operations, including software development.

To conclude, the choice of public, private or hybrid cloud depends upon many factors including size of organization, sensitivity of data, application workload, number of users. By carefully considering these factors, organizations should choose the cloud services, providers and cost model.

Q-2: Oracle Virtual Box: [3], [4]

Oracle virtual box is an open source, class-platform virtualization application which runs on windows, Linux, Macintosh and Solaris. By using oracle virtual box, user can create as many virtual machines as needed. Users can create multiple guest operating systems from a single host operating system. Each guest operating system can be started, paused, stopped independently. Guest operating systems can be configured to communicate with each other. There are two types of virtualization in oracle virtual box, software-based virtualization and hardware-based virtualization.

Software-based virtualization mode supports 32-bit guest operating systems which run in rings 0 and 3 on intel ring architecture. Whenever a fault occurs, virtual box uses CSAM and PATM to inspect and patch the instructions due to which the fault occurred. In hardware-based virtualization mode, virtual box uses intel's VT-x and AMD's AMD-v and runs each guest in its own address space.

During the virtualization process, the virtual box emulates the hard disks into one of the following image formats, VDI (virtual box disk image), VMDK (virtual machine disk), VHD (virtual hard disk). The features of the oracle virtual box include snapshots, seamless mode (parallel usage of virtualized applications), public API's (Java, python, SOAP), 3D graphics acceleration, 2D output acceleration, shared folders, shared clipboards, command line interaction, raw hard disk access (guest system will have host system's hard disk partitions).

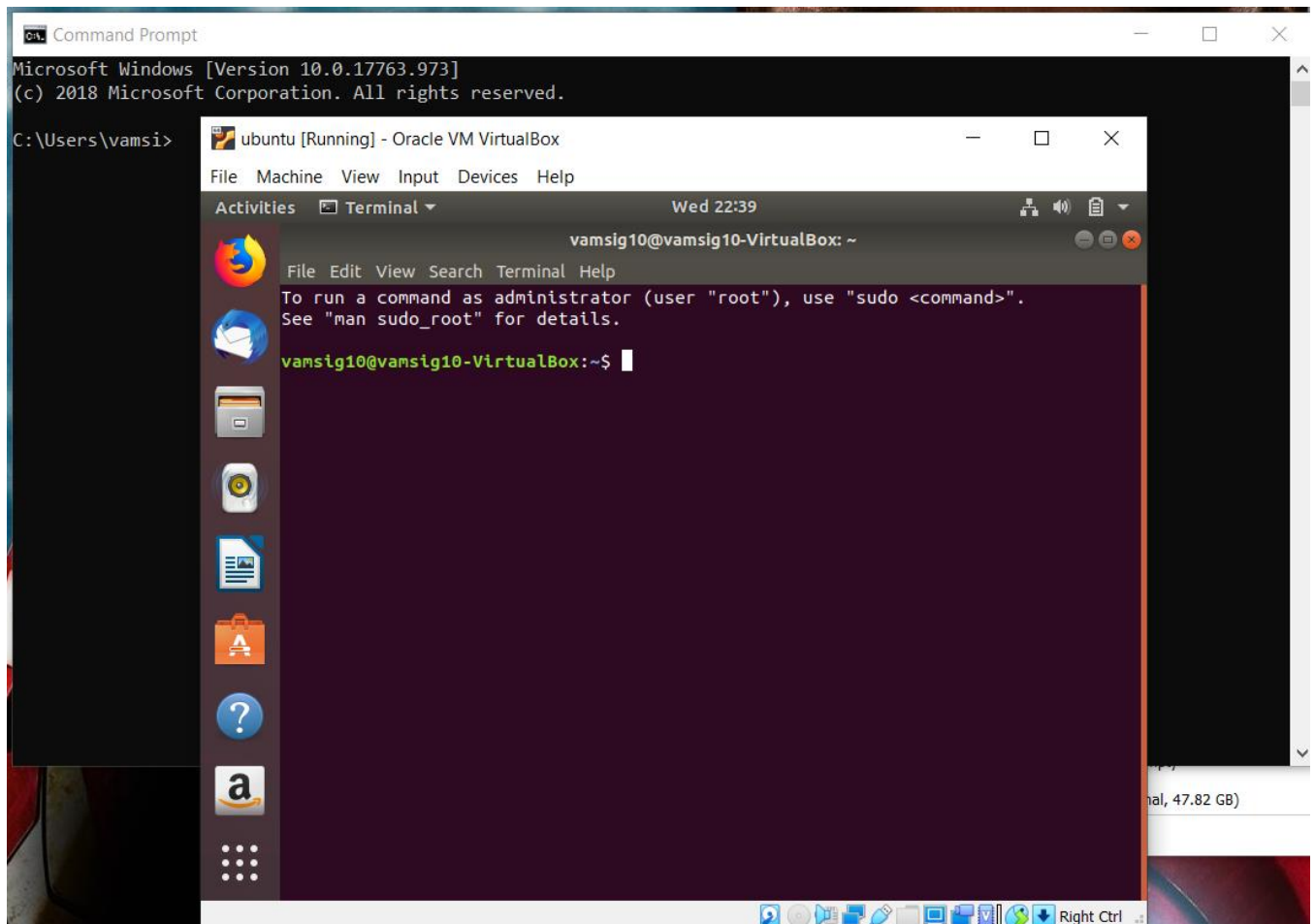


Figure:2 Ubuntu installed using Oracle VirtualBox

Q-3: [1]

- A)** If all the 1000 users send 1000 requests per hour, the ABC's system will receive 10,00,000 requests per hour which is a huge number. Depending on the configuration of ABC's system, we have to scale up if needed. If it doesn't have the capacity to handle those many requests, we can perform vertical or horizontal scaling. We have to increase the processing capacity or RAM or CPU configuration in order to perform vertical scaling whereas horizontal scaling involves increasing the number of resources. Autoscaling will be a good idea here as resources can be scaled up or down based on the requirement.
- B)** Private cloud offers many advantages, however, whether ABC wants to rent a private cloud depends upon their requirements from the client. If ABC is more concerned about sensitive data, security issues, private cloud will be a good choice. As the customers are using public cloud, it doesn't make much sense for ABC to rent a private cloud. They can continue with the public cloud which will reduce cost. They can also consider hybrid cloud which offers advantages from both private and public clouds.

Q-4:

The below figure shows the graphical representation of implemented scenario.

- Initially, the client sends a request to the server to complete a task which requires various cloud resources.
- I have assigned a randomly generated number to the users.
- The request will be sent to the cloud resource load balancer and auto scaling classes.
- Based on the type of the user (public cloud user/private cloud user/hybrid cloud user), resources will be scaled accordingly for each type of user.
- For public cloud user, no autoscaling will be performed. For private cloud user, autoscaling will be provided and for hybrid cloud users, autoscaling will be done after 60% of the requests.
- I have divided the resource pool into part to accommodate 50% of resources to private cloud users, 30% of resources to hybrid cloud users and 20% of resources to public cloud users.
- Finally, I have plotted a graph with x and y axes as number of requests and number of cloud resources allocated.

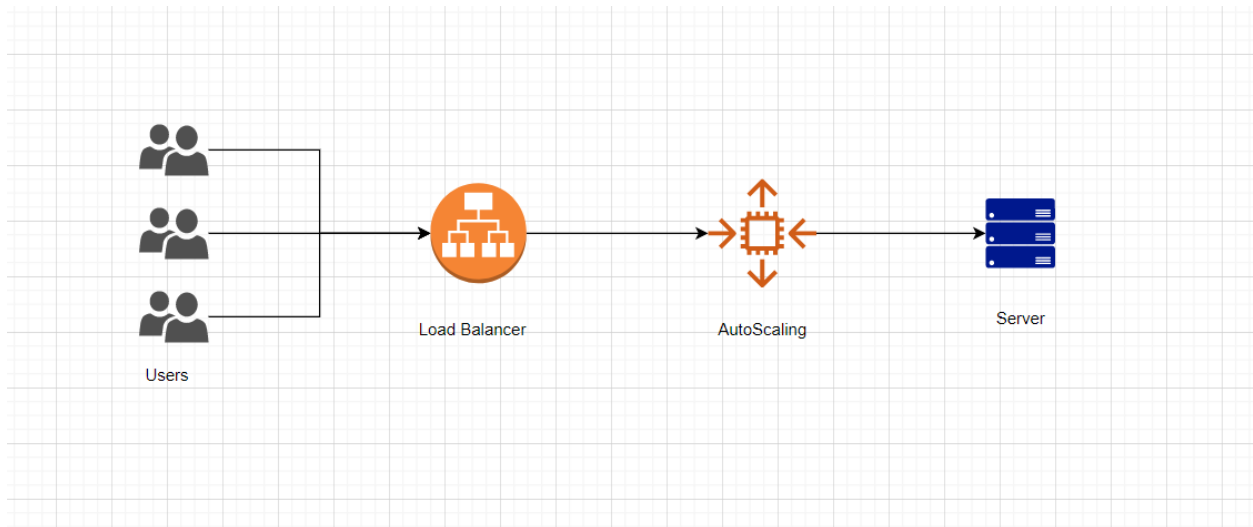


Figure:2 Graphical Representation of implemented scenario

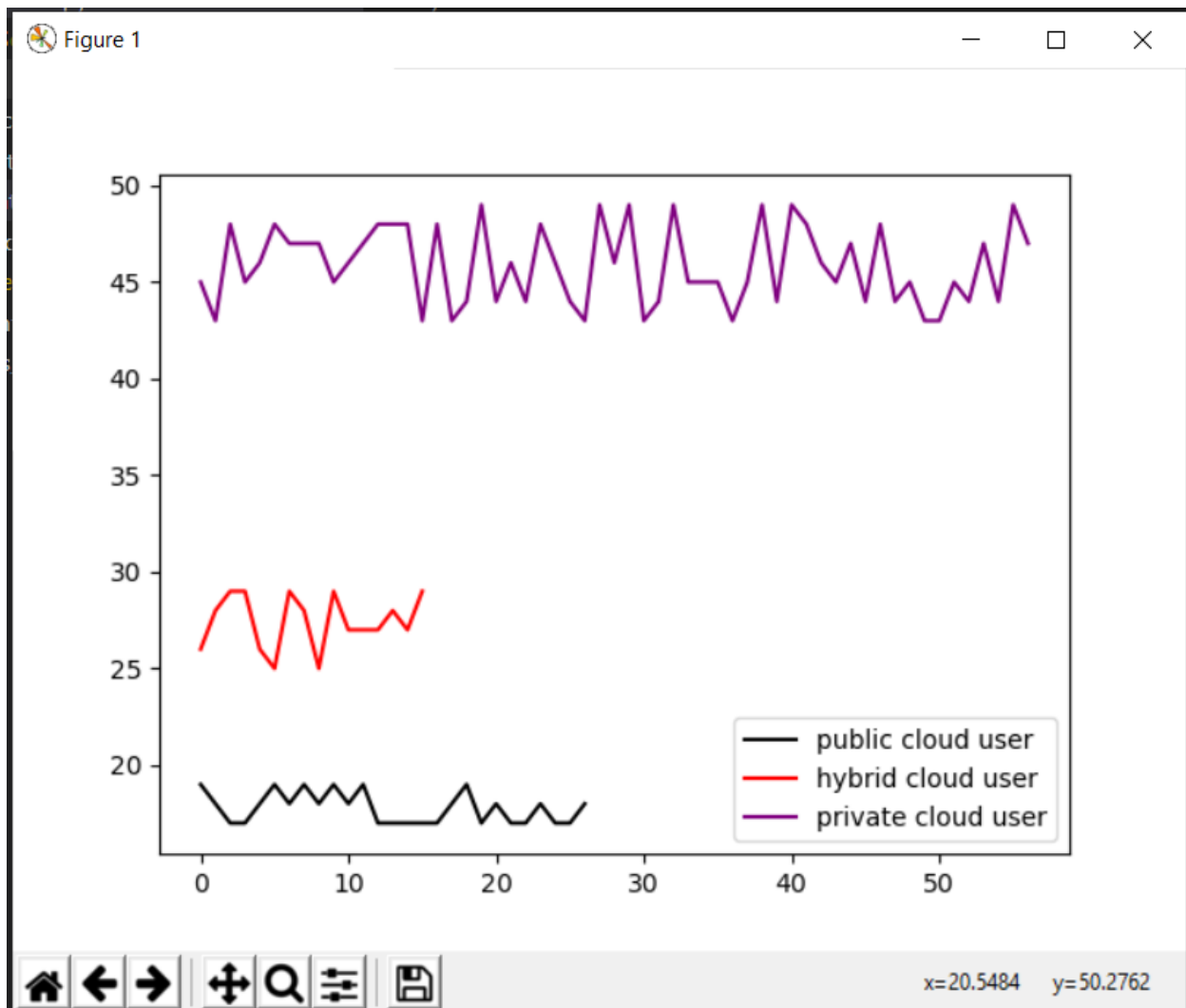


Figure:3 Cloud Resource Usage for 100 requests

The above figure represents the graph when only 100 requests were sent to the load balancer for autoscaling.

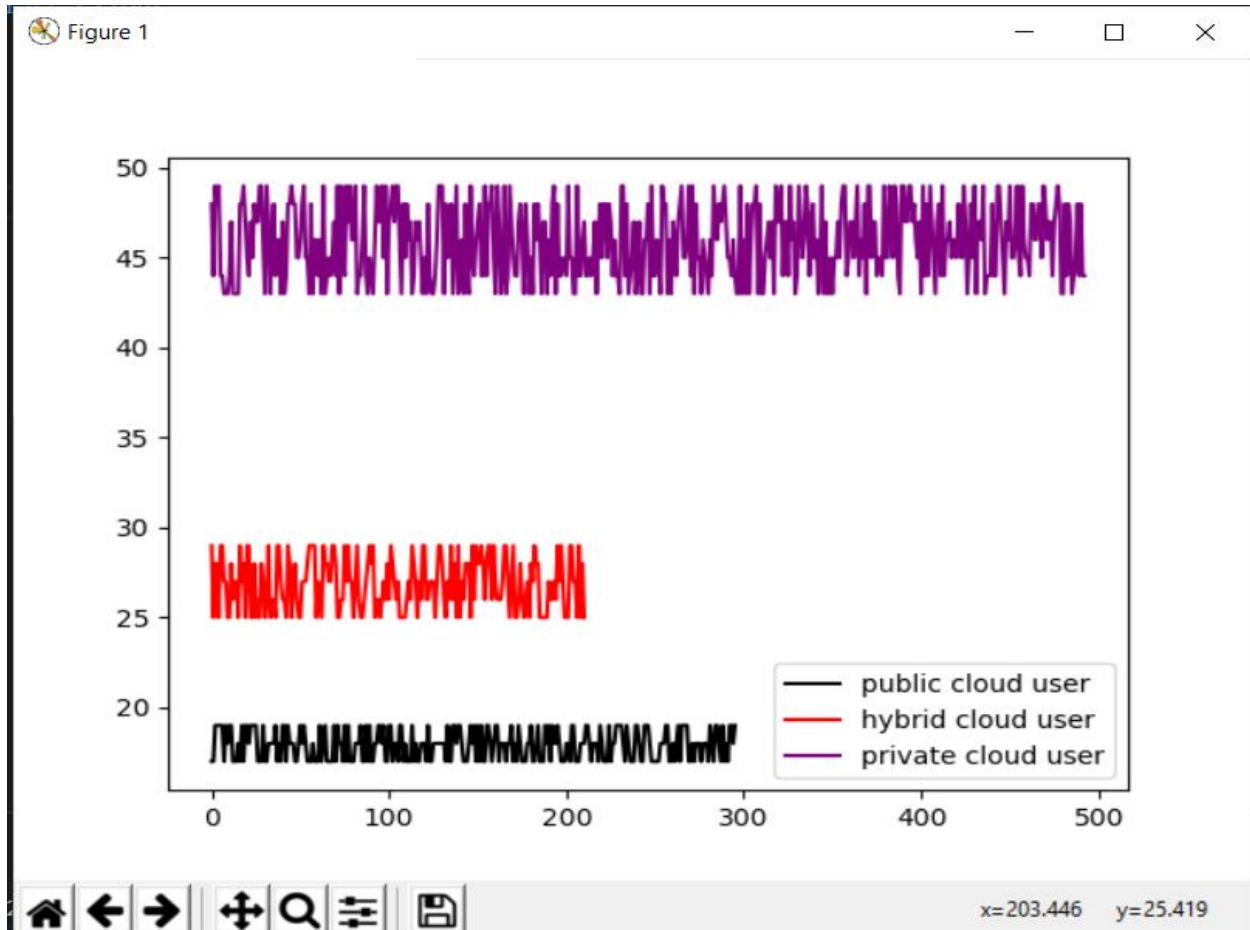


Figure:4 Cloud Resource Usage for 1000 users

The above figure represents the graph when only 100 requests were sent to the load balancer for autoscaling.

```
Task completed
User id 7381225 Private Cloud User
resources required: 1
Private Cloud User: Autoscaling Completed

Task completed
User id 7256071 Public Cloud User
resources required: 3
Public Cloud User: No Autoscaling
Task completed
User id 2923443 Public Cloud User
resources required: 1
Public Cloud User: No Autoscaling

Task completed
User id 5071600 Hybrid Cloud User
resources required: 1
Hybrid Cloud User: Autoscaling will be performed after 60% of requests

Autoscaling Completed
Task completed
User id 5230392 Hybrid Cloud User
resources required: 5
Hybrid Cloud User: Autoscaling will be performed after 60% of requests
```

Figure:5 Sample Output

The sample output can be seen in the above figure which contains randomly generated user id, resources required (randomly generated), user type and the status of autoscaling.

References:

- [1] CloudFare's 'Public vs Private Cloud'[Online]
Available: <https://www.cloudflare.com/learning/cloud/what-is-a-public-cloud/>
[Accessed on Jan. 29, 2020]
- [2] W. Hassan, T. Chou, L. Pagliari, J. Pickard and O. Tamer, "Is Public Cloud Computing Adoption Strategically the Way to Go for All the Enterprises?," *2019 IEEE 5th Intl Conference on Big Data Security on Cloud (BigDataSecurity), IEEE Intl Conference on High Performance and Smart Computing, (HPSC) and IEEE Intl Conference on Intelligent Data and Security (IDS)*, Washington, DC, USA, 2019, pp. 310-320.
- [3] Virtual Box Documentation, Available: <https://www.virtualbox.org/> [Online]
[Accessed on Jan 30, 2020]
- [4] Wikipedia's 'Virtual Box', <https://en.wikipedia.org/wiki/VirtualBox> [Online]
[Accessed on Jan 30, 2020]