Comparing Google Cloud and Microsoft Azure Platforms for Undergraduate Laboratory Use

Valeriu Manuel Ionescu[1(✉)] and Jose Manuel Lopez-Guede[2]

[1] FECC, University of Pitesti, Pitesti, Arges, Romania
manuelcore@yahoo.com
[2] Systems and Automatic Control Department,
University College of Engineering of Vitoria,
Basque Country University (UPV/EHU), Vitoria, Spain

Abstract. Knowing the advantages of public cloud services is important for undergraduate students that will work in the IT domain. The study of cloud technology should cover not only the theoretical aspects but should also give hands on access and experience with the management interface. Two important players on this market offer access to services as a free trial that allows testing and light cloud platform usage: Microsoft Azure and Google Cloud. This paper compares these free services and their usability in an undergraduate laboratory at the Computer Science specialization and proposes a laboratory structure that should cover this process of investigation.

Keywords: Microsoft Azure · Google cloud platform · Compare · Educational

1 Introduction

There is a constant push in recent years from big companies such as Microsoft, Google, Amazon to attract internet users and businesses to their cloud services, but the strategy for these companies varies in regard to the free access offering. Some promote free software based on their solution, while others give free but limited access to their solutions. It could be argued that the best way to proceed in interacting with cloud technology in an undergraduate environment is to create a private cloud with free technologies such as Open Stack or CloudStack, however as most commercial applications will target public cloud platforms from Amazon, Microsoft or Google, having hands-on experience with these platforms at undergraduate level can give an advantage to the students. It is therefore important to compare the solutions that offer free access to the commercial level user interface and their usability in and educational environment (laboratory class), in order to test operating systems and services for undergraduate students.

The idea of Cloud Computing was introduced with the first implementation of the internet when a globally connected world with applications that could run across the globe seemed only a short distance away [1]. However the real start was made by Amazon Web Services in 2002, which provided a suite of cloud-based services to the internet users. In 2009 Google and others started to offer browser-based enterprise applications, though services such as Google Apps. Microsoft is the latest to join the

M. Graña et al. (eds.), *International Joint Conference SOCO'16-CISIS'16-ICEUTE'16*,
Advances in Intelligent Systems and Computing 527, DOI 10.1007/978-3-319-47364-2_79

cloud offerings and is promoting many cross platform services that seamlessly interact with their Azure cloud platform. It is clear that cloud computing can bring enormous benefits for IT users. The top Cloud Providers in this moment are: Amazon, Microsoft, Google and Rackspace as seen in Fig. 1.

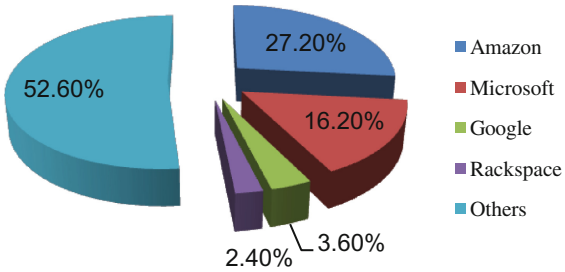

Fig. 1. Amazon is the estimated market leader when it comes to Cloud storage in 2015, followed by Microsoft [2].

This paper presents the results of using Microsoft Azure and Google Cloud platform at undergraduate level students in laboratory classes of Operating Systems and Computer Networks in order to introduce the Cloud concept. Cost control in a university laboratory is an important issue because the expenses must be planned ahead. Many cloud providers offer educational access to the cloud services [3–5] but in some cases the offer can be limited geographically or needs an authorized institution Id. For the cases that do not meet the requirements, the free access is the option left. For example Amazon free cloud services have the policy that starts automatically billing the credit card when the user ends the free offering, presenting the problem of unintentional costs in the classroom: "When your free usage expires or if your application use exceeds the free usage tiers, you simply pay standard, pay-as-you-go service rates" [6].

The classes where the laboratory was presented were the 3rd and 4th year students in Computer Science that were familiar with basic operating and distributed system courses. The purpose was to: test the usability of the free offerings in a student laboratory, with limitations in time usage and service accessibility; demonstrate cloud services and use them to interact with test applications; test their ease of use, limitations and make comparative analysis.

The paper has the following structure: In the chapter *Google Cloud,* the characteristics of this platform will be presented and similarly the chapter *Microsoft Azure* will present the other cloud services platform. The chapter *Comparing Google Cloud and Microsoft Azure trial offers* compares various aspects of these platforms and the final chapter *Laboratory structure and observations*, observations will be presented regarding the laboratory development and student observations related to the platform utilization. The final chapter *Conclusions* presents the future developments for the ideas presented in this paper.

2 Google Cloud

Google Cloud is a platform provided by Google that is growing fast and is hosted on the same support infrastructure that Google is using for the final users, such as Google Search and YouTube.

The platform offers a set of modular services based on Cloud and developing instruments, for example: hosting and computation, cloud storage, websites development, Virtual Machine (VM), translate Application Programming Interface and predictions. The free offer to this platform consists in access to the services but it is limited to 300$ offered for any Google Cloud Platform services over 60 days. A credit card is necessary for user confirmation in order to avoid non human users. When the trial ends, the account will be paused and an option will be available to upgrade to a paid account. The user will not be charged during or after the free trial ends.

Google Cloud Platform offers global coverage, low cost, low latency, and application availability for the customers. They continue to expand Cloud Platform locations over time. Currently, there are 15 Google Cloud Datacenters [7], and they will add two new regions in 2016: US Western, Oregon and East Asia, Tokyo, Japan. Table 1 presents a speed test (download and latency) to Google Cloud various services to Romania.

In regard to the virtual machine creation, Google supports importing raw device images, Amazon Machine Images and VirtualBox Images, and a collection of operating systems, including Red Hat Enterprise Linux, SUSE and Windows Server: Debian GNU/Linux, CentOS, CoreOS, openSUSE, Ubuntu, Red Hat Enterprise Linux, SUSE Linux Enterprise Server, Windows Server 2008/2012.

Steps necessary to create a Google Cloud VM:

- Access www.cloud.google.com
- Log into your account/sign-up
- Access: My Console
- From the dashboard, select: Compute Engine
- Select: Virtual Machines
- Create a new instance
- Select the desired configuration;
- Finish the process by pressing: Create.

Table 1. Google Cloud performance test

Service	Downlink(MB/s)	Latency(MB/s)
CDN	55.2	22
Storage (eu)	59.29	157.5
Storage (us-east1)	50.94	161
Storage (us-central1)	46.64	161
Storage (us-east3)	39.31	319.5
Storage (us-central2)	37.68	164

3 Microsoft Azure

Microsoft Azure is a Cloud development platform (released in 2010 as Windows Azure and renamed to Microsoft Azure in 2014) created by Microsoft for building, deploying and managing applications and services through a global network of data. The platform provides IaaS (Infrastructure as a Service, VMs, servers, storage, load balancers, etc.), PaaS (Platform as a Service, cloud services allowing customers to develop, run and manage applications) and SaaS (Software as a Service) services and supports many different programming languages, tools and frameworks, including Microsoft specific (Visual Studio) and third-party software and systems.

Microsoft has recently proven itself as one of the fastest expanding Cloud providers in the industry with a large number of datacenters [8] that allows providing regional content and good global service load balancing. The free offering from Microsoft presented in Table 2 gives 200$ for a period of 30 days to the user and, as with the free Google Cloud trial, when it ends the user will be warned that it will have to switch to a paying account.

Microsoft makes it easy to create a virtual machine using a custom image. The easiest way is to create a virtual hard disk file and import it into Azure. Although you can build VHD-based images from scratch, System Center Virtual Machine Manager can help with the image creation process.

Microsoft built its Azure public cloud on top of Windows Server and Hyper-V. It is easy to migrate VMs between local data centers and Azure. The process isn't seamless, but is relatively easy once connectivity is established between Azure and a local network. The operating systems available for the virtual machines include: CentOS; Datastax Enterprise; Debian GNU/Linux; Docken on Ubuntu Server; Hortonworks Data Platform; MapR Distribution Including Hadoop in Azure; OpenSUSE; Red Hat Enterprise Linux; Service Fabric Cluster; SLES; SQL Server 2016; Ubuntu Server; Windows Server (up to 2016, while Google Cloud is limited to Windows Server 2008/2012 offerings).

Steps to create a VM on Microsoft Azure platform:

- Log into your Microsoft account
- Access: www.portal.azure.com
- Choose: New, then select: Virtual Machine
- Select the operating system for the Virtual Machine
- Configure your virtual machine from the cascade of windows
- Start the virtual machine.

Table 2. Facilities offered by Microsoft Azure (trial version)

Number of hours	Unlimited
Websites	10
Databases	1 GB SQL instances
Storage	20 GB
Number of storage transactions	1.000.000

Azure is available in 24 regions around the world, and has announced plans for 8 additional regions. Geographic expansion is a priority for Azure because it enables the customers to achieve higher performance by accessing close datacenters and it supports their requirements and preferences regarding data location. The closest Microsoft Azure datacenters to Romania are West Europe (Netherlands) and North Europe (Ireland). Another interesting aspect of Microsoft Azure is that after you finish the free trial they do not restrict your access to that account and they let you explore what is new and how to use the platform better until you create a full account.

4 Comparing Google Cloud and Microsoft Azure Trial Offers

The first aspect compared regards the extent of the free offering. While the money received at sign-up for each platform differs (Google Cloud: 300$/60 days, Microsoft Azure: 200$/30 days), the prices for the services should also be considered. As one of the easiest things to create on the cloud platform is a Virtual Machine (VM), we compared the top configurations VMs that we can get with the money for the free trial and the results are presented in Fig. 2 (a) and (b). It is visible that both the pricing and the top specification differ. If the user decides to use all the money for the VM, the Google Cloud presents a better offer. If we compare the price of the same VM configuration on each platform we obtain the results presented in Fig. 2 (c) that highlight the Google Cloud advantage.

The second aspect investigated was the latency for different platform services. This aspect influences the type of application that can be deployed (for example latency sensitive and jitter sensitive applications may be better suited for a specific platform). For this test we have used the site https://cloudharmony.com/ that is able to connect to various platform components. Table 3 presents the latency to these datacenters from Romania.

Table 3. Comparing latency of Microsoft Azure and Google Cloud closest to Romania

Component	Google Cloud latency (ms)	Microsoft Azure latency (ms)
DNS - Domain Name System	51	75
VM/Compute Engine	126	56
Storage	70.5	61
Websites/Google CDN	22	49.5

Both platform offer good latency but overall, Microsoft Azure has a lower latency comparing to Google Cloud. The tests also showed that Microsoft Azure's latency variation is quite low, and doesn't fluctuate as much as Google Cloud's latency (good jitter). The latency and jitter results were tested also for the applications that the students have placed in the virtual machines and confirm these results.

The Bandwidth was investigated next. The results are presented in Table 4 and target only the Europe datacenters of both providers.

Table 4. Comparing download and upload speed for Google Could and Microsoft Azure

Platform	Download	Upload
Google Cloud	13.33 Mbps	4.664 Mbps
Microsoft Azure	12.38 Mbps	2.824 Mbps

The results show that the speeds are comparable for both upload and download, with a slight advantage for Google Cloud. The download is faster for the virtual machines that were tested indicating that they are better suited to provide content (such as a web site) then to be the target of content upload.

For a university laboratory these tests show to the students that all types of applications can be developed, from low latency applications to file upload/download solutions and even inter-VM communication. Other factors that contribute to the Quality of Service (even if for the free services there is no Service Level Agreement) and can be investigated are service availability (providers keep sites dedicated to downtime), jitter (latency variation) and packet loss.

Limitations such as 8 core running at the same time, crypto currency mining, CPU time/day, bandwidth or Web Sockets per instance are left high enough to make the implementation of simple application servers unrestricted. Also it is possible to run Google App Engine web application with low traffic and capacity requirements even after the free trial period.

5 Laboratory Structure and Observations

Prior to the laboratory where the cloud provider services were tested, the students were presented with two courses that had introduced the virtualization subject and the structures used in virtualization: cluster, grid, cloud. The students have also had prior laboratory hands-on experience with virtual machines in the Operating Systems and Computer Network classes, in the form of type 2 Hypervisor solution: VirtualBox.

The laboratory started with a short introduction of the two platforms and the limitations of the platforms that will be used. The targets were to: inspect the platform functions and their ease of use; deploy a web site on the virtual machine and access its content by using a browser; place a simple server application on the cloud platform and to test its connectivity to a local client application. The operating system that was installed was Ubuntu Linux as it is available on all platforms.

The first observation was that the Microsoft Azure interface has a very short learning curve and is very intuitive by virtually presenting all the information in a single screen. The user starts with the main menu where you can find the most common services that you can use or explore on this platform. If the user wants to install a different option that is not present in this menu it is possible to click on the “New button” and to access a second menu with all Microsoft Azure applications. To simplify even more this approach, there is a search bar present. This proved for the students to be an advantage when they first explored the platform.

On the other hand the Google Cloud interface has adopted the same minimalist design and most options are placed in menus that are out of sight most of the time in

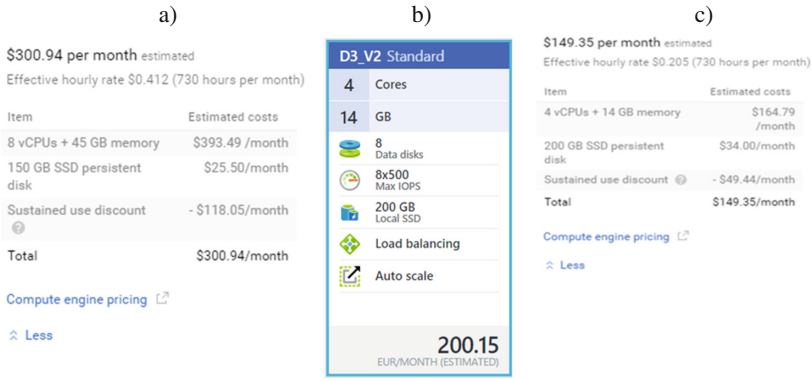

Fig. 2. Comparing VM's that can be created for the freely offered money in a) Google Cloud (top configuration ∼ 300$) b) Microsoft Azure (configuration for ∼ 200$) c) Google Cloud (for the same money as Microsoft Azure ∼ 200$)

order to give the user more screen space for information selection. Google Cloud places on the first page all the information about the user account and in the left corner a hidden menu. When the user opens that menu it can access all applications, sorted and presented by categories. For most actions on the Google Cloud Platform, it is necessary to install the API Manager, so this option is placed it the second place after Home. This positioning proved to be a slowdown in the beginning but after the student learned the site structure, it proved to be an acceptable design choice.

Regarding the platform performance, the network latency was observed and the down-load and upload were monitored. The results are visible in Tables 3 and 4.

The next action was to perform a web site's deployment. Visual Studio was be used to deploy it on both the Google Cloud platform, and Microsoft Azure, but the latter integrates better by presenting a solution to deploy directly to Microsoft Azure platform [8]. If this option is chosen, a dialog box will pop up, where the user has to log into the Microsoft account, then options are presented to select the last publish details, as site name, Region and Service plan. After the website has been deployed on Microsoft Azure it is possible to verify the success in the Visual Studio console and in the Microsoft Azure console. This simple option inserted into the publishing flow subtly helps to keep the users inside a Microsoft software ecosystem.

6 Conclusions

This paper preselected comparatively the Google Cloud and Microsoft Azure platforms. A full four hour laboratory was used to make the students use both platforms and complete successfully the proposed tasks.

Both platforms proved not too difficult to use so a first time user can work on them without too much problems. Microsoft Azure proved to have the lease steep learning curve. Students were able to understand how services that are installed "in the cloud"

are actually functioning and they were able to publish their own web site. Another simple application that can be created during this laboratory is a Google App Engine application that is deployed in the cloud and is accessed via the browser.

The level where the students have worked most of the time is IaaS that is very closely related to the operations that they were used to make in the virtual machines on the local computer and ensured a comprehensive transition.

The similarities between the two cloud platforms showed that both can be used individually for laboratory applications because they offer similar basic services and the differences are mainly in the naming conventions that the two providers use.

Complex services such as application virtualization (SaaS) or DNS load balancing were not tested, but can be tested in the future, the only limit being the time necessary to make the applications and test the implementation.

The two platforms proved to have differences and reflected each company's approach to the application implementation and went deeper then the user interface. The services and their pricing are different but each platform can present advantages that can influence a user to choose it.

References

1. Srinivasan, S.: Security, Trust, and Regulatory Aspects of Cloud Computing in Business Environments (2014). ISBN: 9781466657885
2. Bocchi, E., Drago, I., Mellia, M.: Personal cloud storage: usage, performance and impact of terminals. In: 2015 IEEE 4th International Conference on Cloud Networking (CloudNet), pp. 106–111 (2015)
3. Google Inc. Education Grants for Computer Science (2016). https://cloud.google.com/edu/
4. Microsoft Corporation. Try Microsoft Azure (2016). https://www.microsoftazurepass.com/azureu
5. Amazon Web Services, Inc. AWS Educate - Teach Tomorrow's Cloud Workforce Today (2016). https://aws.amazon.com/education/awseducate/
6. Amazon Web Services Inc. AWS Free Usage Tier FAQ (2016). https://aws.amazon.com/free/faqs/
7. Kaufmann, A., Dolan, K.: Price Comparison: Google Cloud Platform vs. Amazon Web Services, Whitepaper (2015). https://cloud.google.com/files/esg-whitepaper.pdf
8. Collier, M., Shahan, R.: Microsoft Azure Essentials - Fundamentals of Azure. Microsoft Press (2015). ISBN: 978-0-7356-9722-5