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Comparative Analysis of Different Cloud Computing Security Services offered By Microsoft Azure, Amazon Web Services and Google Cloud Platform

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Abstract: *This paper presents a novel approach toward a comprehensive analysis of various simulation-based tools to test and measure the Cloud Datacenter performance, scalability, robustness and complexity. There are different Cloud Datacenter resources in cloud Computing Infrastructure like Virtual Machine, CPU, RAM, SAN, LAN and WAN topologies. The server machines need to be analyzed for their utilization in terms of energy and service to clients in cloud computing. We have analyzed various Cloud resources using CloudSim, CloudReports and Cloud Analyst tools. Resources provIsIOning, Cloud Management, Load Balancing, Robustness and Cloud Scalability are this paper's primary scope of work. In this regard, some Simulation test results and Simulations are presented to compare them with real-time scenarios to bring the performance and scalability issues to our notice for future directions*

Keywords: Cloud Security, Honeypots, Cyber Threats, AWS, Azure, GCP, Adversarial Activity, Situational Awareness, Cloud Vulnerabilities, Cybersecurity

I. INTRODUCTION

Recent years have seen a sharp rise in the demand for cloud services, which has led to a significant growth in the scalability of cloud platform users. In the modern world, cloud computing has emerged as one of the key technologies. Customers and service providers are directly impacted by the advantages of cloud computing. Companies like Microsoft, Google, Amazon, Verzion, and Rockspace frequently modify their price structures in order to offer services that are more suited to their customers[1]. Platforms for cloud services offer a range of services, including storage, upload, and download. The traditional approach to data management and storage has been replaced by a new cloud approach thanks to cloud computing. Data management is made available through cloud computing at an affordable price. Different forms of SLA certificates are offered by the cloud between the customer and the service provider.

Links describe how one activity influences another and turns into a source of benefit and added value[4]. Products and services flow through each activity in a sequential manner, gaining value at each stage, therefore this chain of activities adds some value to the product.

This section will go through the many kinds of costs associated with the cloud computing model. One of the key benefits of cloud computing is cost savings. In a cloud environment, costs for all forms of hardware, software, maintenance, coding, power, and networks are included.

- Hardware cost: The price of all the hardware in the data centre.
- Maintenance costs: Maintenance costs include the expense of security tools.
- Labor: The cost of labour is a component of troubleshooting.
- Cost per Gigabyte of Virtual RAM for computing; cost per Gigabyte of Virtual Disk for storing
- Cost-sharing: In a cloud setting, IaaS, PaaS, and SaaS are examples of shared costs.

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Cloud Provider Provider	Small	Medium	Large
Amazon	$0.08	$0.12	$0.22
Microsoft	$0.07	$0.12	$0.22
Google	$0.05	$0.10	$0.19
Internap	$0.02	$0.03	$0.05
1&1	$0.02	$0.03	$0.08

Table 1. Cloud Cost pricing

1. Cloud Service Providers Google Cloud Platform, Microsoft Azure, Amazon Web Service (Aws) (Gcp)

One of the market's veteran companies, Amazon Web Services (AWS), was founded in 2006. It offers a variety of computing services, including mobile computing, cloud storage, database services, analytics, and network Internet of Things. As a result of these services, a company can expand more quickly, cut costs, and increase revenue. As one of the most well-known and established cloud platforms, AWS is also one of the oldest. AWS is therefore broadly accessible. There are 63 availability zones for Amazon Web Services (AWS) worldwide.

Figure 1.1 Amazon Web Services Growth Since 2004

Google established the Google Cloud Platform (GCP) in 2011 to offer its clients cloud computing services. Storage, big data, databases, analytics, cloud artificial intelligence, networking, mobile computing, development tools, management tools, Internet of things, cloud security, and data transmission are among the services offered by GCP. Globally, there are 21 availability zones for the Google Cloud Platform (GCP).

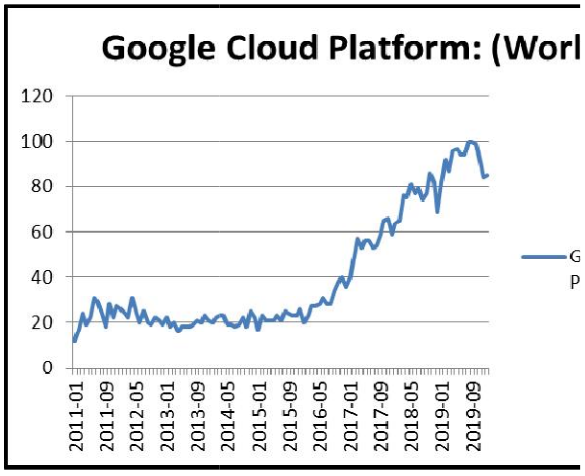

Figure 1.2 Google cloud platform (GCP) since 2011

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II. CLOUD SERVICE PROVIDERS

Companies like IBM, Google, Amazon, and Microsoft are in race to provide best cloud services to its clients. As US and UK market is dominated by Amazon and Microsoft they are said to be leading tech giants in the world. There is a long list of companies providing cloud service. Now day's small tech organization also started investing in cloud domain. Amazon Web Services (AWS) has the highest market share as compared to Microsoft Azure and Google Cloud Platform (GCP). The graph in figure 6 represents the growth among three cloud service platforms in last 5 years. It is clearly visible that in last 5 years the popularity of Amazon Web Services (AWS) has surpassed Microsoft Azure and Google cloud platform (GCP) worldwide. There are numerous big clients like

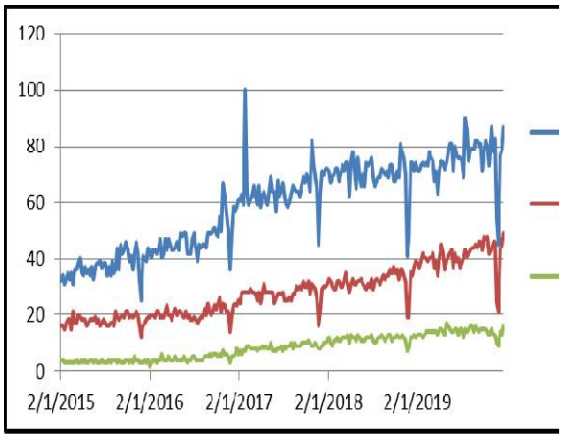

Figure 1.3 Amazon Web Services (AWS) vs Microsoft Azure vs Google cloud platform (GCP)

Netflix, Facebook, BBC, Adobe, Twitter, BMW, Disney, Expedia and many more. Microsoft Azure also has list of clients like Delaware Resource Group, Erickson Advisors, Hudson River Fruit Distributors etc. Google Cloud Platform (GCP) clients are Spotify, HSBC, Snapshot, HTC, Philips, Coca Cola, Domino's, Sony Music, etc.

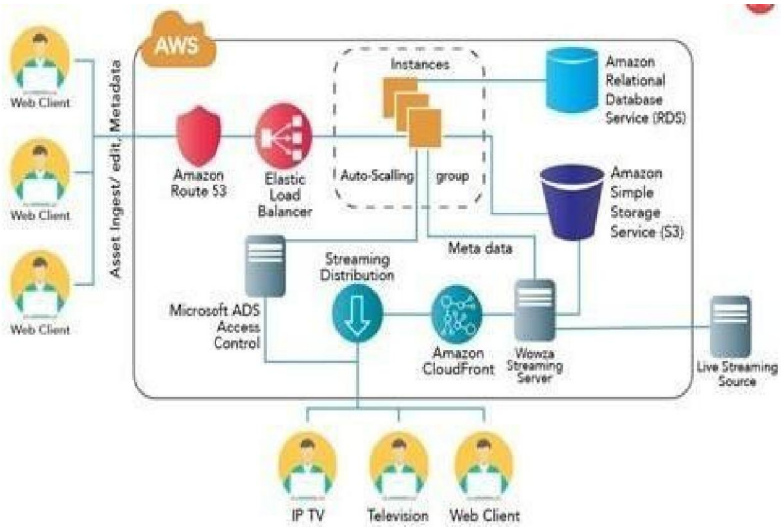

Figure1.4 Amazon Web Services Architecture components

III. RESEARCH METHODOLOGY

1. With support for TLS and IPv6. Logging goes beyond straightforward service logs, as this work intends to capture actual malware payloads with support for shell code detection.

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2. Is a medium-interaction honeypot which logs all forms of brute-force attacks and the preceding shell commands performed via SSH and Telnet. This tool can mimic successful compromises and log further interactions, which may help uncover an attacker's motivations.
3. A low-interaction honeypot that captures, logs, and analyses traffic supports TCP and SSH. Glutton listens on all ports and takes action based on a rule file, allowing for fake SSH session interaction, which closes the connection after accepting a username and password.
4. A low-interaction honeypot emulates several login interfaces to capture entered credentials and source/destination ports. Supports a variety of protocols, including, but not exclusive to, Telnet, SSH, FTP, HTTP, POP and SMPT. Sensors 2021, 21, 2433 6 of 19
5. A low-interaction honeypot emulates a very vulnerable Web server, hosting a variety of pages and applications. Glastopf utilizes Remote File Inclusion (RFI) and Local File Inclusion (LFI) techniques, extracting strings that allow it to emulate expected responses and lead an attacker to believe it was exploited successfully.

IV. RESEARCH TOOLS

Cloud Services

Cloud services are infrastructure, platforms, or software that are hosted by third-party providers and made available to users through the internet.

1. Google Cloud Platform

Google Cloud is a suite of public cloud computing services offered by Google. The platform includes a range of hosted services for compute, storage and application development that run on Google hardware.

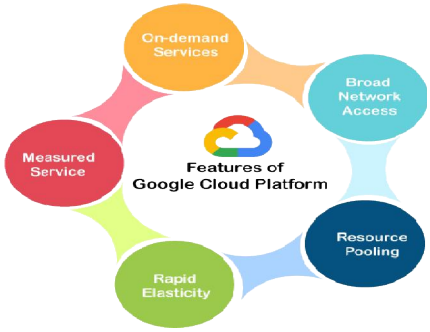

Figure 2 Features of Google cloud platfrom

Technology Used
1. Cloud Sim 3.0
2. Cloud Analyst
3. Green Cloud

Green cloud is a buzzword that refers to the potential environmental benefits that IT services delivered over the internet can offer society. The term combines the words green -- meaning environmentally friendly -- and cloud, the traditional symbol for the internet and the shortened name for cloud computing.

V. RESULTS AND DISCUSSION

The CVIP MATLAB toolbox package was developed during this research study, which has a collection of computer vision and image processing functions. It currently consists of 201 functions covering different areas of image analysis and computer vision such as arithmetic and logic, band, colour, conversion, edge/line detection, image geometry, histogram, mapping, morphological, noise, objective fidelity metrics, pattern classification: classification algorithm, distance/similarity metrics, feature extraction, normalization methods, segmentation, spatial filters, and transform and transform filter. Following is the list of functions developed during this research study, and many other functions are included and packaged into the toolbox.

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Table 2: List of Functions developed in this research.

Category	Functions
Arithmetic and Logic	Arithmetic Operation – Add, Subtract, Multiply, Divide Logical Operation – AND,OR,XOR,NOT
Band	Extract Bands , Assemble bands
Color	Luminance Average , Luminance, Principal Component Transform, color Contrast Enhancement , color Space (RGB, HSL, HSV,CCT,L*a*b*,L*u*v*,SCT,PCT)
Conversion	Gray Binary
Histogram	Histogram, histogram equalization, Histogram Stretch, Histogram Slide, Histogram Shrink

Cloud Service Providers	Benefits	Limitations
Amazon Web Services	• Breadth and depth of its services • Developer functionality • Economic benefits for customers • Gold standard for reliability and security • Control market position • Sizeable , develop fully offerings • Help for huge organizations • Worldwide reach	• Cost prohibitive • Usage is not facile • Stewardship of price • Overcoming • Technical support fee
Microsoft Azure	• Adjustable billing • Platform-as- Service (PaaS) is a well-defended suit of Microsoft • Accuracy and expandable. • High level availability •Price-effective differentiate to the competition • After the first biggest provider • Combination with Microsoft devices and software • Integrated public and private cloud • Help for open source	• Consequences with documentation • Imperfect management devices • Comparatively hard to use • Expensive • Data transfer cost • Require platform expertise
Google Cloud Platform	• Deep expertise technology • Current innovation, well- authorize in cloud computing • Adjustable pricing model • Advance costing than Competitors • Live Migration of Virtual Machines • Delegation to • Continued	• Safety and privacy • Bounded control and flexibility • Vendor pin- down • Insufficient characters orservices • Historically not as enterprise focused

Table 3. Amazon Web Services (AWS) vs Google cloud platform (GCP)

	AWS	Azure	GCP
Compute	Amazon EC2	Azure Virtual Machines	Google Compute Engine
File Storage	Amazon S3	Azure Blob Storage	Google Storage
NoSQL	Amazon DynamoDB	Azure DocumentDB	Google Cloud Datastore
Function as a Service	Amazon Lambda	Azure Functions	Google Cloud

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			Functions
Relational Database	Amazon RDS	Azure SQL Database	Google Cloud SQL
Container Scheduler	Amazon EC2 Container Service	Azure Container Service	Google Kubernetes Engine
App Deployment	Amazon Elastic Beanstalk	Azure Cloud Services	Google App Engine
Data Warehouse	Amazon Redshift	Azure SQL Data Warehouse	Google BigQuery

Table 4: AWS, Azure, GCP

• add_cvip ()

This function performs the bitwise addition of two images. Adds each element from inputImage1 to the corresponding element in inputImage2 and returns the sum in the corresponding element of the output image. If inputImage1 and inputImage2 are numeric arrays of different sizes, smaller size arrays are zero-padded and added to larger size arrays.

Image	Format	Data Type	Size	Range	Minimum	Maximum
InputImage1	BMP	Uint8	256x256	246	7	253
InputImage2	BMP	Uint8	256x256	255	0	255
OutputImage	BMP	Double	256x256	508	0	508

Table 5: MATLAB Output for ADD operation

Image	Format	Data Type	Size	Range	Minimum	Maximum
InputImage1	BMP	BYTE	256x256	246	7	253
InputImage2	BMP	BYTE	256x256	255	0	255
OutputImage	BMP	FLOAT	256x256	508	0	508

Table 6: CVIP tools Output for ADD operation

VI. CONCLUSION

This research began with the objective of making a MATLAB CVIP toolbox more extensive by adding more CVIPtools library functions. This was the continuation of work performed by Krishna Regmi on his thesis titled “Computer Vision and Image Processing Toolbox for MATLAB ”, where he ported the 108 CVIPtools library function to MATLAB using the MEX interface, which involved calling CVIPtools C library function with the help of the MEX wrapper function. [40]

During the initial phase of this research, more functions were developed using the MEX interface and added to the computer vision and image processing toolbox. However, when extensively testing the functions in batch mode using many sets of test images, the functions did not perform well. The execution of functions in the batch mode often led to the crashing of the MATLAB application because of inappropriate memory allocation and trying to access the restricted area of memory. Due to the failure to execute many functions in the batch mode, the Toolbox did not serve its purpose. As a result, research was done to explore alternative methods to create the Toolbox. During the research, it was found that most of the functions can be re-written in MATLAB as M-files with comparable performance to MEX functions using the vectorization technique to avoid the loop structure and improve functional performance. Selective functions were re-written in MATLAB to evaluate this method, and a computational speed comparison between the MEX and M-files functions was performed. The result of the computational speed comparison indicated that the functions could perform comparably well when written as MATLAB M-files. Therefore, the decision was made to re-write all the toolbox functions in MATLAB as M-file functions.

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