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Department of Computer Science & Engineering (AI & ML)
(2023-2024)

For Assignment [5 Marks]

Class : TE - CSE(AIML)
Subject Name: Cloud Computing
Subject Code:

Assignment No:	1
Title:	51
Date of Performance:	5/2/24
Date of Submission:	21/2/24
Roll No:	211714
Name of the Student:	Gram Mohd Ahmed Shaikh.

Evaluation:

Sr. No	Rubric	Marks
1	On time Submission & Completion (2)	2
2	Technical Content (2)	2
3	Presentation & Organization (1)	1
4	Total (5)	(5)

Signature of the Teacher:

Date:

21/2/24

What is cloud computing? What are different cloud computing services? Write its types examples, advantage and disadvantage

Cloud Computing:-

Cloud Computing is on-demand access, via the Internet to computing resources - applications, server, data storage, development tools, networking capabilities, and more hosted at a remote data centre managed by a Cloud Service Provider [CSP]

The CSP makes these resources available for a monthly subscription free or bills them according to usage.

The term 'cloud Computing' also refers to the technology that makes cloud work.

Example: A single hardware server can be divided into multiple virtual servers.

8 Cloud Computing Services :-

IaaS, PaaS and SaaS are the three most common cloud Computing services and it's not uncommon for an organization to use all three.

1] SaaS [Software-as-a-Service] :

SaaS also known as cloud based software or cloud applications, is a application Software that's hosted in the cloud, and that user access via a web browser a dedicated desktop or mobile client, or an API that integrates with a desktop or mobile operating System. This service is based on monthly, annual Subscription free or pay as you go pricing based on your actual usage.

Advantage -

- Cost Saving
- Scalability & Flexibility
- Innovation & Collaboration
- Integration & Compatibility
- Security & Compliance

Disadvantage -

- Lack of Control
- Limited range of application
- Performance
- Security & data concern
- Connectivity requirement

Examples -

- Zoom
- G Suite
- Drop box
- Netflix

2] PaaS [Platform-as-a-Service]

PaaS provide Software developers with on-demand platform hardware, complete software stack, infrastructure, and even development tools for running, developing and managing application without the cost, complexity and inflexibility of maintaining that platform on-premises. With PaaS, the cloud provider hosts everything - server, networking, storage, operating system, software, middleware, databases at their data center. Developer simply pick from a mens of spin-up server and environment they need to run, build, test, deploy, maintain, update and scale applications.

Advantage :

- Cost Effective
- Speed to Market
- Increase Security
- Time Saving
- Flexibility.

Disadvantage :

- Vendor dependencies
- Compatibility
- Risk of Lock-in
- Security Risks.

Examples :

- IBM Cloud
- Google App Engine
- AWS Elastic Beanstalk

3] IaaS [Infrastructure-as-a-Service] :

IaaS provides on-demand access to fundamental computing resources - physical and virtual servers, networking and storage - over the internet on a pay-as-you-go basis. IaaS enables and user to scale and shrink resources on an as-needed basis, reducing the need for high, up-front capital expenditures or unnecessary on-premises or owned infrastructure & for overbuying resources to accomodate periodic spikes in usage. IaaS provides the user with the lowest-level control of computing resources in the cloud.

Advantages -

- Reduced Cost
- Disaster Recovery
- Improved Security
- Improves business productivity
- Uptime.
- Support

Disadvantage-

- Security Risk
- Dependency on Third-Party Service Provider.
- Technical Problem
- Unexpected Cost

Example -

- Linode
- Salesforce
- Zendesk
- Digital Ocean.

What are different cloud Computing models? Write types, examples, advantage & disadvantage.

There are four main types of cloud Computing models. They are private clouds, public clouds, hybrid clouds, and multiclouds. Choosing a cloud type is a unique decision.

1] Public cloud :-

It is a type of cloud computing in which a cloud service provider makes computing resources - anything from SaaS applications, to individual virtual machine (VMs) to bare metal computing hardware, to complete enterprise grade infrastructure and development platforms, available to users over the public internet. These resource might be accessible for free or access might be sold according to subscription-based or pay per usage pricing models.

Advantage -

- Low Cost
- Location Independent
- Saves time
- Quick & Easy Set-Up
- Scalability & Reliability.

Disadvantage -

- Low Security
- Performance
- Less Customizable.

Example -

- (a) Google Workspace (b) AWS (c) Dropbox (d) Microsoft 365 & Azure.

2] Private Cloud :

Private cloud is a cloud environment in which all cloud infrastructure & computing resource are dedicated to, and accessible by, one customer only. Private cloud combines many of the benefits of cloud computing including elasticity, with scalability & ease of service delivery with the access control, security and resources customization of on-premises infrastructure. It is typically hosted on-premises in the customer's data center. But a private cloud can also be hosted on an independent cloud providers infrastructure or built on rented infrastructure housed in an offset data center.

Advantage -

- More Control
- Security & Privacy
- Improved Performance.

Disadvantage -

- High Cost
- Restricted area of operations.
- Limited Scalability
- Skilled people.

Example -

- HPE
- DELL
- IBM
- Oracle.

3] Hybrid Cloud :

Hybrid cloud is just what it sound like - a combination of public and private cloud environment. Specifically and ideally a hybrid cloud connects an organization's private cloud service & public cloud's into a single flexible infrastructure for running the organization's application & Workloads. The goal of hybrid cloud is to establish a mix of public and private cloud resources and with a level of orchestration between them, that gives an organization the flexibility to choose the optimal cloud for each application or workload & to move workload freely between the two clouds as circumstances changes.

Advantage -

- Agility & Scalability
- Control & Flexibility
- Security
- Cost Optimization
- Reliability

Disadvantage -

- Implementation
- Technical Complexity
- Visibility
- Vendor Management & Cost Control.

Example -

- AWS Outposts
- Azure Stack
- Azure Arc
- Google Anthos.



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Subject Name: Cloud Computing

Subject Code:

For Assignment | 5 Marks |

Assignment No:	2
Title:	
Date of Performance:	7/3/24
Date of Submission:	21/3/24
Roll No:	211714
Name of the Student:	Gram Mohd Ahmed Shaikh.

Evaluation:

Sr. No	Rubric	Marks
1	On time Submission & Completion (2)	2
2	Technical Content (2)	2
3	Presentation & Organization (1)	1
4	Total (5)	5

Signature of the Teacher:

Date:


21/3/24

Q1 Explain concept of Visualization along with their types, Structure and mechanism.

Concept of Visualization -

Visualization in Cloud Computing refers to the creation of virtual version of computing resources, such as servers, storage, and network. This abstraction enables multiple virtual instances to run on a single physical resource, optimizing resources utilization, enhancing scalability & flexibility in managing infrastructure.

Types of Visualization

Server Virtualization -

Create multiple virtual machine on single physical server, each running its own operating system and application.

Network Virtualization -

Abstract the physical network hardware allowing creation of virtual network with independent functionalities and configuration.

Storage Virtualization -

Pool physical storage resources from multiple devices into a single logical unit, offering enhanced flexibility and management.

B Structure of Virtualization

Top Layer

Guest Operating System

This is the OS running within a virtual machine. It's unaware of the virtualised environment and behaves as if it has dedicated hardware resources.

Middle layer

Virtual Devices

These are software emulations of physical devices like CPUs, network cards, and storage controllers.

They provide hardware functionality to the guest OS on a virtualised environment.

Bottom Layer

Hypervisor (VMM)

This software layer fits directly on the physical hardware and acts as the core components of virtualization. It manages the allocation and isolation of resources like CPU, memory and storage between multiple VMs.

Here are 2 main types of hypervisor: Type 1 - Hypervisor (Bare-metal) and Type 2 - Hypervisor (Hosted)

C Mechanism of Virtualization

i) Resource Management

Partitioning -

Physical resources like CPU, memory and storage are divided into isolated slices allocated to individual VMs. Each VM receives a guaranteed share of resources, ensuring its smooth operation.

Scheduling-

The hypervisor decides which VM gets access to the CPU at any given moment, ensuring fair and efficient resources utilization. Scheduling algorithm can be Static (pre-define allocation) or dynamic (adaptive based on workload demands).

Memory management

Virtual memory technique are used to create the illusion of having more memory than physically available. This involves paging and swapping data between RAM and Storage as needed.

ii) Instruction Handling

Full virtualization :

Emulates the underlying hardware completely allowing unmodified guest OSes to run without special configuration. This approach involves intercepting and translating every guest instruction, which can be performance-intensive.

Para virtualization

Requires modification to the guest OS to improve virtualization efficiency. These modifications allow for direct communication with the hypervisor, resulting in better performance compared to full virtualization. This is called para-virtualization.

iii) Optimization

Live Migration :

Enables seamless migration of running VMs between physical host without downtime. This ensures high availability and facilitates load balancing across the infrastructure. Enables seamless mi

Snapshot & Backups :

Virtual machines can be easily snapshotted to capture their state at a specific point in time. This allows for quick recovery from failures or rollbacks to previous configurations.

Resource Pools :

Groups of physical resources can be pooled together and dynamically allocated to VMs based on their requirement. This improves resources utilization and eliminates resource

Q2 Explain to create and run virtual machine inside hosted hypervisor like virtual Box & KVM.

"Running VMs with AMD Processor on Hosted Hypervisors"

Both virtual Box and KVM can successfully run VMs with AMD processor, although there are some to consider. Here's a breakdown :-

VirtualBox :

Native Support -

virtual Box offers native support for AMD processor, including 64 bit architecture

Hardware Acceleration-

To leverage AMD-specific feature like nested virtualization and performance enhancements.

Performance-

Virtual Box Performance with AMD processors can be good, but enabling hardware acceleration significantly improves it.

KVM :

Native Support -

KVM, being apart of the Linux kernel, inherently supports AMD processor, including nested virtualization.

Hardware acceleration-

It is automatically enabled when using KVM on a system with -v support.

Performance -
KVM generally offers better performance than virtual box due to its deeper integration with the hardware.

Additional Consideration / Tips :

Guest OS Compatibility -
Ensure the guest OS you plan to run is compatible with the chosen hypervisor.

Resource Allocation -
Allocate sufficient R.A.M and C.P.U cores of your VMs based on their expected workload.

Security -
Implement proper security measures within your VMs and the hypervisor itself.

Troubleshooting -
If you encounter issues, consult the respective hypervisor documentation and forums for troubleshooting steps specified to AMD processors.

Performance -
Consider enabling features like nested virtualization for potentially better performance, but be aware of potential security implications.

STEPS

Virtual Box :

Step 1 - Enable AM-V in BIOS

Step 2 - Download & Install Virtual Box

Step 3 - Create a New Virtual Machine

Step 4 - Configure Hardware Settings.

Step 5 - Install the Guest OS.

STEPS

KVM :

Step 1 - Verify Kernel Support

Step 2 - Install KVM and Tools.

Step 3 - Create a new Virtual Machine

Step 4 - Configure Hardware setting

Step 5 - Install the Guest OS

Step 6 - Done.

Q3 Compare Virtual Box & KVM based on various Virtualization parameters.

	Virtual Box	KVM
Hypervisor:	'Types 2' hypervisor: Runs on top of an existing operating system	'Types 1' hypervisor: Runs directly on the host hardware
Ease of Use:	User friendly GUI with easy VM creation & management.	Require command-line configuration or third-party GUI tools.
Performance:	Slightly slower due to Type 2 Architecture	Leverages hardware-assisted virtualization for near-native performance
Management Tools:	Built-in GUI and Command line tools.	Requires separate tools like libvirt & -manager
Scalability:	limited to host machine resources.	Can scale to multiple physical machines.
Security:	Good, but not as secure as KVM.	More secure due to direct hardware access & deeper integration with the kernel.



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Class: CSE (AIML) - TE

Subject Name: CC

Subject Code:

For Assignment [5 Marks]

Assignment No:	3
Title:	
Date of Performance:	28-3-24
Date of Submission:	4/4/24
Roll No:	211714
Name of the Student:	Gram Mohd Ahmed Shaikh

Evaluation:

Sr. No	Rubric	Marks
1	On time Submission & Completion (2)	2
2	Technical Content (2)	2
3	Presentation & Organization (1)	1
4	Total (5)	(5)

Signature of the Teacher:

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Explain functionality of bare metal hypervisor and their relevance in cloud computing services.

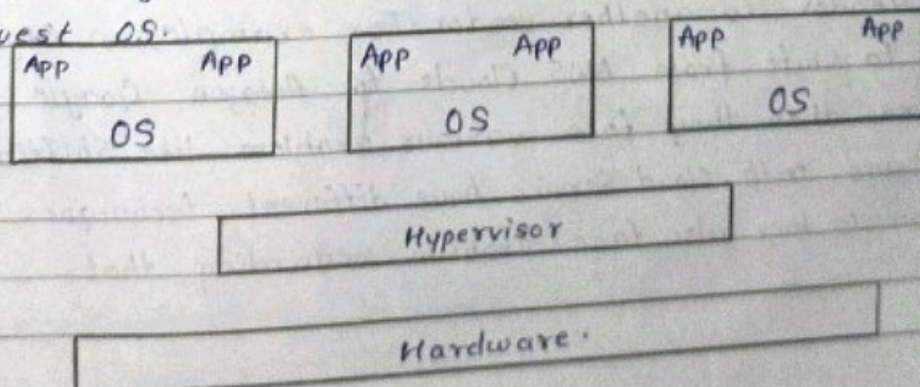
A hypervisor, is also known as virtual machine monitor or VMM is a type of virtualization software that supports the creation of management of virtual machines by separating a computer software from its hardware. Hypervisor translate the request between the physical and virtual resources making virtualization possible when a hypervisor is installed directly on the hardware and operating system of a physical machine between the hardware and operating system, it is called a bare metal hypervisor.

Because the bare metal hypervisor separate the OS from the underlying hardware the software no longer relies on or is limited to specific hardware allows OS and their associated application to run on a variety of types of hardware.

The term bare metal refers to the fact that there is no OS between the virtualization software and the hardware. The virtualization software resides on the "bare metal" or the hard disk of this hardware where the OS is usually installed.

A bare metal hypervisor also known as a Type 1 hypervisor is virtualization software that has been installed directly onto the computing hardware.

This type of hypervisor control not only hardware but one or more guest OS.



Q2 Explain major security issues in the cloud and mechanism to address them.

There is no doubt that, cloud Computing provides various advantages but there are also some Security issues in cloud computing. Below are some following Security issues:

1. Data Loss - Data Loss is one of the issues faced in cloud computing. This is also known as Data Leakage. As we know that our sensitive data is in the hand of somebody else, and we don't have full control over our databases. So, if the security of cloud services in its is to break by hackers. Then it may be possible that hackers will get access to our sensitive data or personal files.
2. User Account Hijacking - Account hijacking is the most serious security issues in cloud computing. If somehow the account of user or an organization is hijacked by a hacker then the hacker has full authority to perform unauthorized activities.
3. Changing Service Provider - Vendor is also an important security issues in cloud Computing. many Organization will face different problem while shifting from one vendor to another vendor. For example, an Organization want to shift from AWS Clouds to Amazon Google Cloud Services then they face various problem like Shifting of all data and both cloud Service have different techniques & function, so they also face problem regarding that.

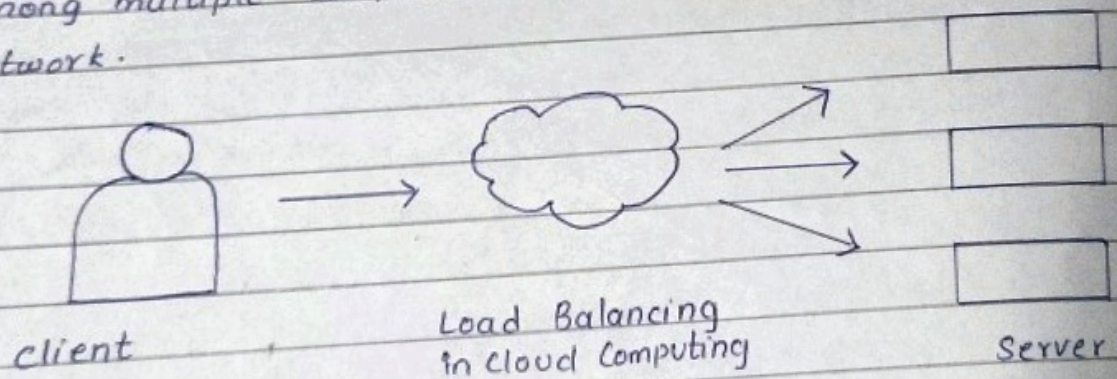
(2)
Lack of Skills - while working, shifting to another services provides need an extra feature, how to use a features etc, are main problem caused in IT company who doesn't have skilled employee, so it requires skilled person to work with cloud computing.

Denial of Service (DOS) attack - This type of attack occurs when the system receives too much traffic. mostly DOS attack occur in large organization such as the banking sector, government sector, etc. when a DOS attack occurs, data is kept lost. So, in order to recover data, it requires a great amount of money as well as time to handle it.

Q3

Explain Load balancing and Auto Scaling in cloud Computing and compare them.

Load Balancing is cloud Computing distributed traffic and workloads to ensure that no single server or machine is under-loaded, overloaded or idle, load balancing optimizes various constrained parameter such as execution time, response time and system stability to improve overall cloud performance. Load balancing architecture in cloud computing consist of a load balancer that sits between server and client devices to manage traffic. Load balancing in cloud Computing distributes traffic, workloads and computing resources evenly throughout a cloud environment to deliver greater efficiency and reliability for cloud application. cloud load balancing enables enterprises to manage client request and cost resources distribution among multiple computer application, server or computer network.



Auto Scaling

Auto-scaling is a features in cloud computing that allows a cloud-based application to automatically adjust the resources it uses, such as servers compute instances based on demand. The goal of auto scaling is to ensure that the application has sufficient resources availability, while also optimizing resources utilization and minimizing costs.

Auto Scaling Vs Load Balancing

Auto Scaling and Load Balancing are two important concept in cloud computing and network infrastructure.

Auto Scaling is a features that helps to adjust the capacity of a system automatically based on its current demand.

The goal of auto Scaling is to maintain the performance of the system and to reduce by only using the resources that are actually needed. On the other hand, Load balancing is a device that distributes network or application traffic across multiple server.

The primary objective of a Load balance is to increase the availability and reliability of the system by distributing the workload evenly across multiple servers and by providing failure capabilities.