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Assignment.

Cloud Computing.

Q1. Define virtualization? Explain different types of virtualization

→ 1. Definition - virtualization is the process of creating a virtual version of a resource, such as a server, storage device, network or operating system, instead of a physical one. It allows multiple virtual instances to run on a single physical machine, optimizing resource utilization, reducing costs, and improving scalability in IT environments including cloud computing.

2. Types of virtualization -

(a) Server virtualization -

- This involves partitioning in a single physical server into multiple virtual machines, each running its own operating system and applications.
- It increases efficiency by allowing multiple workloads to run on the same hardware.
- Example - VMware, Vsphere, Microsoft Hyper V.

(b). Storage virtualization -

- Combines multiple physical storage devices into a single logical storage pool.
- It enhances storage management, performance and flexibility.
- Example - IBM storage virtualization, NetApp ONTAP.

(c). Network virtualization -

- Creates multiple virtual networks within a physical network, improving flexibility and scalability.
- Virtual networks can run independently with their own configurations
- Example - VMware, NSX, Cisco ACI.

(d). Desktop virtualization -

- Separates the desktop environment from physical device, allowing users to access their desktops remotely.
- Reduces hardware dependencies and improves security.
- Example: Citrix Virtual desktops, Windows Virtual desktop.

(e). Application virtualization -

- Allows applications to run in isolated environments without being installed on underlying os.
- Improves compatibility and security.
- Example - Microsoft App-V vmware ThinApp.

(f) Operating system virtualization -

- Allows multiple OS instances to run on a single hardware system using containers or virtual machines.
- Ex - Docker, Kubernetes OS LXC.

Q2. Explain the importance of hypervisor in cloud computing? Compare Type1 and Type 2 hypervisor?

→ A hypervisor is software that creates and manages VMs by enabling multiple operating systems to run on a single physical host. It plays a crucial role in cloud computing by :

- Enabling multi tenancy : Supports multiple VMs on a single hardware system allowing multiple users to share resources.
- Efficient resource utilization - Allocates CPU, memory, and storage dynamically maximizing efficiency.
- Isolation and security: Ensures that VMs remain independent and secure from each other.
- Scalability and flexibility - Helps cloud providers scale resources as per demand.
- Disaster recovery - Enables VM migration and replication to prevent data loss.

Comparison.

	Feature	Type 1 Hypervisor (Bare Metal)	Type 2 Hypervisor (Hosted)
1.	Definition	Runs directly on hardware without an OS.	Runs on top of an existing OS.
2.	Performance	High, as it has direct hardware access.	Lower, as it depends on host OS.
3.	Security	More secure due to direct hardware control.	Less secure as it relies on OS Security.
4.	Use Case.	Enterprise data centers, cloud computing.	Personal computers, testing environment.
5.	Example.	VMWare ESXi, Microsoft HyperV, Xen, KVM.	VMware workstation, Oracle virtualbox, Parallels desktop.
6.	Complexity	More complex due to set up and manage	Easier to install and user friendly.
7.	Hardware dependency.	Requires dedicated hardware.	Can run on existing OS without specific hardware.

Q3 Explain virtual clustering in cloud computing.

→ 1. Virtual clustering in cloud computing refers to the technique of grouping multiple virtual machines together to function as a unified system.

2. These VMs distributed across multiple physical servers, work collaboratively to enhance resource utilization, scalability and fault tolerance.

3. Working of virtual clustering -

(1). Cluster formation - Multiple VMs are created across cloud data centers and grouped into a logical cluster.

(2) Resource allocation - A cloud orchestrator assigns resources dynamically based on workload demands.

(3). Parallel processing - Workloads are distributed among VMs to improve performance and efficiency.

(4) Fault tolerance - If one VM fails, workloads are redistributed, ensuring high availability.

(5). Scalability - VMs can be added or removed from cluster based on demand.

4. Use Cases -

- Cloud based Big data analytics (Eg. Apache Hadoop cluster)
- Scientific computing requiring high performance simulations.
- AI and machine learning workloads for deep learning

Q4 Write application for healthcare : ECG Analysis in the cloud; Biology : Protein structure prediction, Geosciences : Satellite image processing.

→ 1) Healthcare : ECG analysis in cloud.
Enables real time electrocardiogram analysis, improving remote patient monitoring and diagnosis.

Working. -
1. Data collection: Wearable ECG sensors capture heart signals and transmit them to cloud.
2. Cloud processing: AI based algorithms analyze ECG data to detect abnormalities (eg arythmia, heart attack risk).
3. Remote access: Cardiologist can access patient reports via web or mobile app.
4. Alerts and notifications to healthcare providers.

Example - Google cloud Healthcare API
AWS Health lake.
IBM Watson Health.

2) Biology : Protein structure prediction -

Crucial for drug discovery and genetic research.
Cloud computing accelerates simulations and data analysis.

Working -
1. Sequence input : amino acid sequences of protein.
2. AI models (Alphafold) run complex computations.

3. Parallel processing through cloud.
4. Data sharing and collaboration.

3) Geosciences : Satellite image processing.

Cloud computing processes vast amounts of satellite imagery for environmental monitoring, disaster management and climate change analysis.

Working -

1. Image aquisition - satellites capture earth images and store in cloud repositories.
2. Preprocessing and enhancement - AI based cloud services remove noise and enhance image quality.
3. Analysis and interpretation - Machine learning algorithms detect land cover changes, weather patterns
4. Visualization and reporting. - Generate interactive maps and reports.

Q5 Explain steps to configure server for EC2?

→ Amazon EC2 (Elastic compute cloud) provides scalable virtual servers in cloud. Setting up an EC2 instance involves the following steps.

Step 1: Log in to AWS Management Console.
- Navigate to EC2 dashboard under compute section.

Step 2: Launch EC2 instance

- Click "Launch Instance" to create a new virtual server.
- Provide instance name.

Step 3: Choose Amazon Machine Image (AMI).
- AMI is a pre configured machine image of os.
- Common - Amazon linux 2, Ubuntu, Windows.

Step 4: Select Instance type.
t2. micro (for small application).
m5. large (general purpose)
c5. xlarge (compute intensive workload).

Step 5: Configure instance details.
- No. of instances.
- Networking - vpc., security group.
- Auto assign public ip.
- IAM role.

Step 6: Configure storage (Elastic Block storage).
- Default storage - 8 GB.
- Enable encryption for security.

Step 7: Configure security group.

Step 8: Create and select a key pair for SSH. - Download and store key properly.

Step 9: Review and launch instance.

Step 10: Connect to instance.

Step 11: Install software and configure services.
Update the system:

```
sudo yum update -y
sudo apt update
```

Step 12: Install and test server.

```
sudo yum install httpd -y.
sudo systemctl start httpd
sudo systemctl enable httpd.
```

Visit the public ip to verify the set up -

Q6. Explain steps to create an amazon S3 bucket. and managing associated objects.

→ Amazon S3 (Simple Storage Service) provides scalable object storage for various applications. Creating and managing an S3 bucket involves a few essential steps.

Step 1: Log In to Aws and open S3.

Step 2: Create a new S3 bucket - give a name

Step 3: Configure bucket settings.
- Block public ip address.
- Visioning.
- Encryption.

Step 4: Click "create bucket" to finalize.

- Managing objects in S3 bucket -

- Uploading objects:
1. Open created bucket.
2. Click "upload", then "Add files" or "Add Folder".
3. Choose files (eg. images, documents).
4. Configure permissions and storage class (Standard Tiering, Glacier)
5. Click "Upload".

- Downloading objects:
1. Open Bucket to navigate to the file
2. Click download to save it locally.

- Setting object permissions -
  - Modify bucket policies or ACLs (Access control list) to grant access to users or applications.

- Deleting objects -
  Select files to delete and click "delete" to remove them permanently.

- Enabling life cycle rules -
  - Automate file archiving or deleting move old files to Glacier after 30 days.

Hence, this is how we can manage S3.