Department of Artificial Intelligence and Machine Learning

CLOUD COMPUTING AND ARCHITECTURES

Scheme and Solutions

SL. No		Questions	Marks
1	a)	**Discuss what are the technologies on which cloud computing relies.** **Each technology carries 1 mark with an explanation** **Ans:** A list of cloud computing technologies is given below 1. Distributed systems 2. Virtualization 3. Service-Oriented Architecture (SOA) 4. Web 2.0 5. Utility Computing **1. Distributed systems** A distributed system is a collection of independent computers that appears to its users as a single coherent system. Clouds are essentially large distributed computing facilities that make available their services to third parties on demand. **2. Virtualization** Virtualization is another core technology for cloud computing. It encompasses a collection of solutions allowing the abstraction of some of the fundamental elements for computing, such as hardware, runtime environments, storage, and networking. or Virtualization confers that degree of customization and control that makes cloud computing appealing for users and, at the same time, sustainable for cloud services providers **3. Service-Oriented Architecture (SOA)** This approach adopts the concept of services as the main building blocks of application and system development. Service-oriented computing (SOC) supports the development of rapid, low-cost, flexible, interoperable, and evolvable applications and systems. Or Services are composed and aggregated into a service-oriented architecture (SOA), which is a logical way of organizing software systems to provide end users or other entities distributed over the network with services through published and discoverable interfaces. **4. Web 2.0** The Web is the primary interface through which cloud computing delivers its services. At present, the Web encompasses a set of technologies and services that facilitate interactive information sharing, collaboration, user-centered design, and application composition. Or Web-based access to all the functions that are normally found in desktop applications. These capabilities are obtained by integrating a collection of standards and technologies such as XML, Asynchronous JavaScript and XML (AJAX), Web Services. **5. Utility Computing** Utility computing is a vision of computing that defines a service-provisioning model for compute services in which resources such as storage, compute power, applications, and infrastructure are packaged and offered on a pay-per-use basis	5

	b	**Describe the characterization of a distributed system** Any five Characteristics of Distribution with explanation **Transparency** Transparency is the notion that the user interacts with a whole quantity rather than a cluster of cooperating elements. A system capable of presenting itself as a whole to the user is called transparent. **Openness** Openness The openness of a computer system is the characteristic that determines whether the system can be extended and implemented in various ways. **or** The openness of distributed systems is determined primarily by the degree to which new resource-sharing services can be added and be made available for use by a variety of client programs **Security** Security Many of the information resources that are made available and maintained in distributed systems have a high intrinsic value to their users. Their security is therefore of considerable importance. **Scalability** It refers to the ability of the system to handle growth as the number of users increases. Scalability is accomplished by adding more computer systems to the existing networks. **Fault Tolerance** A distributed system is very likely to be prone to system failures. This is because several computers have diverse-aged hardware. **or** The ability of a system to handle these failures is called fault tolerance. Fault tolerance is achieved by: **Recovery**: Systems and processes will have a stored backup. It takes over when the system fails. **Redundancy**: When a component acts predictable and in a controlled way is called redundancy. **Concurrency** Concurrency is the system's capability to access and use shared resources. It means multiple actions are performed at the same time. **Efficiency** Efficiency refers to the capability of the system to use its resources effectively to execute the given tasks. Or The system's design, the workload handled by the system, and the hardware and software resources used are some critical factors affecting the system's efficiency.	5

2 a **Illustrate how cloud development is different from traditional software development?** **5**

Any 5 points (Each Carries 1 marks)

Cloud Computing	Traditional Computing
It refers to delivery of different services such as data and programs through internet on different servers.	It refers to delivery of different services on local server.
It takes place on third-party servers that is hosted by third-party hosting companies.	It takes place on physical hard drives and website servers.
It is ability to access data anywhere at any time by user.	User can access data only on system in which data is stored.
It is more cost effective as compared to tradition computing as operation and maintenance of server is shared among several parties that in turn reduce cost of public services.	It is less cost effective as compared to cloud computing because one has to buy expensive equipment's to operate and maintain server.
It is more user-friendly as compared to traditional computing because user can have access to data anytime anywhere using internet.	It is less user-friendly as compared to cloud computing because data cannot be accessed anywhere and if user has to access data in another system, then he need to save it in external storage medium.
It requires fast, reliable and stable internet connection to access information anywhere at any time.	It does not require any internet connection to access data or information.
It provides more storage space and servers as well as more computing power so that applications and software run must faster and effectively.	It provides less storage as compared to cloud computing.
It also provides scalability and elasticity i.e., one can increase or decrease storage capacity, server resources, etc., according to business needs.	It does not provide any scalability and elasticity.
Cloud service is served by provider's support team.	It requires own team to maintain and monitor system that will need a lot of time and efforts.
Software is offered as an on-demand service (SaaS) that can be accessed through subscription service.	Software in purchased individually for every user and requires to be updated periodically.

Or

Here are the 5 major factor that illustrates how cloud is different from traditional software development

Cost

Cloud computing can be much more cost-effective than traditional computing because it eliminates the need to purchase, install, and maintain hardware and software.

<table>
<tr><td></td><td></td><td>Scalability
With traditional computing, companies must purchase additional hardware and software to increase their capacity or add new features.

With cloud computing, however, companies can quickly scale up or down as needed without having to make any large investments in hardware or software.

Reliability
Cloud computing takes the lead in terms of reliability, thanks to its extensive network of data centres located worldwide.

These data centres are under constant surveillance and maintenance by skilled engineers, ensuring uninterrupted service.

Security
The security of cloud-based systems is also superior to traditional systems because cloud providers employ state-of-the-art security measures such as encryption and identity management tools that protect user data from unauthorized access or theft.

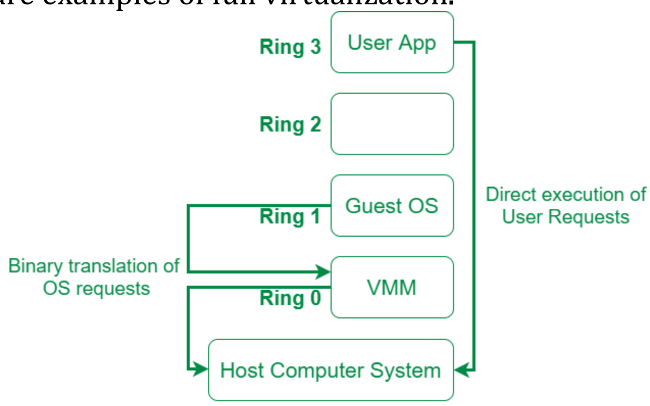
Traditional systems are much more vulnerable to attack because they lack these advanced security measures and tend to rely on outdated methods of protection such as firewalls and antivirus software

Flexibility
Cloud computing provides users with unparalleled flexibility as it enables them to effortlessly access their applications from any device, anywhere in the world, at any time, without the need for any prior installations on their devices.

This makes it easier for users to work remotely or collaborate with colleagues who may be located in different parts of the world without having to worry about compatibility issues or installation delays</td><td></td></tr>
<tr><td></td><td>b</td><td>How Cloud Computing handles the following
i. Load Balancing
In cloud computing, load balancing can be implemented at various levels, including the network layer, application layer, and database layer or Storage Level.
ii. Reliability
Reliability can be achieved
▪ you can use redundancy, which involves having multiple copies or backups of your services or applications, to increase availability and fault tolerance.
▪ Monitor the status and performance of your services or applications
iii. Resource Control
Resource management in cloud computing refers to the orchestration of cloud resources to meet application demands, budget constraints, and security requirements. It involves provisioning, monitoring, scaling, optimizing, and securing resources to ensure smooth operations and cost-effectiveness.</td><td></td></tr>
<tr><td>3</td><td>a</td><td>Discuss the Candidate Sector for Community Clouds
Each sector with explanation carries 1 marks
1. Media industry
2. Healthcare industry
3. Energy and other core industries
4. Public sector
5. Scientific research</td><td></td></tr>
</table>

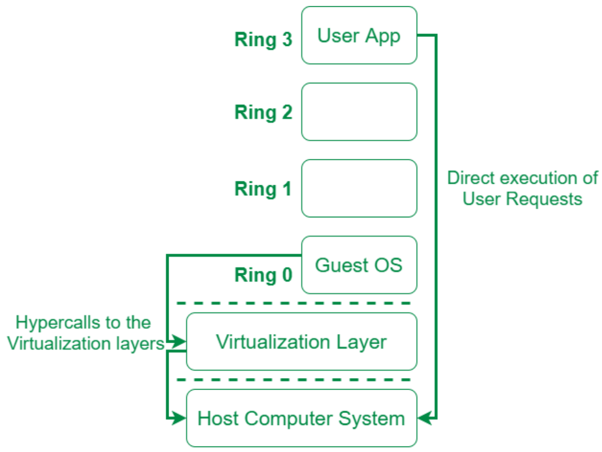
b **Compare Full Virtualization and Para Virtualization**

1. Full Virtualization: Full Virtualization was introduced by IBM in the year 1966. It is the first software solution for server virtualization and uses binary translation and direct approach techniques. In full virtualization, guest OS is completely isolated by the virtual machine from the virtualization layer and hardware. Microsoft and Parallels systems are examples of full virtualization.



Full Virtualization

2. Paravirtualization: Paravirtualization is the category of CPU virtualization which uses hypercalls for operations to handle instructions at compile time. In paravirtualization, guest OS is not completely isolated but it is partially isolated by the virtual machine from the virtualization layer and hardware. VMware and Xen are some examples of paravirtualization.



Paravirtualization

Or

Any Five Difference among these

SN	Full Virtualization	Paravirtualization
1	In Full virtualization, virtual machines permit the execution of the instructions with the running of unmodified OS in an entirely isolated way.	In paravirtualization, a virtual machine does not implement full isolation of OS but rather provides a different API which is utilized when OS is subjected to alteration.
2	Full Virtualization is less secure.	While the Paravirtualization is more secure than the Full Virtualization.

		3	Full Virtualization uses binary translation and a direct approach as a technique for operations.	While Paravirtualization uses hypercalls at compile time for operations.	
		4	Full Virtualization is slow than paravirtualization in operation.	Paravirtualization is faster in operation as compared to full virtualization.	
		5	Full Virtualization is more portable and compatible.	Paravirtualization is less portable and compatible.	
		6	Examples of full virtualization are Microsoft and Parallels systems.	Examples of paravirtualization are Microsoft Hyper-V, Citrix Xen, etc.	
		7	It supports all guest operating systems without modification.	The guest operating system has to be modified and only a few operating systems support it.	
		8	The guest operating system will issue hardware calls.	Using the drivers, the guest operating system will directly communicate with the hypervisor.	
		9	It is less streamlined compared to para-virtualization.	It is more streamlined.	
		10	It provides the best isolation.	It provides less isolation compared to full virtualization.	

4	**a**	**Write the Roles and Responsibilities of the following components in implementing Virtualization** **i. ABI** The **Application Binary Interface (ABI)** separates the operating system layer from the applications and libraries, which are managed by the OS. ABI covers details such as low-level data types, alignment, and call conventions and defines a format for executable programs. System calls are defined at this level. **ii. VID** **Virtualization Infrastructure Driver (VID),** which controls access to the hypervisor and allows the management of virtual processors and memory. The parent partition is also the one that manages the creation, execution, and destruction of child partitions. **iii. ISA** **Instruction Set Architecture** (ISA), which defines the instruction set for the processor, registers, memory, and interrupt management. ISA is the interface between hardware and software, and it is important to the operating system (OS) developer	
	b	**Identify the activity that causes performance degradation in Virtualization** The causes of performance degradation can be traced back to the overhead introduced by the following activities: 1. Maintaining the status of virtual processors 2. Support of privileged instructions (trap and simulate privileged instructions) 3. Support of paging within VM 4. Console functions	
5	**a)**	The hypervisor is the component that directly manages the underlying hardware (processors and memory). It is logically defined by the following components: • Hypercalls interface. This is the entry point for all the partitions for the execution of sensitive instructions. This is an implementation of the paravirtualization approach already discussed with Xen. This interface is used by drivers in the partitioned operating system to	

		contact the hypervisor using the standard Windows calling convention. The parent partition also uses this interface to create child partitions. • Memory service routines (MSRs). These are the set of functionalities that control the memory and its access from partitions. By leveraging hardware-assisted virtualization, the hypervisor uses the Input/Output Memory Management Unit (I/O MMU or IOMMU) to fast-track access to devices from partitions by translating virtual memory addresses. • Advanced programmable interrupt controller (APIC). This component represents the interrupt controller, which manages the signals coming from the underlying hardware when some event occurs (timer expired, I/O ready, exceptions and traps). Each virtual processor is equipped with a synthetic interrupt controller (SynIC), which constitutes an extension of the local APIC. The hypervisor is responsible of dispatching, when appropriate, the physical interrupts to the synthetic interrupt controllers. • Scheduler. This component schedules the virtual processors to run on available physical processors. The scheduling is controlled by policies that are set by the parent partition. • Address manager. This component is used to manage the virtual network addresses that are allocated to each guest operating system. • Partition manager. This component is in charge of performing partition creation, finalization, destruction, enumeration, and configurations. Its services are available through the hypercalls interface API previously discussed.	