Virtualization and Cloud Computing

Unit-1

2 Marks Question

1. **What is parallel system and computing?**

Ans: A system is said to be a parallel system in which multiple processors have direct access to shared memory which forms a common address space. Parallel computing is the use of two or more processors in combination to solve a single problem.

2. **Why are we using Parallel Computing?**

Ans:

- To be run on a single computer having a single CPU;
- A problem is broken into a discrete series of instructions.
- Instructions are executed one after another.
- Only one instruction may execute at any moment of time.

3. **What are the applications of Parallel Computing?**

Ans:

Parallel computing means using multiple computers or processors to work together on a problem.

An example of this is two servers that work together to manage tasks like routing mail or managing connections to a database.

Supercomputers often use parallel computing architecture to solve very complex problems.

In contrast, traditional computer systems typically have multiple terminals connected to a single server.

4. **Explain Distributed System and Computing.**

Ans: A distributed system is a collection of independent computers, interconnected via a network, capable of collaborating a task.

Distributed computing is a system where multiple computers work together to solve complex problems. It enables efficient processing of large amounts of data and provides fault tolerance. It is used in various applications, including scientific simulations and cloud computing.

5. **List down some examples for Distributed Systems:**
    - Telephone networks and cellular networks used for voice and data communication
    - Computer networks such as the internet or intranet used for sharing information and resources
    - ATM machines used for banking transactions
    - Distributed databases and database management systems
    - Networks of workstations used for distributed computing
    - Mobile computing devices such as smartphones and tablets used for computing on-the-go.
6. **Explain Personal Computing Environment?**

Ans:

- In personal computing environment there is a stand-alone machine.
- Complete program resides on computer and executed there.
- Example: Personal computing environment are laptops, mobiles, printers, computer systems, scanners etc. That we use at our homes and offices.

7. **Explain Time-Sharing Computing Environment?**

Ans:

- In this environment multiple users share system simultaneously.
- Different users (different processes) are allotted different time slice and processor switches rapidly among users according to it.
- For example: student listening to music while coding something in an IDE. Windows 95 and later versions, Unix, IOS, Linux operating systems are the examples of this environment.

8. **Explain Client-Server Environment?**

Ans:

- In client server computing environment two machines are involved i.e., client machine and server machine, sometime same machine also serve as client and server.
- In this computing environment client requests resource/service and server provides that respective resource/service.
- A server can provide service to multiple clients at a time and here mainly communication happens through computer network.

9. Explain Grid Computing Environment.

Ans:

- In grid computing environment, multiple computers from different locations works on single problem.
- In this system set of computer nodes running in cluster jointly perform a given task by applying resources of multiple computers/nodes.
- It is network of computing environment where several scattered resources provide running environment for single task.

10. Explain Cloud Computing Environment.

Ans:

- In cloud computing environment on demand availability of computer system resources like processing and storage are availed.
- Here computing is not done in individual technology or computer rather it is computed in cloud of computers where all required resources are provided by cloud vendor.
- This environment primarily comprised of three services i.e Software-as-a-service (SaaS), Infrastructure- as-a-service(IaaS) and platform-as-a-service (PaaS).

11. Explain Cluster Computing Environment.

Ans:

- In cluster computing environment cluster performs task where cluster is a set of loosely or tightly connected computers that work together.
- It is viewed as single system and performs task parallelly that's why also it is similar to parallel computing environment.

- Cluster aware applications are especially used in cluster computing environment.

12. What is Virtualization?

Ans:

- Virtualization refers to the act of creating a virtual (rather than actual) version of something, including virtual computer hardware platforms, operating systems, storage devices, and computer network resources.
- It offers a layer of abstraction between the computing resources and the applications running over it.

13. Explain terms of Virtualization.

Ans:

- Virtual Machine: it is a closely detached software device that could run its own operating system and application as if it is running on a physical machine. It contains its own virtual RAM,CPU,Disk,Network etc.
- Guest operating system: Operating system running in a VM environment.
- Hypervisor: It is a thin layer of software that provides virtual partitioning abilities that run directly on hardware, but underneath higher-level virtualization services.
- Virtual machine monitor: this can be a part of hypervisor or can be a separate software entity, that runs between the host operating system and hypervisor.
- Hosted Virtualization: A method where virtualization and partitioning services run on top of a typical OS.

14. Explain x86 hardware virtualization.

Ans:

The x86 architecture offers four levels of privilege known as Ring 0, 1, 2 and 3 to

operating systems and applications to manage access to the computer hardware. While user level applications typically run in Ring 3, the operating system needs to have direct access to the memory and hardware and must execute its privileged instructions in Ring 0.

15. Explain type of Hypervisors.

Ans:

A hypervisor is a software layer that allows multiple operating systems to run on a single physical server, sharing its resources. There are two main types of hypervisors:

Type 1 Hypervisor:

Type 1 hypervisors, also known as bare-metal hypervisors, run directly on the host's hardware. They provide direct access to hardware resources, such as CPU, memory, and I/O devices, to the virtual machines (VMs). Type 1 hypervisors are typically used in enterprise environments for server virtualization, where the primary focus is on performance and security. Examples of type 1 hypervisors include VMware ESXi, Microsoft Hyper-V, Citrix Hypervisor, and KVM.

Type 2 Hypervisor:

Type 2 hypervisors, also known as hosted hypervisors, run on top of an existing operating system. They rely on the host operating system to manage hardware resources and provide services to the virtual machines. Type 2 hypervisors are commonly used for desktop virtualization and testing environments, where the primary focus is on flexibility and ease of use. Examples of type 2 hypervisors include Oracle VirtualBox, VMware Workstation, and Parallels Desktop.

Q.16. What is SAN and its benefits?

Ans: When a Logical partition is created within a physical storage area network (SAN), it is called virtual storage area network (VSAN). Virtualization technology enables division and allocation of entire storage area network into more logical SANs

- Enhanced application availability
- Higher application performance
- Centralized and consolidated storage
- Data transfer and vaulting to remote sites
- Simplified centralized management

Q.17. What is VM Migration?

Ans: It refers to the movement or transfer between different physical machines without any discontinuity

Q.18. What is Utility Computing?

Ans: Utility computing is a computing service model where computing resources are provided to users on a metered basis, similar to how utilities like electricity or water are charged based on usage. Users can access computing resources as needed and pay only for what they use, rather than investing in their own IT infrastructure. This model provides cost savings, flexibility, and scalability in IT operations. Cloud computing is one example of a utility computing service model.

Q.19. What is Cloud Computing?

Ans: Cloud computing is a technology service model where computing resources, such as servers, storage, and applications, are provided to users over the internet on a pay-per-use basis. Users can access these resources from anywhere with an internet connection, without the need for their own IT infrastructure. Cloud computing provides flexibility, scalability, and cost savings for organizations.

Q.20. What is Abstraction in Cloud Computing?

Ans:

- Cloud computing abstracts the details of system implementation from users and developers.
- Applications run on physical systems that aren't specified,
- Data is stored in locations that are unknown,
- Administration of systems is outsourced to others, and access by users is ubiquitous.

Q.21. What us VMWare ESXI?

Ans:

- Pioneer in virtualisation, bare metal hypervisor,
- Provides advanced virtualization techniques of processor, memory, and I/O. Especially, through memory ballooning and page sharing, it can overcommit memory,

Q.22. What is Xen?

Ans:

- Open-source project
- It has pioneered the para-virtualization concept, on which the guest operating system, by means of a specialized kernel, can interact with the hypervisor, thus significantly improving performance

Q.23. What is KVM?

Ans:

- Kernel-based virtual machine (KVM) is a Linux virtualization subsystem
- It has been part of the mainline Linux kernel since version 2.6.20, thus being natively supported by several distributions.

Q.24. What is Virtual Appliance?

Ans:

An application combined with the environment needed to run it (operating system, libraries, compilers, databases, application containers, and so forth) is referred to as a “virtual appliance.”

Q.25. What is Open Virtual Format(OVF)?

Ans: OVF (Open Virtualization Format) is an open standard for packaging and distributing virtual appliances. It includes a set of files that describe the virtual machine, its configuration settings, and associated virtual disks or media. OVF allows for easy portability and interoperability of virtual machines across different virtualization platforms.

10 Marks Question

1. **What is parallel computing and explain its advantages and disadvantages?**

   Ans: Parallel computing is the use of two or more processors in combination to solve a single problem.

   Advantages of parallel computing are:

- Provide concurrency (do multiple things at the same time)
- Taking advantage of non-local sources
- Cost savings
- Save time and money
- Overcoming memory constraints
- Global addresses space provides a user-friendly programming perspective to memory

Disadvantages of Parallel computing:

- Shared memory computers have some disadvantages.
- One issue is that it can be hard to scale the memory and CPUs as the number of processors grows.
- Programmers are responsible for using synchronization tools to prevent errors when accessing memory.
- As we try to make computers with more processors, it becomes harder and more expensive to do so reliably.

2. Explain Parallel Computer Architecture?

Ans: Parallel computing follows von-Neuman Architecture and consists of four components given below:

- Memory is used to store both program instructions and data
1. Program instructions are coded data which tell the computer to do something
2. Data is simply information to be used by the program
- Control unit fetches instructions/data from memory, decodes the instructions and then sequentially coordinates operations to accomplish the programmed task.
- Arithmetic unit That performs basic arithmetic operations
- Input/Output is the interface to the human operator

Parallel Computing also follows Flynn's classical Taxonomy.

- SISD (Single Instruction Single Data): **(2 Marks)**

SISD stands for "Single Instruction Single Data" and is a type of computer architecture that executes one instruction at a time on one piece of data at a time. This architecture is simple, low cost, and easy to program, but not very efficient for processing large amounts of data simultaneously. It is commonly used in traditional von Neumann computers.

- SIMD (Single Instruction Multiple Data): **(2 Marks)**

SIMD stands for "Single Instruction Multiple Data" and is a type of computer architecture that processes multiple pieces of data using a single instruction. This means that the computer processor can execute the same operation on multiple data elements at the same time. SIMD is commonly used in high-performance computing systems, such as graphics processing units (GPUs) and digital signal processors (DSPs), which require fast and efficient processing of large amounts of data.

- MISD (Multiple Instruction Single Data): **(2 Marks)**

MISD stands for "Multiple Instruction Single Data" and is a theoretical computer architecture that executes multiple instructions on a single data element. This architecture is not widely used in modern computing systems as it is complex and provides limited practical benefits. Other architectures, such as SIMD and MIMD, are more commonly used in high-performance computing systems.

- MIMD (Multiple Instruction Multiple Data): **(2 Marks)**

MIMD stands for "Multiple Instruction Multiple Data" and is a computer architecture that allows multiple processors to work independently on multiple data elements simultaneously. This architecture is used in high-performance computing systems, such as supercomputers and clusters, to process large amounts of data quickly and efficiently. MIMD allows for parallel processing, which greatly improves the processing speed and overall system performance.

3. Explain advantages and disadvantages of Distributed System.

(Mention 5 points each for 10 marks)

Ans: Advantages of distributed systems:

- Scalability: Distributed systems can scale easily by adding more resources as needed.
- Fault tolerance: A distributed system can continue to function even if some of its components fail.
- High availability: A distributed system can provide continuous availability even if some of its components are unavailable.
- Improved performance: Distributed systems can improve performance by distributing processing across multiple machines.
- Cost-effectiveness: Distributed systems can be more cost-effective than centralized systems, as they can make use of cheaper hardware and infrastructure.
- Flexibility: Distributed systems can be designed to support different types of applications and workloads.
- Geographic distribution: Distributed systems can be used to connect users and resources that are located in different geographic locations.
- Better resource utilization: Distributed systems can make more efficient use of resources by distributing workloads across multiple machines.
- Easy integration: Distributed systems can be easily integrated with other systems and applications.
- Improved security: Distributed systems can provide improved security by distributing data and processing across multiple machines, reducing the impact of any security breaches.

Disadvantages of distributed systems:

- Complexity: Distributed systems are more complex than centralized systems, which can make them harder to design, implement, and maintain.
- Network dependence: Distributed systems rely heavily on networks, which can be unreliable and subject to performance issues.
- Increased latency: Distributed systems can suffer from increased latency due to the need for communication between nodes.
- Difficulty in debugging: Identifying and fixing problems in a distributed system can be more challenging than in a centralized system.
- Security risks: Distributed systems can introduce new security risks, such as unauthorized access and data breaches.

- Lack of standardization: Distributed systems can lack standardization, which can make it difficult to ensure interoperability between different systems.
- Coordination overhead: Distributed systems require coordination between nodes, which can introduce additional overhead and reduce performance.
- Complexity of transactions: Distributed systems may require complex transaction management to ensure data consistency across multiple nodes.
- Complexity of programming: Programming for distributed systems can be more complex than programming for centralized systems.
- Increased administrative overhead: Managing a distributed system can require more administrative effort than managing a centralized system.

4. Difference between Parallel Computing and Distributed Computing?

Criteria	Parallel Computing	Distributed Computing
Definition	Use of multiple processors within a single computer to execute a program.	Use of multiple computers connected via a network to execute a program.
Coordination	Coordinated execution of a single program across multiple processors.	Execution of multiple programs across multiple computers.
Communication	High-bandwidth, low-latency communication between processors within a single computer.	Lower-bandwidth, higher-latency communication between computers across a network.
Hardware	Typically uses shared memory architecture.	Typically uses distributed memory architecture.
Programming	Usually requires specialized programming techniques, such as message-passing or shared-memory programming.	May use familiar programming techniques with distributed computing frameworks such as Apache Hadoop or Spark.
Performance	Can achieve very high performance for compute-intensive tasks.	Can handle very large datasets or problems, but with higher communication overhead.
Fault tolerance	Typically limited to hardware redundancy or checkpoint/restart techniques.	Can employ techniques such as replication or load balancing to handle failures.
Examples	High-performance computing, scientific simulations, graphics rendering.	Cloud computing, web services, big data processing.

Q.5. Difference between paravirtualization and full virtualization?

	Full Virtualization	Para virtualization
Guest OS	Unmodified	Modified
Hardware Access	Emulated	Direct access to hardware
Resource Sharing	Less efficient	More efficient
Performance	Lower	Higher
Guest OS Support	Any OS	Limited OS support
Implementation	Software-based	Hardware-based

Q.6 Explain types of virtualizations.

Ans:

(1) Server Virtualization (SerV)

- It is focused on partitioning a physical instance of an operating system into a virtual instance or virtual machine.
- Major Server Virtualization vendors are Citrix, Microsoft, VMware

(2) Storage Virtualization (StoreV)

- It is used to merge physical storage from multiple devices so that they appear as one single storage pool.

(3) Network Virtualization (NetV)

- It lets you control available bandwidth by splitting it into independent channels that can be assigned to specific resources.
- For example, the simplest form of network virtualization is the Virtual Local Area Network (VLAN), which creates a logical segregation of a physical network.

(4) Management Virtualization (ManageV)

- It is focused on the technologies that manage the entire datacenter, both physical and virtual, to present one single unified infrastructure for the provision of services.

(5) Desktop Virtualization (DeskV)

- Desktop virtualization moves desktop computing to virtual machines hosted on servers.

(6) Presentation Virtualization (PresentV)

- Until recently called Terminal services
- provides only the presentation layer from a central location to users
- The need for PresentV is diminishing because of the introduction of technologies such as Application Virtualization

(7) Application Virtualization (AppV)

- Uses the same principles as software based SerV, but instead of providing an engine to run an entire operating system, AppV decouples productivity applications from the operating system.

Q.7. What is VLAN and its benefits?

Virtual LAN is a logical segmentation of local area network (LAN) into different set of broadcasting domains. Because the segmentation is not physical it is called virtual. Different Users in same location or in different locations can use the same LAN.

- Network Segmentation: VLANs can be used to segment a network into smaller subnets, which improves network performance by reducing the size of the broadcast domain. This can also help to reduce network congestion and improve overall network reliability.
- Improved Security: VLANs can be used to restrict access to network resources and improve network security. By separating traffic into different VLANs, users and devices can be isolated from each other, preventing unauthorized access to sensitive data or applications.
- Simplified Network Management: VLANs can simplify network management by allowing network administrators to group devices together based on their function or location. This makes it easier to manage and troubleshoot network issues.

- Cost Savings: VLANs can help reduce costs by allowing multiple physical networks to share a single physical infrastructure. This can reduce the need for additional network equipment and cabling.
- Better Traffic Control: VLANs can be used to prioritize traffic and provide better Quality of Service (QoS) for critical applications. This can ensure that important traffic is given priority over less important traffic, improving overall network performance.