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Q1)  
(a) Cloud Computing Paradigm.

1) Virtualization → Virtualization is an abstraction of a computing system that provides interface to hardware. Virtualization at a system level allow multiple virtual machine to operate on same physical platform. Examples are Xen, VMwares & KVM.

Types of virtualization are :-

- ) Full virtualization
- ) Para virtualization
- ) Partial virtualization
- ) Hardware assisted virtualization.

2) Service oriented architecture.

Service oriented architecture patterns are used to designs that are standardized, well understood & predictable. SOA is widely adopted architectural pattern for designing distributed & loosely system.



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## Q) Different computing models

- 1) Distributed computing
- 2) Grid computing
- 3) Cluster computing
- 4) Utility computing



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Q1

(b) There are 3 cloud reference model.

- ① SaaS (Software as a Service) - Consumer can use provided application on cloud infrastructure.
- ② IaaS (Cloud Infrastructure as a Service) - Consumer can use fundamental computing resources such as processing & memory on cloud.
- ③ PaaS (Platform as a Service) - Consumer can deploy local applications using tools provided in cloud.

Types of deployment models

- 1) Private - For a single organization.
- 2) Community cloud - for several organizations
- 3) Public - for all people & organizations
- 4) Hybrid - mix of the above models for specific needs



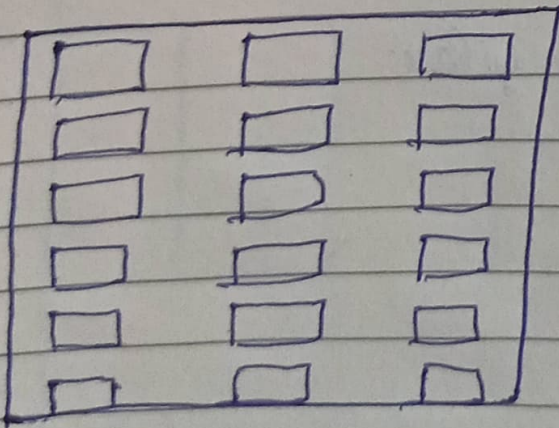
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Q2) (a)

(i)

Structured data

- ① It is clearly defined & is usually in searchable formats
- ② Exists in predefined formats
- ③ Stored in data ware houses
- ④ It is quantitative
- ⑤ Eg - Names, data, numbers etc



Structured data

Unstructured data

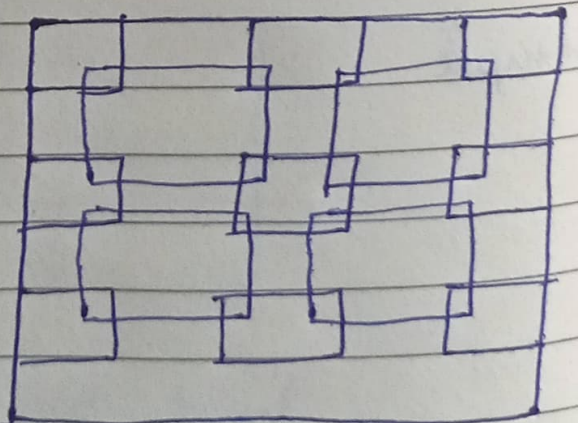
It is usually stored in its native format, difficult to analyse.

Exists in a variety of formats

Stored in data lakes

It is qualitative

Ex → audio, video etc.



Unstructured data



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(Q2) Compare &amp; contrast.

(ii) File storage &amp; object storage.

File storage	Object storage
① Have hierarchical structure	Have flat structure
② It is less scalable as compared to object storage	It is more scalable
③ Slow performance	Fast access capabilities
④ Used in NFS & NAS	Used in AWS Simple Storage device
⑤ Simple	Complex



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Q2)

(b)

Fault Tolerance in HDFS:

It refers to the working strength of a system in unfavourable conditions & how there that system can handle such a situation.

HDFS is highly fault tolerant. Before Hadoop 3, it handles faults by the process of replica creation. It creates replica of user data on different machine in the HDFS cluster.

Hadoop3 introduced erasure coding to provide fault tolerance.

Map Reduce Programming

- It is a programming framework that allow us to perform distributed & parallel processing on large data sets in a distributed environment. It consist of two different task - Map & Reduce. It mainly has 2 classes Mapper & private class.



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Q3)

(a)

Virtualization is the creation of a virtual version of something such as a server, a desktop, a storage device or OS.

Virtualization is a technique which allows to share a single physical instance of a resource or application among multiple organizations.

Types of virtualization.

- ① Hardware Virtualization → when the virtual machine software is directly installed on hardware system  
eg - full virtualization.
- ② Operating System Virtualization → when the VM is installed on the host operating system instead of hardware. Ex → VMWare, Virtual Box.
- ③ Server Virtualization - when VM is directly installed on the server system  
eg - VMWare ESX server.



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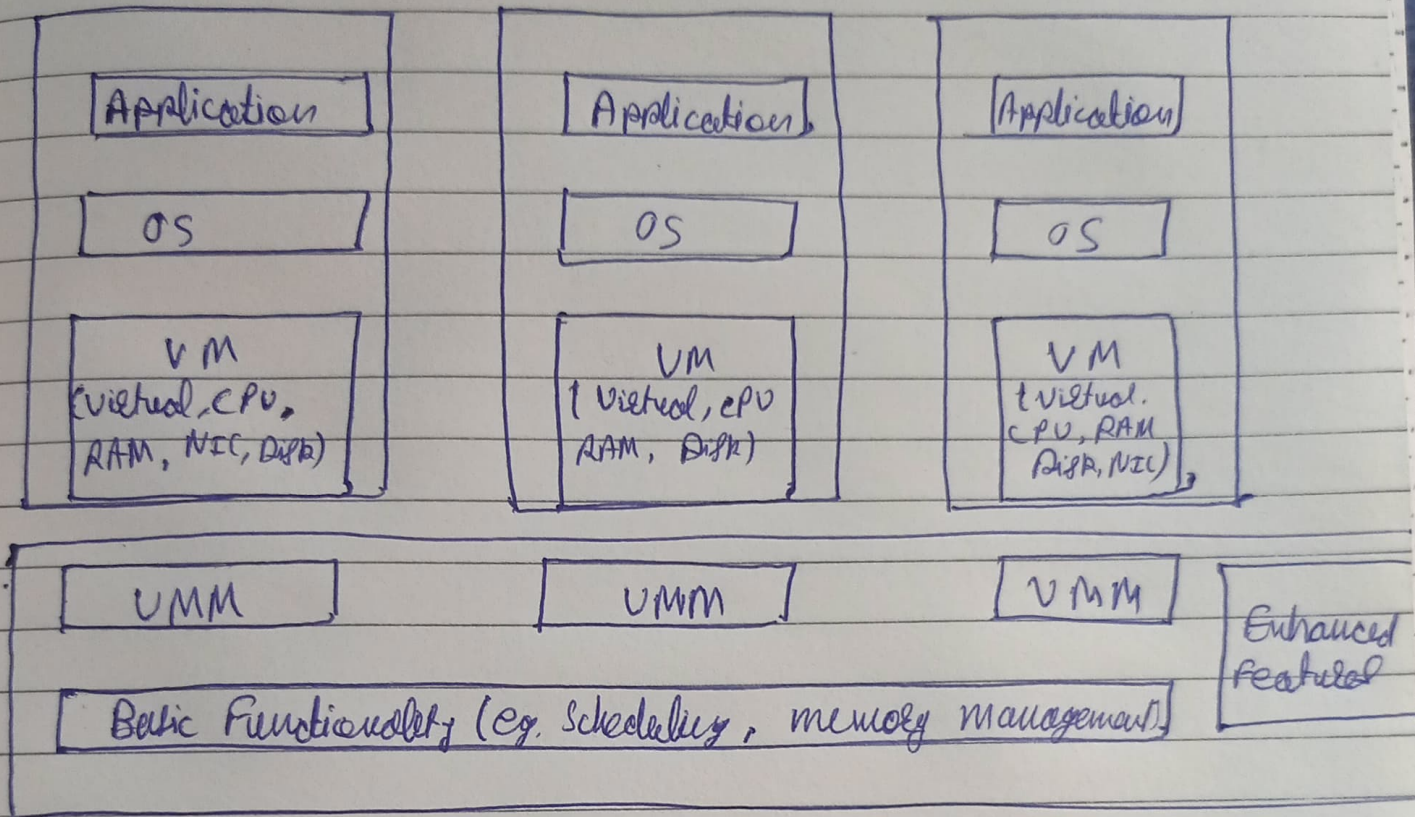
- ④ Storage virtualization → It is the process of grouping the physical storage from multiple n/w storage device so that it looks like a single storage device



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Q3

(b)



The main difference b/w Type 1 vs Type 2 hypervisors is that Type 1 runs on bare metal & Type 2 runs on top of an OS. Each hypervisor has its own pros & cons & specific use cases.

Both hypervisor varieties can virtualize common elements such as CPU, memory & networking but based on its location in the stack, a hypervisor virtualizes these elements differently.