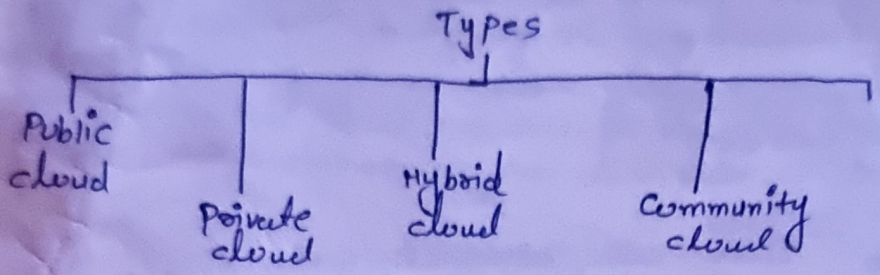
SUB:- Cloud Computing

Q.2 MODULE:-1.

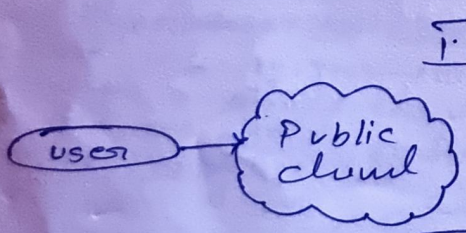
A.Q-1 explain different types of cloud and its application.

→ There are 4 types of cloud.



1] public cloud:- public cloud is open all to store and access information via the internet using the pay-per-usage method.

- in public cloud, computing resources are managed and operated by the cloud service provider (csp). csp looks after the supporting infrastructure and ensures that the resources are accessible and scalable for the users.
- Due to open architecture, anyone with an internet connection may use the public cloud, regardless of location or company size. users can use the csp's numerous services, store their data and run apps. By using pay-per-usage strategy, customes can be assured that they will only be charged for the resources they actually use.



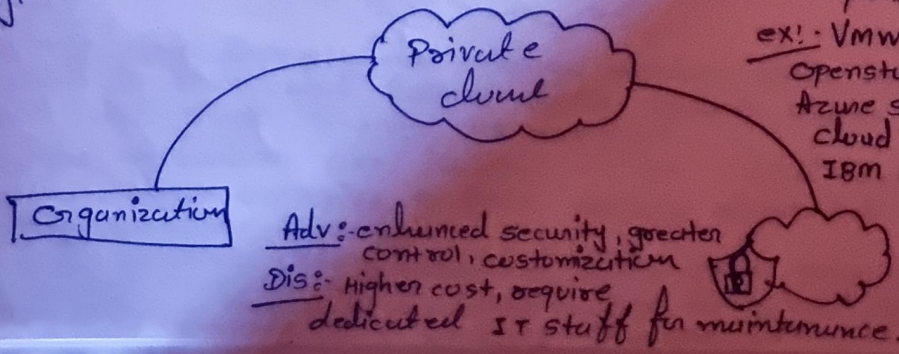
ex:- Amazon elastic compute cloud (EC2), IBM, microsoft, Google app engine, windows Azure services platform.

Advan:- cost effective, scalable, no maintenance

Dis:- less control over security and customization.

2] Private cloud:- Private cloud is also known as an internal cloud or corporate cloud. it is used by organizations to build and manage their own data centers internally or by the third party.

- it can be deployed using opensource tools such as openstack and Eucalyptus.



ex:- VMware Vsphere, Openstack, microsoft Azure Stack, Oracle cloud at customer, IBM cloud private.

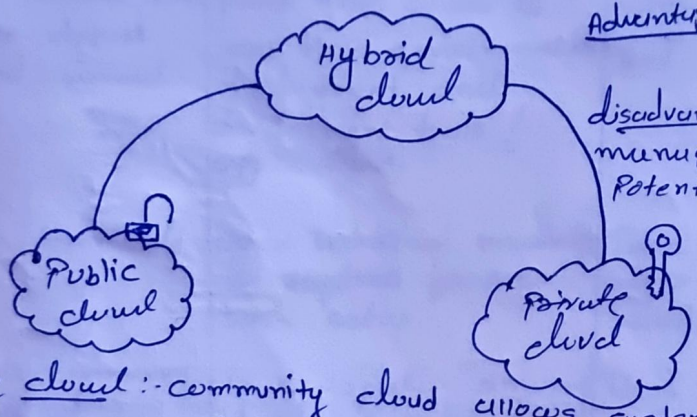
Adv:- enhanced security, greater control, customization

Dis:- Higher cost, require dedicated IT stuff for maintenance.

3] Hybrid cloud:- Hybrid cloud is a combination of public cloud and private cloud. Hybrid cloud = public cloud + Private cloud

- Hybrid cloud is partially secure because the services which are running on the public cloud can be accessed by anyone, while the services which are running on a private cloud can be accessed only by the organization's users.
- offers flexibility to use public cloud resources for non-sensitive data and private cloud resources for sensitive data.

ex:- Amazon web services, Google Application suite, office 365

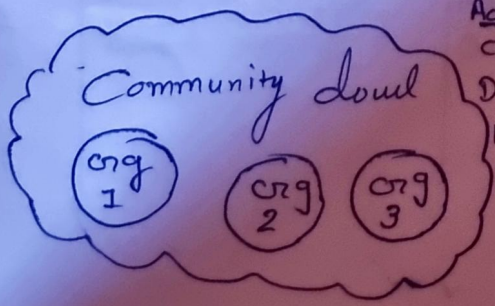


Advantage:- flexibility, scalability, data control.

disadvantage:- complexity in managing both environments, Potential security challenges

4] Community cloud:- community cloud allows systems and services to be accessible by a group of several organizations to share the information between the organization and a specific community. it is owned, managed and operated by one or more organizations in the community, a third party, or a combination of them.

in this cloud step, the participating organizations, which can be from the same industry, goverment sector, or any other community, collaborate to establish a shared cloud infrastructure. this infrastructure allows them to access shared services, applications and data relevant to their community.



Advantage: cost-sharing, collaboration, tutorial services.

Disadvantage: Limited scalability. Potential conflicts of interest among community members.

Applications:

1. Data storage and Backup: cloud storage services allow individual and organization to store and Backup data securely, access it from anywhere and scale storage as needed.
2. SaaS: saas application are hosted in the cloud and accessed via the internet. users subscribe to these services rather than purchasing and maintaining software licenses.
3. IaaS: Iaas providers offers virtualized computing resources including servers, storage and networking.
4. Paas: Paas provide a platform for developers to build, deploy and manage application without worrying about underlying infrastructure.

Difference between IAAS, PAAS, SAAS

IAAS	PAAS	SAAS
1] It stands for infrastructure as a services.	It stands for platform as a service.	It stands for software as a services.
2.] IAAS is used by network architects.	PAAS is used by developer.	SAAS is used by end user.
3.] IAAS gives access to the resources like virtual machine and virtual storage.	PAAS gives access to run time environment to deployment and development tools for application.	SAAS gives access to the end user.
4.] It requires technical knowledge.	some technical knowledge is required for the basic setup.	There is no requirement about technicalities company handles everything.
5.] it is popular among developers and researchers.	it is popular among developers who focus on the development of apps and scripts.	it is popular among consumers and companies, such as file sharing, email and networking
6. it is highly scalable and flexible.	it is highly scalable to suit the different businesses according to resources.	it is highly scalable to suit the small, mid and enterprise level business.
7. cloud services: Amazon web services, Sun, Vcloud express.	facebook, Google search engine.	ms office web, facebook and Google Apps.

List and explain various cloud characteristics in short.

→ 1. On-demand self services: cloud computing allows on-demand self-services include storage, networking, analysis etc. user can select and use single or multiple services depending on their needs. users become more accountable for their intake, which improves their ability to make wise decisions.
- users can make use of resources following their needs and specifications
- they are charged at the end of the billing cycle based on how much they use the services provided by the cloud service providers.

2. Broad Network Access: The cloud is accessible to any device from any location because of widespread network access. A cloud Provider must offer its clients numerous network access options.

3. Scalability:- A system's capacity to manage an increasing volume of work by adding resources is known as scalability. cloud services must quickly develop to keep up with the ongoing expansion of businesses. one of the most flexible aspects of cloud computing is scalability.

4. Elasticity:- similar to scalability but emphasizes the ability to automatically adjust resources in real-time to handle fluctuating workload.

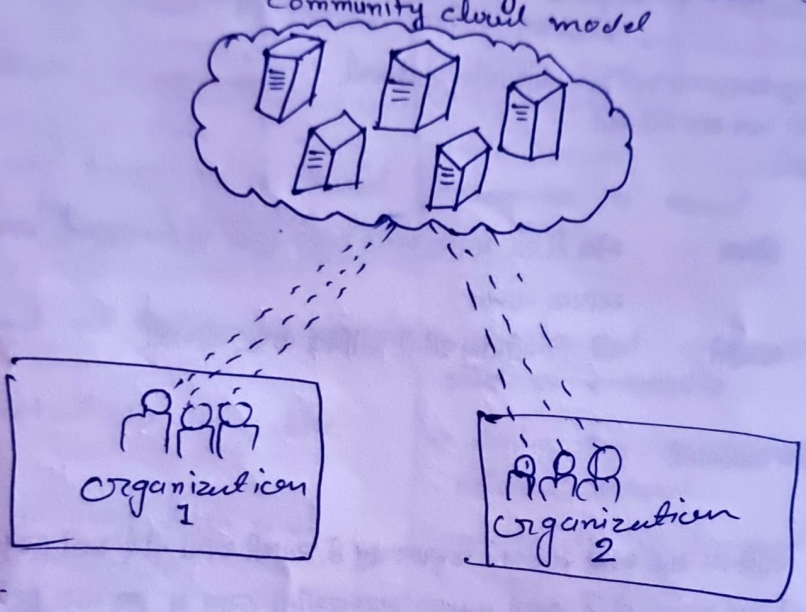
5. Resource pooling:- Resource pooling is one of the core components of cloud computing. A cloud service provider can provide each client with different services based on their demands by employing resources pooling to divide resources across many clients.
- it is multi-client approach for location independence, network infrastructure pooling, storage systems, etc.

6. Security:- users of cloud computing are particularly concerned about data security. cloud service providers store user's encrypted data and offer additional security features like user authentication and protection against breaches and other threats.

7. Flexibility:- cloud computing users can access data or services with internet-enabled devices like smartphone and laptops. you can instantly access anything you want in the cloud with just a click. making working with data and sharing it simple.

Explain community cloud model. How it is different from public cloud?

→ community cloud allows system and services to be accessible by group of organizations. it shares the infrastructure between several organizations from a specific community. it may be managed internally by organizations or by the third-party. the community cloud model is shown below:



Benefits:-

- cost effective
- more secure than public cloud but less than private cloud.
- community cloud offers same advantage as that of private cloud at low cost.

Disadvantage:-

- Data is accessible between organization. this can result in overall security concern about the rules and regulation to compliance within a community cloud.

→ In community, infrastructure is shared by a specific group or organization with similar needs, while in a public cloud resource shared among unrelated users or organizations.

→ community cloud offers more customization and control over security and compliance, tailed to the specific requirement of the participating organizations, compared to be more general purpose nature of public cloud.

What is the difference between public cloud and private cloud? Give 3 names of cloud service providers. List novel application of cloud computing.

→ Difference

Public cloud	Private cloud
1. cloud computing infrastructure is shared with the public by service providers over the internet. i.e. it supports multiple customers.	cloud computing infrastructure is shared with private organizations by service providers over the internet. it supports one enterprise.
2. Multi-tenancy i.e. Data of many enterprise are stored in a shared environment but are isolated. Data is shared as per the rule, permission and security.	single tenancy i.e. Data of a single enterprise is stored.
3. it is hosted at the service provider site.	it is hosted at the service provider site or enterprise.
4. it is connected to the public internet.	it only supports connectivity over the private network.
5. Scalability is very high and reliability is moderate.	Scalability is limited and reliability is very high.
6. example: Amazon web service (AWS) and Google AppEngine etc.	example: Microsoft KVM, HP, Red Hat & VMWare etc.

→ Three cloud service providers:

1. Amazon Web service (AWS)
2. Google cloud
3. Microsoft Azure

→ Novel Application:

- Healthcare management:- cloud platform facilitate sharing and analyzing vast amount of medical data, improving patient care and research efforts.
- Smart Agriculture:- cloud based solution enable realtime monitoring of crops, weather patterns and soil conditions for precision farming.
- virtual reality (VR):- cloud infrastructure can provide the computational power needed to render complex VR environments, making it accessible.
- ML and AI solution:- cloud provide scalable infrastructure tools for building, training and deploying ML and AI models. Novel application include predictive maintainance in manufacturing, personalized recommendation in e-commerce, fraud detection in finance and natural language processing in health care.

1.

1. Define cloud computing and identify its core features?

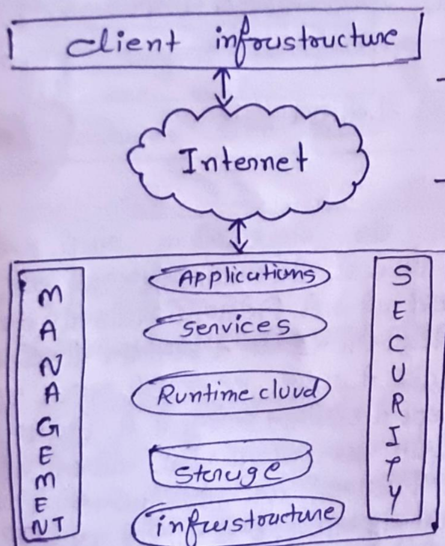
→ Cloude computing defines as The delivery of different services through the internet which includes tools and applications like data storage, servers, databuses, networking and software.

→ features:- A. Q-3

Q-3. Describe architecture of cloud computing.

→ it is combination of both SOA (service oriented architecture) and EDA (event Driven architecture)

frontend



Frontend:-

→ Frontend of the cloud architecture refers to the client side of cloud computing system.

→ means it contain all user interfaces and application which are used by client to access CC services/resources.

→ **client infrastructure:** is a part of frontend component. It contain application and user interfaces which are required to access the cloud platform. in other words it provide GUI to interact with cloud.

Infrastructure: include hardware and software components that are needed to support cloud computing model. it provide services on host level, application level and network level.

Management:- used to manage components such as application, services, runtime cloud, storage, infrastructure in the backend and establish coordination b/t them.

Security: is an in-built back end component of cloud computing. it implements a security mechanism in the backend.

Backend:- refers to the cloud itself which is used by service providers.
- it manages all the resources that are required to provide CC services.
- it include huge amount of data storage, security mechanism, virtual application, virtual machine, traffic control mechanism etc.

Application: refers to a software platform to which client access. it provide services in backend as per client requirements.

services: major 3 types: SAAS, PAAS, IaaS manages that which type of services you access according to client requirement.

Runtime cloud: provide execution and runtime environment to virtual machine.

storage: provide huge amount of storage capacity in cloud to store and manage data.

...ance needs or even cyber...
...tages or downtime.

What do you mean by high availability and Dynamic Resource allocation ~~no~~ features in cloud computing?

→ They both are important features of cc that helps ensure reliable and efficient operation of cloud services.

High availability

↳ ensure availability that cloud services remain accessible and operational, even during hardware failure or distruption.

↳ it achieves this through redundancy, load balancing, failover mechanism and disaster recovery plan.

↳ the goal is to minimize downtime and ensure uninterupted access to cloud services for user.

Dynamic Resource allocation

↳ automatically adjust computing resources based on workload demands and performance metrics.

↳ it include features like auto-scaling, elasticity and resource optimization.

↳ aim is to optimize resource utilization, improve performance, reduce costs by scaling resources up and down in response to changying workload plutform.

Q-6. List and explain at least four application of cc.

→ Saas:- is a cloud computing model where software applications are hosted by 3rd party provider and made available to customer over internet. User can access these application through a web browsers without needing to install or maintain any software locally. Eg. Gmail, microsoft office 365 etc.

Iaas:- Provides a virtualized computing resources over the internet including servers, storage, networking and other infrastructure components. user can rent these resources on demand and scale them up or down as needed, paying only for resources they use. eg. Aws, Microsoft Azure, Google cloud plutform.

Paas:- provides a complete development and deployment environment in the cloud, allowing developers to built, test, deploy and manage application without the complexity of underlying infrastructure. Paas offering typically include development tools, databases, middleware and runtime environment.

Data storage and Backup:- cloud computing offers scalable and cost effective solution for storing and backing up data. cloud storage services often features such as data replication, encryption and automatic backup to ensure data durability and availability.

~~explain the significance of viz~~

Q-11 What is hybrid cloud? How can it be managed?

→ A hybrid cloud is a computing environment that combines on premises infrastructure (private cloud) with public cloud services, allowing data and applications to be shared them.

- This approach provides business with greater flexibility and scalability by enabling them to leverage the benefits of both private and public cloud.

Can be managed:

(1) Resource monitoring and management:
- implement tools to monitor and manage resources across both private and public cloud environment. it includes monitoring performance, usage and availability of resources to ensure optimal operation.

(2) Integration and orchestration:
- use integration and orchestration tools to streamline the deployment and management of applications and services across the hybrid cloud environment.

(3) Security and compliance
- implement comprenshive security measures to protect data and applications across the hybrid cloud. it includes encryption, accesscontrol, identity mangment.

(4) Data management and migration
- Develop strategies for managing data across the hybrid cloud, including data storage, backup and recovery. Implement data migration tools and process to move data between the private and public cloud as needed.

(5) Vendor management
- manage relationship with cloud services providers and other venders to ensure they meet service level agreement (SLAs) and provide necessary support and resources for hybrid cloud environment.

Q-12 explain challenges in cloud computing.

→ Data Security and privacy:-
- Security issues on the cloud include identity theft, data breaches, malware injections and a lot more which eventually ↓es the trust amongst the user of application.

→ performance and Latency:-
- performance and latency issues can arrise when accessing cloud services over the internet for application that require low latency or high bandwidth. factor such as network congestion, geographic distance, and shared resource in multitenant environment can affect application performance.

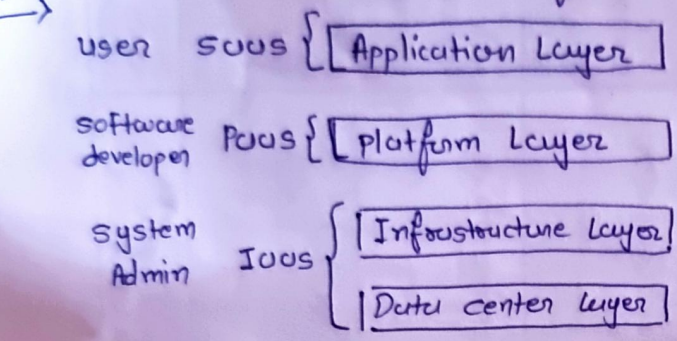
→ vendor lock-in:-
- vendor lock-in occur when organisation become heavily dependent on a specific cloud provider services and technologies, making it difficult to migrate to alternative platform switching cloud providers can be complex, time consuming and costly.

management and optimization

While cloud computing offer the potential for cost saving through pay as-you-go pricing models and scalability. cloud cost can quickly escalate if not managed effectively.

Q-13. explain various layers of cloud computing.

→



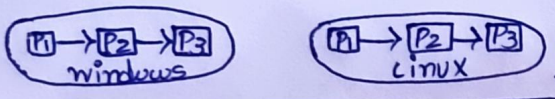
→ Application Layer:-
- Top layer where cloud application resides
- enables automatic scaling for improved performance, availability and cost efficiency.
- Determine availability of communication Partners and resources for data centers.
- Responsible for processing IP traffic handling protocol like HTTP, FTP etc.

→ platform Layer:-
- consist of OS and Application software
- provide scalability, dependability and security for application
- deploy application directly to virtual machine.
- uses OS and Application framework to simply deployment on virtual machine.

→ Infrastructure Layer:-
- virtualize physical resource into virtual resource using technologies like Xen, KVM and VMware.
- Serves as a central hub of cloud environment, adding resources via virtualization.
- provide the foundation for the platform layer with virtualized network, storage and computing resources.

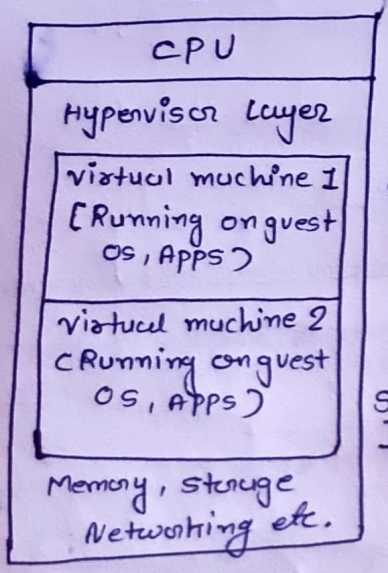
→ Data center Layer:-
- manages physical resources such as servers, switches, routers; power suplies etc.
- ensures availability and management of resources in data center.
- control physical server through high speed devices like router, switches.

explain cpu virtualization. illustrate with a neat diagram.



Hypervisor

CPU



→ also known as hardware virtualization
→ is a technology that enables multiple VM to run on a single physical CPU simulations.
→ allows for efficient resource utilization and enables the creation of isolated environment where different os and application can run independently.

Step 1: physical Hardware
→ consist of cpu, memory, storage, networking components and other peripherals.

Step 2: Hypervisor Installation
→ also known as VMM (virtual machine monitor) is installed directly on physical hardware. the hypervisor create and manages VM and provides a layer of abstraction bit physical hardware and the virtualized environment.

Step 3: virtual Machine creation
→ Hypervisor creates multiple VMs on the physical hardware.
→ Each VM has its own virtual cpu, memory, storage and networking interface.

Step 4: CPU Time slicing
→ Hypervisor allocates cpu time slices to each VM.
→ cpu times is divided among VM allowing them to execute their instruction concurrently.

Step 5: Execution
→ Each VM run on its own guest os and application.
→ the hypervisor manages the execution of VMs, ensuring that they run concurrently without interfering with eachother.

runtime. even cyberattack

MODULE:-2

Q-1. what is on demand computing? How it is to be handled? [ODC]

→ also known as utility computing or cloud computing.

→ is a delivery model in which computing resources are made available to the user as needed.

→ on demand computing normally provides computing resources such as storage capacity or hardware and software application.

Handling on demand computing involve several steps:

- planning and requirement gathering
- selecting a provider
- provisioning resources
- monitoring and management
- Scaling resources
- Security and ensure compliance
- cost optimization

Q-2. benefits of cloud computing technology.

Q-3. cons of cloud computing.

→ Benefits:-

- Data Backup and Restoration: it offers a quick and easy method for data backup and restoration. Businesses may simply access and restore their data in the event of any data loss or system failure by keeping it in the cloud.
- improved collaboration: collaboration is improved because cloud technologies make it possible for teams to share information easily.
- cost-effective maintenance: organizations using cloud computing can save money on both hardware and software upkeep. bcz cloud service providers manage the maintenance and updates, businesses no longer need to make costly infrastructure investment.
- Pay-per-use model: cloud computing uses a pay-per-use business model that enables companies to only pay for the services they really utilize.
- Enhanced data security: it places a high focus on data security. it guarantee that data is handled and stored safely in cloud.
- Scalable storage capacity: Businesses can virtual store and manage a limitless amount of data in the cloud.

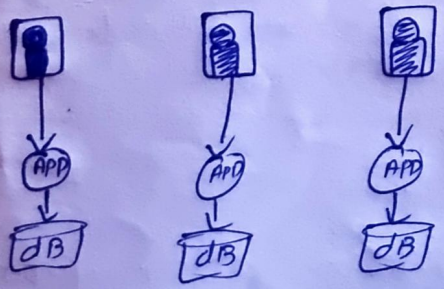
→ Cons:-

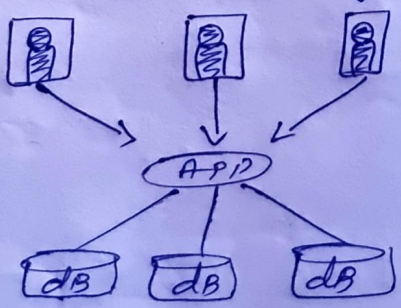
- Vendor Reliability and Downtime:-
  Because of technological difficulties, maintenance needs or even cyberattacks cloud service providers can face outrages or downtime.

to loss or theft
Data leakage
- account or service hijacking
- insecure interfaces and APIs
- limited control

Q-4. Difference between single Tenant and multi-tenant Applications.

Single Tenant	multi-Tenant
1. are designed to serve a single client or customer	1. are designed to serve multiple client or customer from the same application instance.
2. each instance has its own dedicate database	2. All tenant share a single database usually with data isolation mechanism.
3. High customized to fit the specific need of the client.	3. customization may be limited to ensure compatibility and prevent or conflict between tenant.
4. higher cost due to dedicated resources and maintenance effort.	4. low cost due to resource sharing and centralized maintenance.
5. performance may be optimized for the specific need of the organization or client.	5. performance may very depending on the activity of other tenant sharing the resource.
6. maintenance and updates are done individually for each instance.	6. maintenance and updates are applied to entire application affecting all tenant simultaneously.





explain Grid computing and utility computing.

→ Grid Computing: is a distributed computing model.
- is a collection of computer resources from multiple location to reach a common goal.
- can be defined as network of computer working together to perform a task that would rather be difficult for a single machine.
- for controlling the network and its resources a software/networking protocol is used generally known as middleware.

Components:
- control Node - it is a group of server which administrate whole network.
- provider (Grid node) - it is a computer which contributes its resources in the network resources pool.
- user: computer which use resources on the network.

→ utility computing:
- user pay only for the ~~ser~~ resources they consume, similar to a utility bill.
- This model allows organizations to scale their computing resource up or down as needed, reducing cost and improving flexibility.

Q-6. explain SAAS with an example.
→ is known as "on Demand Software".
- is a cloud computing model where software application is hosted by 3rd party provider and made available to customer over the internet.
- The end user do not need to install any software on their devices user can access the application via web browser or API, typically on the subscription basis.

Eg. Salesforce, a customer relationship management (CRM) platform. Instead of buying and installing CRM software on their own server businesses subscribe to salesforces and access its CRM functionalities through web browser.
This eliminate the need of software installation updats, and maintainance while also providing access to the application from any device with an internet connection.

Q-7. Justify the statement, "Saas integration is hard".
→ Integration Complexity: Integrating saas application can be complex due to differences in data formad, Apps and security protocol.
Data migration challenge: moving data from existing system to SAAS app^n ensuring data consistency and integrity can be challenging.
customization limitation
API management: managing API for integrating multiple SAAS app^n can be challenging

what are the services provided by SaaS?
→ Software access: through web browser or API without the need of local installation
- Maintenance and update: SAAS provider handle maintenance, updates and patches for the software ensuring the user always have access to latest version.
- Scalability: SAAS application can typically scale up or down to accomodate changing user needs for business requirement.
- Security: SAAS provides often implement robust security measures to protect user data and ensure compliance and regulations.
- Support: provide customer support service to help users troubleshoot issues and maximize their use of the software.

Q-10. what are the services provided by paas?
→ Development tools: for application development including IDEs, version control system, and debugging tools.
- Middleware: such as databases, messaging queries, caching and application servers, simplifying the development and deployment of application.
- Runtime environment: PAAS offers runtime environment for deploying and running applications.
- Scalability and Resource management: provide automatic scaling and resource manage feature allowing application to scale up or down based on demand.
- Integration and API: offers integration capabilities and API for connecting application with other services.

Q-11. what are the benefits of "service" (PAAS)?
→ Accelerated Development: speed up application development and deployment by providing prebuilt tools and infrastructure.
- cost efficiency: reduce infrastructure cost and operational expenses.
- Scalability: easy scalability to handle fluctuating workload.
- focus on Innovation: free up time for development to focus on innovation.
- Streamlined processes: simplifies development and collaboration process.

explain Iaas technology in cc with real-world example.

→ it is a cc model where virtualized computing resources are provided to user over the internet.

- Resources include VM, storage networking and other infrastructure component which user can rent on a pay-as-you go bases.

Eg. AWS, EC2

with EC2, user can provision virtual servers, known as instance, in the cloud to run their application and workload.

Q-13. explain Availability management in cloud for paas and Iaas.

→ involves ensuring that cloud services and resources are consistently accessible and operational to meet user's need.

→ for paas: It is responsible for ensuring availability of the underlying platform and related services, including runtime environment, development tools etc.
- implementing measures such as redundancy, load balancing, failover mechanism to maintain high availability and uptime for application.
- offers SLAs specifying uptime guarentees and response time to ensure reliability and performance.

→ for Iaas: ensuring availability of virtualized infrastructure resources including VM, storage and other components.
- involves implementating redundency, fault tolerance, data replication, disaster recovery measure to minimize downtime and ensure continuous availability resources.

Q-14. explain the following virtual machine migration services. 10
① Hot migration ② cold migration

→ Assi-1 Q-8.

Q-15. Describe virtual machine migration services

→ Assi-1 Q-9

Q-16. Detail out the steps involved in a live VM migration

→ Assi-1 Q-10.

explain the common strategies for migrating applications to the cloud.

→ Rehosting: This involves lifting your stack & shifting it from on-premises hosting to cloud. you can transport an exact copy of your current environment.

Replatforming: modify application to make them compatible with cloud environments while retaining core functionalities.

Repurchasing: moving your application to a new, cloud native product, most commonly Saas platform.

Refactoring: it means rebuilding your application from scract.

Retiring: once you have accessed your application portfolio for cloud readiness, you might find some applications are no longer useful.

Retaining: plan to revisit cloud computing at a later date. you should only migrate what makes sense for your business.

MODULE:-1.

MODULE:-3.

1. what are hypervisors? List its importance.

→ it is also known as virtual machine monitor (VMM) is a software or firmware layer that enables the virtualization of physical computing resources.

- it is responsible for managing & controlling VMs. running on physical server or host machine.

Importance

Hardware independence: enabling seamless migration and compatibility ~~access di~~ across different physical hardware platform.

Cost saving: help to reduce hardware cost and maintenance expensis.

Disaster Recovery: facilitate efficient disaster recovery solutions by enabling replication and backup of VM across multiple physical hosts and data center.

Flexibility: in managing virtualized environments, allowing administrators to allocate and reallocate resource dynamically.

Q-2 Discuss hypervisors storage virtualization in cloud computing.

→ storage virtualization refers to merging physical storage from multiple storage servers into one virtual storage server. A central console then does the work of managing the consolidated storage.

- This process entails pooling several physical disks and having them seem like a single virtual storage gadget. in the end, network, data center and vender storage devices end up in one glass panel.

- storage virtualization in cloud computing is the core element of ~~server~~ storage servers. it fosters the management and analysis of storage within a virtual environment. This includes helping the storage administrator perform backups, archiving and data recovery quickly and more efficiently.

~~Types of storage Virtualization~~

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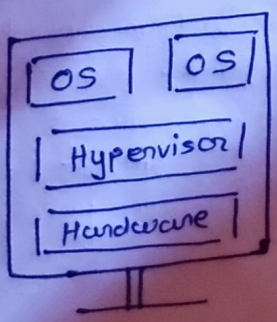
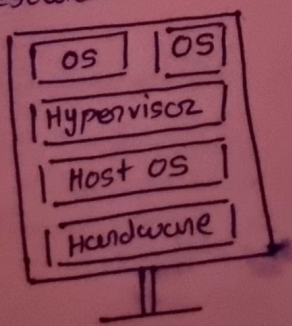
MODULE:- 1

3. difference between Type-1 and Type-2 hypervisors.

Type-1 hypervisor	Type-2 hypervisor
1. install directly on base-metal hardware.	1. install on top of an existing OS.
2. it has thin layer architecture directly on hardware.	2. it has thicker layer architecture on top of host OS.
3. Generally offer better performance.	3. Low performance.
4. Typically used in data centers cloud environment.	4. commonly used on desktops, development environment.
5. eg. VMware ESXi, Xenserver etc.	5. eg. VMware workstation, oracle virtual box etc..
6. it is hard to setup.	6. easy to setup
7. Hardware virtualization	7. OS virtualization
8. faster	8. slower because of system dependency
9. more secure	9. less secure as any prob. in the base operating system affect the entire system include the protected hypervisor.
10. has direct access to hardware along with virtual machine it host.	10. are not allowed to directly access the host hardware and its resources.





Describe various types of hypervisor and mention pros and cons of each.

→ Type-1 hypervisor: Discription in q-3

Pros:
- offer better performance and scalability compared to Type-2.
- provide strong isolation between VM, enhancing security and stability.
- uses fewer system resource since don't rely on host OS.

Cons:
- setting up and configuring Type-1 may require more technical expertise
- have limited hardware compatibility.

→ Type-2 hypervisor: Discription in q-3

Pros:
- easier to install and configure.
- can run on wide range of hardware platforms since they rely on host os.
- allow user to run multiple os simultenously on a single physical machine.

Cons:
- performance overhead due to their dependencis on host os.
- Consume more system resources compared to Type 1.
- many pose security risk due to additional layer of software.

MODULE-7

Q-6. Define load balancing. what is need of load balancing in cloud computing?

→ process of distributing incoming traffic or computing tasks across multiple sources, such as servers, virtual machines or network links, to optimize, utilization, maximize throughout, minimize response time and ensure high availability and reliability of services.

Load balancing is essential due to:
- optimizing resource utilization
- maximizing throughput and performance
- minimizing response time
- ensuring high availability
- Scaling and elasticity

Q-6. Load balancing techniques

(1) Round Robin: Request are distributed evenly across a pool of servers in a circular, sequential manner, each server receives an equal share of incoming request

(2) Least connection: This techniques aim to distribute traffic evenly based on the current load of each server, ensuring heavily loaded servers receives fewer new connection.

(3) Least Response time: This techniques prioritizes servers that can respond quickly to requests, reducing overall latency and improving user experience. Request are sent to the server with shortest response time.

(4) IP Hash: The client IP address is use to determine which server will handle the request.

(5) weighted Round Robin: Server are assigned weight based on their capacity or performance and request are distributed proportionaly to each server's weight.

(6) Dynamic load balancing: load balancing decision are made dynamically based on real time metrics such as server load, cpu utilization, memory usage or network traffic.

(7) Content Based Routing: Request are routed to specific server based on the characteristics of the request such as URL, HTTP headers or content type

(8) Geographical load balancing: Requests are routed to the closest or most geographically appropriate server based on the client location.

Q-7. How machin Imaging help to achieve the goal of cloud computing.

→ Machine Imaging: is a process that is used to provide portability and provision and deploy system in the cloud through capturing the state of system using system image.

MODULE:-1

Q.1. write a short note on Iaas using Eucalyptus

→ Infrastructure as a Service (Iaas) refers to a cloud computing model where virtualized resources are provided over the internet.
- Eucalyptus is an open-source software framework for implementing private and hybrid cloud computing using Iaas principles.
- it allows organizations to create their own private cloud infrastructure, providing them with control over their data and resources while leveraging the scalability and flexibility of cloud computing.
- Eucalyptus is compatible with amazon web services (AWS) APIs, enabling seamless integration with AWS services and tools.

Q-2. write a short note on AppScale

→ AppScale is an open-source platform that enables users to deploy and host applications in a cloud ~~platform~~ environment. it is designed to be compatible with applications written for the Google App Engine (GAE) platform, providing a way to run these applications on any infrastructure, including public, private or hybrid clouds.
- AppScale supports popular programming languages such as python, Java and Go and it provides scalability, reliability and flexibility for hosting web applications.
- With AppScale, developers can leverage the benefits of cloud computing while maintaining control over their application environment.

Q-3. List and elaborate main categories of cloud computing services.

→ ① Iaas ② Paas ③ Saas

1.] Infrastructure as a Service (Iaas):
- Iaas provides virtualized computing resources over the internet. users can rent virtual machines, storage and networking infrastructure on a pay-as-you-go basis.

ex:- Amazon web services (AWS) EC2, microsoft Azure virtual machines, Google cloud compute Engine.

2.] platform as a Service (Paas):
- Paas provides a platform that allows developers to build, deploy and manage applications without having to worry about the underlying infrastructure.

ex:- Heroku, Google App Engine, Microsoft Azure App Service.

Software as a service (SaaS):
SaaS delivers software applications over the internet on a subscription basis. users can access the software through a web browser without needing to install or maintain it.
ex:- Salesforce, Google workspace, Microsoft office 365.

Q-6. write a short note on cloud integration. explain types of cloud integration.

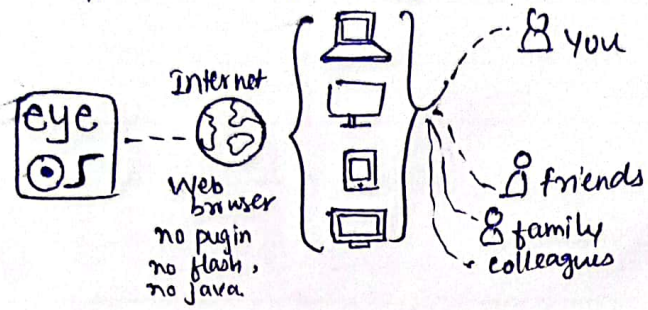
→ cloud integration refers to the process of connecting different applications, systems or services deployed in the cloud or on-premises to work together seamlessly.
- it enables organizations to leverage the benefits of cloud computing, such as scalability and flexibility, while ensuring that their diverse systems can communicate and share data effectively.

Types of cloud integration:

1. Data integration: involves combining data from different sources, such as databases, applications and APIs, to provide a unified view of the data. this can include data migration, data replication and data synchronization.
2. Application :- focuses on connecting different applications to enable them to share data and functionality. this can involve integrating cloud-based applications with on-premises systems or integrating multiple cloud-based application.
3. Process:- involves integrating business processes that span across different systems or applications. this can include automating workflows and ensuring the data flows smoothly between different stages of a process.
4. Service:- Refers to integrating cloud services to create composite services that offer additional functionality. this can involve combining multiple cloud services to create a more comprehensive solution.
5. cloud - to cloud:- involves integrating different cloud services or applications to work together. this can include integrating cloud-based storage with cloud-based analytics or integrating a cloud-based CRM system with a cloud-based marketing automation platform.
6. Hybrid: involves integrating on-premises systems with cloud-based systems. this can include integrating legacy systems with cloud-based applications or integrating data stored on-premises with cloud-based data warehouse.

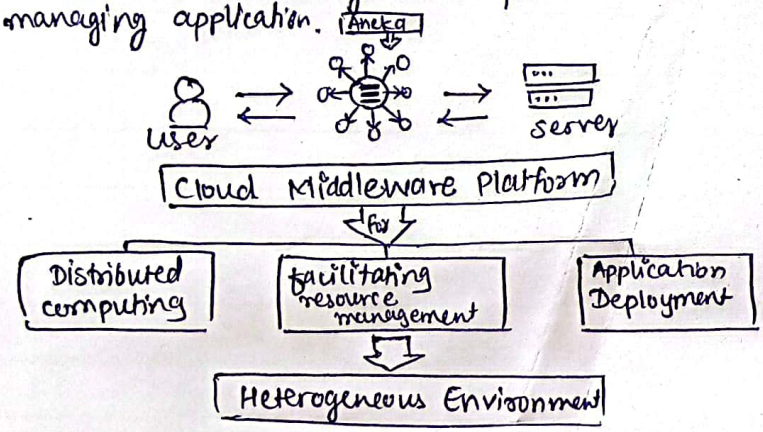
NOTES

EyeOS → open source web desktop OS provide user with cloud based computing environment. accessible through browser
- ↳ It is a private cloud application platform with a web based desktop interface
- ↳ mainly written in PHP, XML and Javascript



Benefits
- World wide availability
- Require only browser
- Remote storage facility
- Browser and platform independent

Aneka → provide API for building distributed application on cloud
- ↳ is a cloud middleware product
- ↳ provide middleware layer that abstract the underlying infrastructure, allowing developer to focus on building and managing application.



Cloudsim → is a framework for modeling and simulation of cloud computing infrastructure and services
- ↳ It is developed by CLOUDS LAB organization and is written entirely in Java.

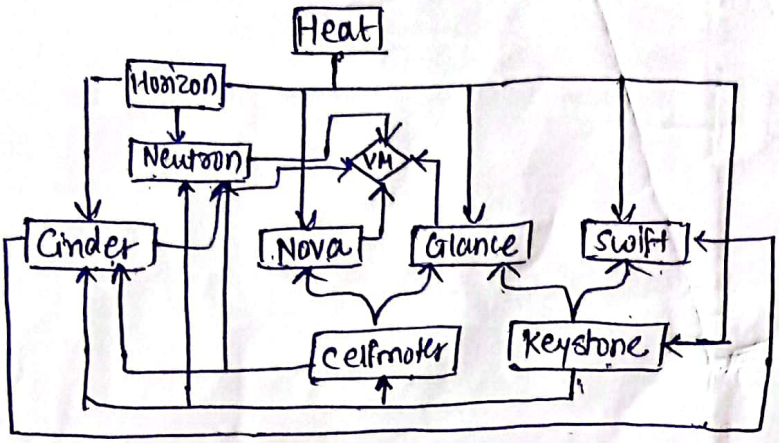
Features :
- support modeling and simulation of large scale CC data center
- support data center network topologies and message passing applications
- dynamic insertion of simulation element
- stop and resume of simulation
- policies for allocation of host to VM.

Openstack → is a open source cloud computing platform that provide IaaS for building and managing public and private cloud.

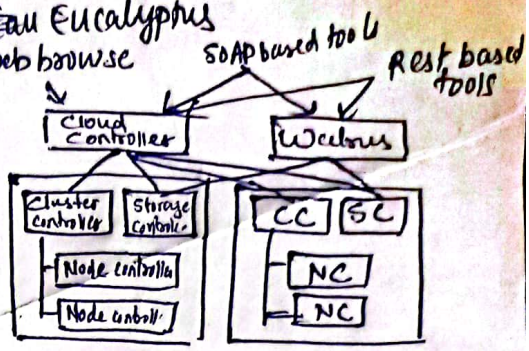
Components :
- Nova (compute service)
- Neutron (networking services)
- Swift (object storage)
- Cinder (block storage)
- Keystone (identity service provider)
- Glance (image service provider)
- Horizon (dashboard)
- Ceilometer (telemetry)
- Heat (orchestration)

~~IAAS~~

Openstack



Eucalyptus



IAM

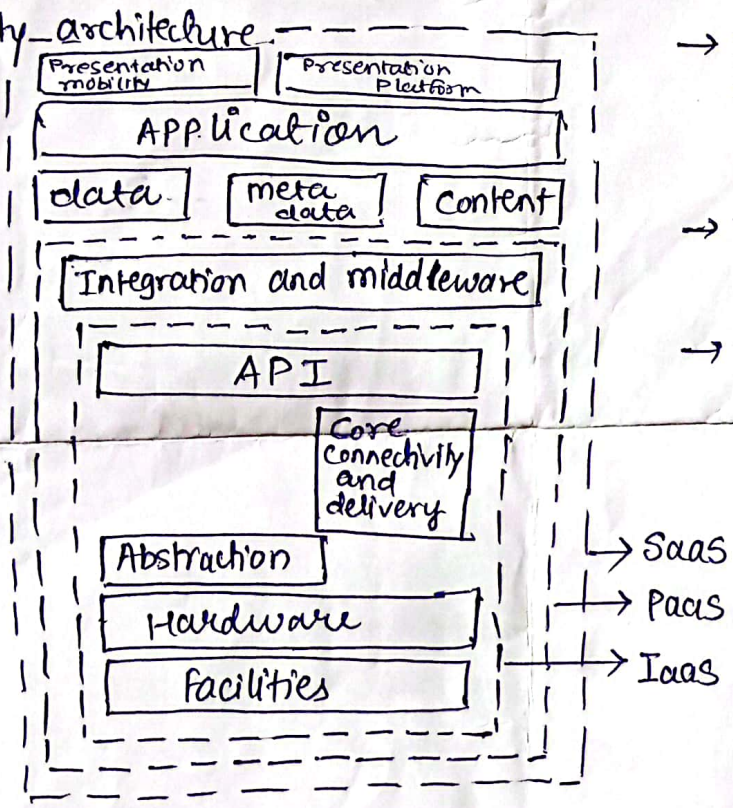
→ ensure right individuals or system have access to right resource in cloud environment

→ It involve administration of user identities, including authentication (verifying user's identities), authorization (determining what resources user are allowed to access)

→ This often includes use of tools like SSO (single sign on), MFA (multi factor authentication), user provisioning

→ This include policies such as RBAC (Role based access control) ABAC (Attribut based attess control like user attribute, resource attribute environment attribute

Security_architecture



Saas Security

→ refers to protection of ~~data and application put in the~~ measure put in place to safeguard data and applicatio hosted on Saas platform.

→ It include,

- Encryption
- Authentication → MFA
- Access control
- Data loss prevention
- Regular security updates.

GAE → is Paas

→ offering Google cloud that allow developed to build and deploy application on google infrastructure.

→ It support multiple programming languages

→ provide auto scaling, load balancing and other services to manage application traffic efficiently.

→ managed services: provide various managed servies such as NoSQL dB, Cloud SQL, caching, task queue.

→ Development tools: provide Cloud SDK, Cloud console, IDE plugins, to streamline the development, deployment, and monitoring processes

→ Billing and Pricing: offer flexible billing model based on resourse consumption with option of automatic scaling and manual scaling

→ Global Reach: with data center located around world, enable developer to deploy appn closer to user, reducing latency.

Module 6

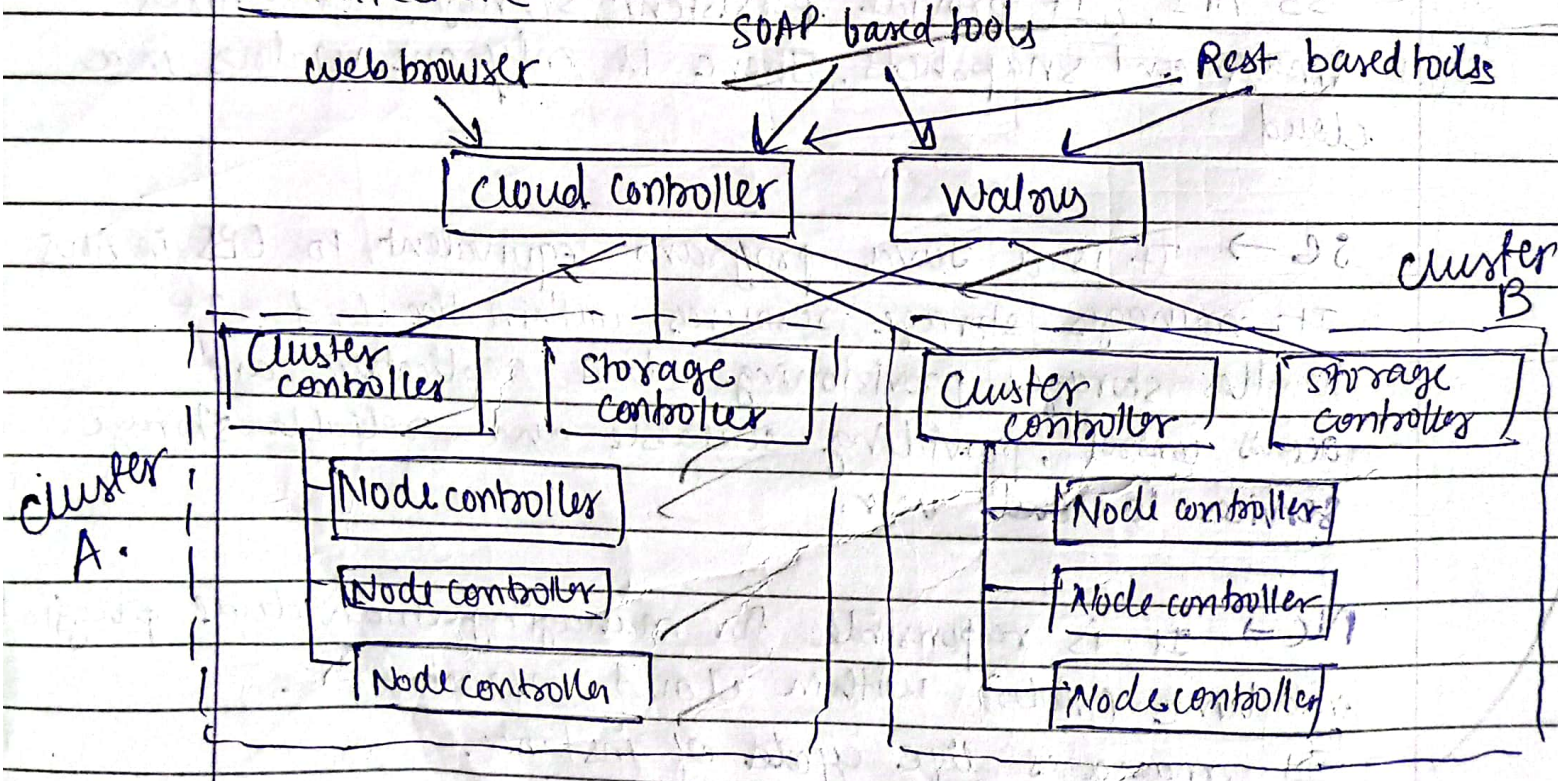
(1.) Eucalyptus → open source software to build private and hybrid cloud in AWS.

→ is a linux based open source software architecture for cloud computing and also a storage platform that implement Iaas.

→ It provide quick and efficient computing services

→ It enables organization to create their own Iaas cloud by pooling together computing, storage, and networking resources within their data centers

Architecture



components

CLC : It is a controller that manages virtual resources like servers, network and storage. There is only one CLC per cloud. It can handle authentication, accounting, reporting and quota management in cloud.

CC → It is a C program that is the front end for Eucalyptus cloud cluster. It can can communicate with storage controller and node controller. It manages group of physical machine with the cloud infrastructure known as cluster. It handles resource provisioning and management within their respective cluster

Walrus → This is a Java program in Eucalyptus is a object storage system compatible with the Amazon S3 API. It provide persistent storage. It stores images and snapshots. There is only one walrus in a cloud

It stores user data as object in buckets

- SC → It is a Java program equivalent to EBS in AWS It manages storage resources within the cloud. It handles storage provisioning, data replication, and access control, providing scalable and reliable storage services to cloud user.

NC → It is responsible for managing individual physical machine (nodes) within cloud infrastructure.
It manages life cycle of instance.
It downloads images from walrus and create instance for computing requirement in cloud.

Microsoft Azure

→ is a cloud computing platform managed by microsoft that provides a wide variety of ~~services~~ cloud services including computing, storage, networking, databases, analytics and more enabling organization to build deploy and manage application and services on a global scale

→ It offers both ~~PaaS~~ PaaS and IaaS capabilities giving user flexibility in how they deploy and manage their resources.

Services

1. Azure compute services
   → VMs, Azure App services, Azure function, container instance etc.
2. Azure storage services
   → Azure Disk storage, Azure Data Lake Storage, Azure Queues etc.
3. Azure Networking services
   → Azure VPN Gateway, Azure Load Balancer, Azure virtual network Azure DNS etc.
4. Azure Data base services
   → Azure SQL dB, Azure Cosmos dB etc..
5. Developer Tools
   → Azure DevOps, Azure DevTest Labs etc.

Open stack

→ Is a open source cloud computing platform that provides infrastructure as a service (Iaas) for building and managing public and private clouds.

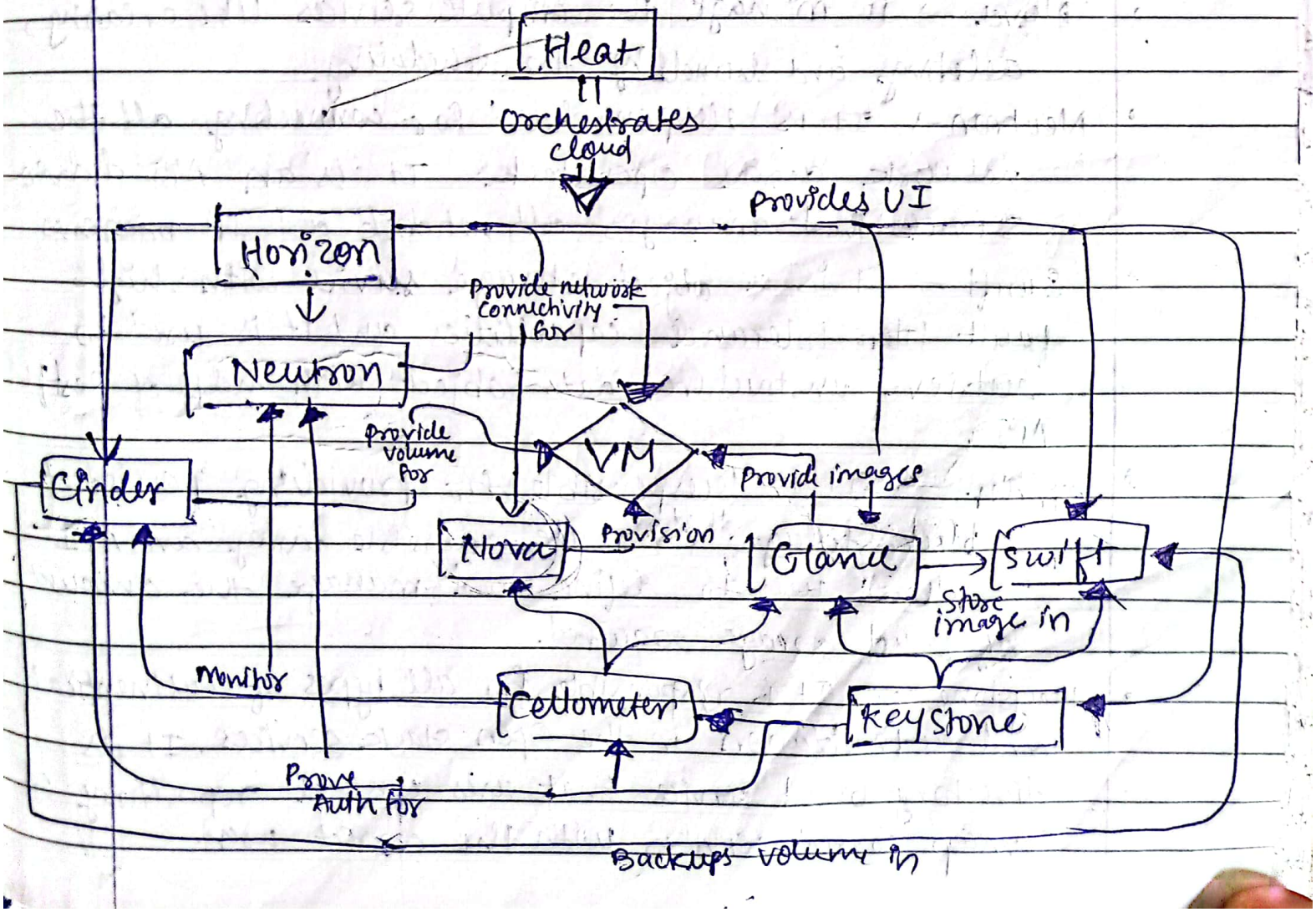
→ It fullfills two main requirement of the cloud, massive scalability and simplicity of implementation

→ Openstack is highly configurable as user can choose whether or not to implement several services offered by the software

Components of Architecture.

- Nova → it manage the compute services like creating, deleting and handling the scheduling.
- Neutron → It is responsible for connecting all the network across openstack. It is an API driven services that manages all network and IP addresses
- Swift → It is a object storage service with high fault ~~tlerc~~ tolerance capabilities and it is used to retrieve unstructured data object with help of Restful API.
- Cinder → It is responsible for providing persistent block storage that is made accessible using an API. It allows user to define and manage the amount of cloud storage required.
- Keystone → It is responsible for all types of authentication and authorization in the Open stack services. It is directory based service that uses central repository to map correct services with the correct user.

- Glance → It is responsible for registering, storing, and retrieving virtual disk images from the complete network. These images are stored in a wide range of back end system.
- Horizon: It is responsible for providing web based interface for open stack services
- Ceilometer: It is responsible for metering and billing of services used.
- Heat → It is used for on demand service provisioning with auto scaling of cloud resources. It works in coordination with the Ceilometer.



Features

- API driven → means all components can be accessed and controlled through a set of APIs.
- ~~Comphor~~ Comprehensive dashboard → enable user to manage their cloud infrastructure and resource through user friendly web interface.
- Resource pooling → enables user to pool computing, storage, and networking resources which ~~are~~ ~~be~~ can be dynamically allocated and de-allocated based on demand.
- Open source software → free to use and modify
- Distributed architecture → enable user to scale their cloud infrastructure horizontally across multiple physical server
- Multi tenancy support → allowing multiple user to access same cloud infrastructure while maintaining security and isolation bit them.
- Modular Architecture → ~~allow~~ enable user to deploy only the component they need.

EyeOS

→ EyeOS is an open source web desktop OS that provides user with cloud based computing environment accessible through web browser.

→ Goals.

- web based computing : enable user to access their desktop environment and application from any device with a web browser and internet connection

- Cloud computing - utilizes cloud computing principles to store user data and application on remote servers
- Open source collaboration - aims to foster collaboration within the developer community, allowing contributors to modify, extend and improve the platform continuously
- User friendly interface - provide user friendly interface that is intuitive and easy to navigate.

Aneka → provide API for building distributed app.

→ is a cloud application platform enables the development and deployment of distributed application on private, public or hybrid cloud.

→ provide middleware layer that abstract the underlying infrastructure, allowing developer to focus on building and managing application rather than dealing with complexity of distributed computing.

Architecture of Aneka framework.

- **Aneka Core**
  → manages distributed application and resources, including job scheduling and communication b/t nodes
- **Resource manager**
  → allocates and utilizes resources within the cloud environment based on demand.
- **Job scheduler**
  → orchestrates task execution within distributed applications to optimize performance and resource utilization

- Execution Node : computing nodes where tasks are executed, running the Aneka Runtime Environment.
- Application Development APIs : provide APIs and libraries for developing distributed application, abstracting away complexities.
- Monitoring and Management Tools : Allow administrators to monitor and optimize the health and performance of cloud environment.
- Integration with Cloud providers : Enable seamless deployment of distributed application across various cloud environment, both public and private

CloudSim

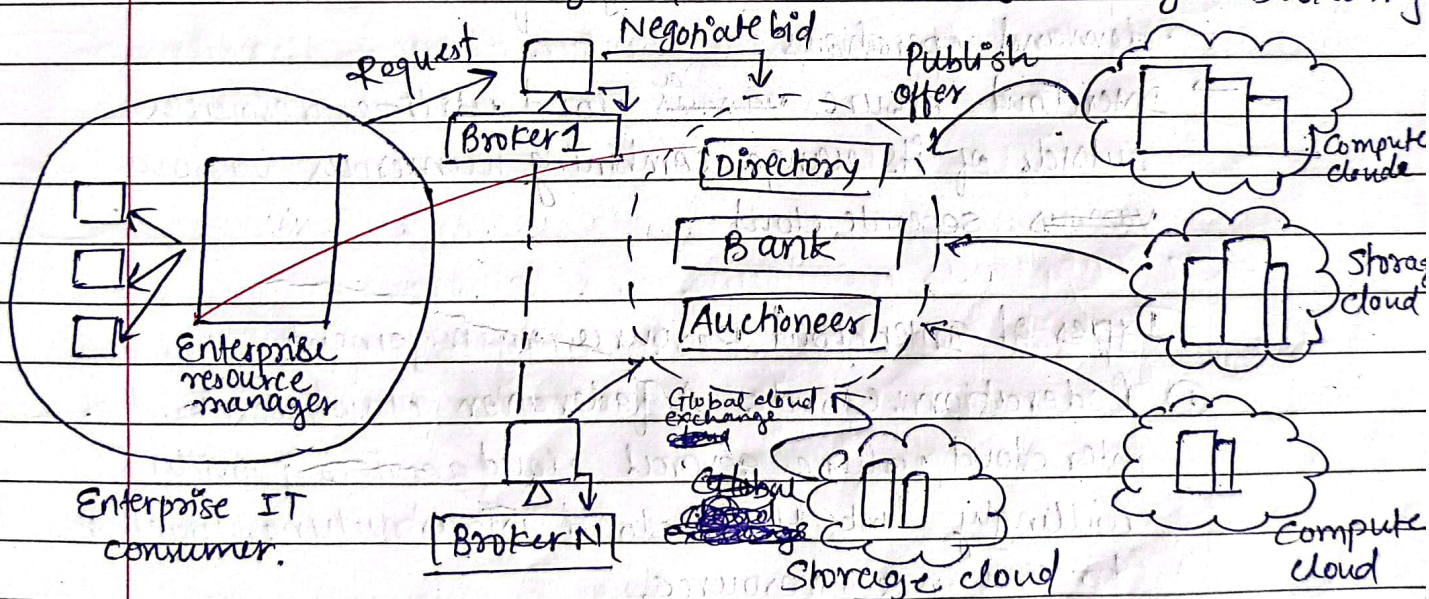
→ is open source framework for modeling and simulating cloud computing infrastructure and services.

→ It enables the modeling and ~~simulating~~ simulation of ~~the~~ cloud data center, virtualized resource scheduling algorithm and application workflow, facilitating performance analysis, resources optimization and system design.

Ans-

- In cloud computing, large numbers of customers use cloud services from all over the world. To ensure reliability in the cloud server, the service provider established various data centers in different locations worldwide.
- For example, the famous e-commerce website AMAZON has data centers in different geographical areas across the world. Even ~~thoo~~ though the site has different data centers, it has specific limitations; for example, they don't have an automatic mechanism by which data centers at different locations can cooperate better and scale their different hosting services

- Inter cloud exchange of cloud resources through brokering



- The cloud exchange acts as a market maker for bringing together service ~~providers~~ producers and consumers. It aggregate the infrastructure demands from application brokers and evaluates them against the available supply currently published by the cloud coordinators.

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Qs.) What is cloud resource management ? Explain inter cloud resource management with its challenge.

Ans The term resource management refers to the operation used to control how capabilities provided by cloud resources and services are made available to other entities, whether users, applications or services.

→ Inter cloud resources, management refers to the process of efficiently allocating, provisioning, and managing computing resources across multiple cloud services providers or cloud environment

→ It is the combination of numerous various seperate clouds into a single fluid mass for on-demand operations.

→ Intercloud ensure a cloud utilize resources outside of its range combining numerous various seperate cloud

Types of Inter cloud Resource management

① Federation cloud: A federation cloud is a kind of inter cloud where several cloud services providers willingly link their cloud infrastructure together to exchange resource.

② Multi cloud: A client or service makes use of numerous independent cloud in a multi cloud. This strategy is utilized to use assets from both public and private cloud portfolios

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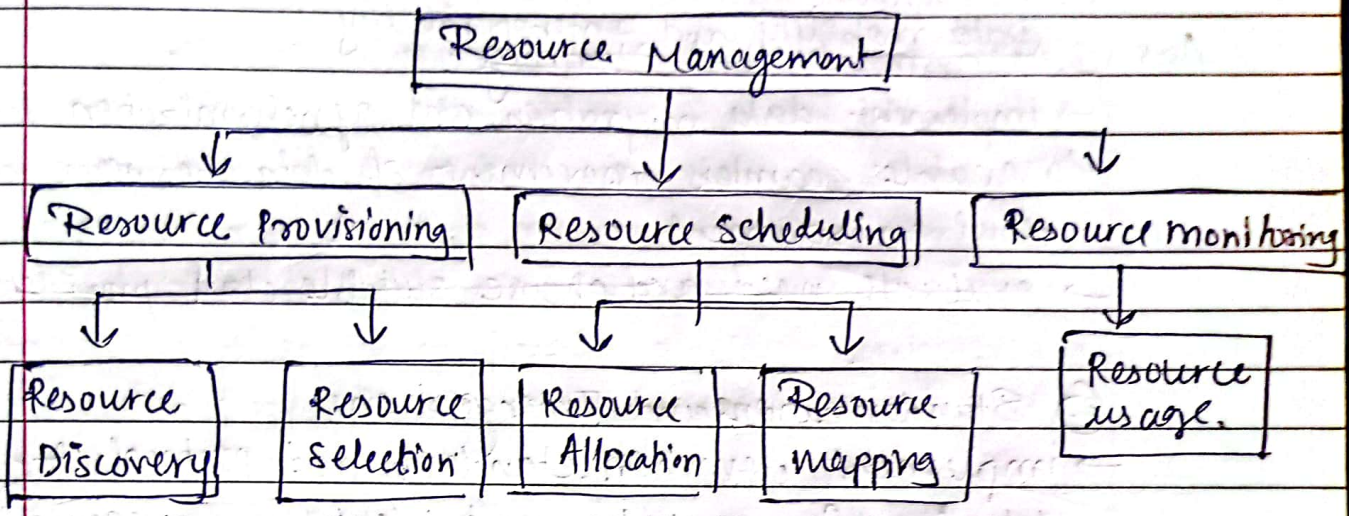
Taxonomy of Inter cloud Resource management



Challenges :

- moving data and workloads between different cloud providers can be complex and time consuming due to data transfer costs, network latency and compatibility issues
- Managing resources across multiple cloud raises security concern such as data protection, access control and compliance with regulatory requirement
- Allocating and scheduling resources across multiple cloud to meet performance, availability and scalability requirement can be complex.
- Negotiating and enforcing SLA (Service level ~~Aggrement~~ Agreements with different cloud providers while maintaining consistent service quality is challenging
- Integrating with multiple cloud platform without becoming ~~overcully~~ overly dependent on a single provider requires careful planning and design.

Q6.) Explain how to manage Inter cloud resource Management.

Ans ~~Assessment and Planning~~ Data mobility and Interoperability:

→ implement data migration and synchronization tools to enable seamless movement of data between cloud environment

→ ~~evaluate need and choose suitable cloud providers~~

(2.) Standardization and Intergration:

→ implement common standards and protocols for data transfer, security and identity management to simplify integration efforts.

(3.) Resource Allocation and optimization

→ Implement policies and automation mechanisms for dynamic resource allocation and scaling across multiple cloud.

(4.) Continuous monitoring and optimization:

→ Establish monitoring and analytics capabilities to track resource usage, performance and cost trends across multiple clouds.

(5.) Cost optimization

→ Implement cost management tools and strategies to optimize spending and maximize ROI.

(6.) Assessmend and Planning

→ Assess your organization need, including performance requirement, scalability, security and compliance consideration. Develop a strategic plan for inter cloud

resource management, considering factors such as workload distribution, data mobility and cost optimization.

Q7) Write a short note on resource provisioning

Ans. Resource provisioning is the process of allocating, deploying and managing software and hardware resources to assure application performance.

→ Over provisioning of resources will lead to resource underutilization and consequently, a decrease in revenue for the provider.

→ Underprovisioning of resource will lead to broken SLA and penalties.

→ Resource provisioning method:

(a) Demand driven method

→ provide static resources and has been used in grid computing for many years. When a resource has surpassed a threshold for a certain amount of time, the scheme increase the resource based on demand.

(b) The event driven method.

→ is based on predicted workload by time. This scheme adds or removes machine instances based on a specific time event.

(c) The popularity driven method.

→ based on Internet traffic monitored. The internet searches for popularity of certain applications and creates the instances by popularity demand.

Q1.) Enlist the features of cloud management products.

Ans Cloud management products come with a variety of features to help users effectively manage their cloud infrastructure and resources. Here's a comprehensive list of common features:-

1. Resource Provisioning
   → Allow users to provision virtual machine, storage, database and other resource on demand.
2. Automation
   → Automates provisioning, scaling, monitoring, maintenance tasks to improve efficiency and reduce manual effort.
3. Monitoring and Alerting
   → Provides real-time monitoring of resource usage, performance metrics, and health status, with alerting capabilities for abnormal behaviour.
4. Cost management
   → offers tools for tracking and optimizing cloud spending, including cost analysis, budgeting and cost-saving recommendation.
5. Identify and Access Management (IAM)
   → Manages user identities, roles, and permissions for secure access to cloud resources.
6. Security and Compliance
   → Implements security control, access management, encryption and compliance monitoring to ensure data protection and regulatory adherence.
7. API access
   → Provide APIs for programmatic access to cloud management

functionalities, enabling integration with third party tools and custom automation.

8. Networking
→ provides networking features such as virtual network, subnets, routing, and firewall configurations to connect and secure cloud resources

9. Data Management
→ include features for data storage, backup, replication, and migration, as well as data analytics and visualization tools.

Q2.) Write a short note on emerging cloud management standards.

Ans Emerging cloud management standards are crucial for ensuring interoperability, security, and consistency across cloud environment. Some emerging cloud management standard include:

(1.) Cloud infrastructure Management Interface (CIMI)
→ CIMI is an open standard developed by the Distributed Management Task Force (DMTF) for managing cloud infrastructure. It provides a common API for provisioning and managing cloud resources, abstracting away the difference between various cloud providers.

(2.) Cloud Data Management Interface (CDMI)
→ CDMI, also developed by the DMTF, is a standard for managing data stored in the cloud. It defines a unified interface for interacting with

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cloud storage systems, including capabilities for data access, metadata management, and data lifecycle management.

3. Cloud Standard Customer Council (CSCC)

→ The CSCC, formed by the object management group (OMG) focuses on developing best practices and standards for cloud computing adoption. It provides guidance on various aspects of cloud management, including security, ~~interpo~~ interoperability, and governance.

4. Open Virtualization Working Group (OVF)

→ Produce the OVF standard, which provide the industry with a standard packaging format for software solution based on virtual system.