

UNIT-4

Scientific applications of cloud computing-

Cloud computing has revolutionized scientific research by providing access to vast computational resources, facilitating collaboration, and enabling scalable data analysis. Here are several scientific applications of cloud computing:

1. High-Performance Computing (HPC): Cloud computing platforms offer access to powerful virtual machines and specialized hardware accelerators like GPUs, which are essential for complex simulations, numerical modeling, and other computationally intensive tasks in fields such as physics, chemistry, and engineering.

2. Big Data Analytics: Cloud-based platforms provide scalable storage and processing capabilities for analyzing massive datasets generated by scientific instruments, sensors, and simulations. Scientists can use cloud services like Amazon S3, Google Cloud Storage, and Azure Blob Storage in conjunction with tools like Apache Hadoop and Apache Spark for large-scale data processing.

3. Genomics and Bioinformatics: Cloud computing enables researchers in genomics and bioinformatics to store, analyze, and share genomic data efficiently. Platforms like Amazon Web Services (AWS) and Google Cloud Platform (GCP) offer specialized services such as Amazon S3 for data storage and Amazon EC2 for running bioinformatics workflows.

4. Climate Modeling and Environmental Science: Cloud computing supports climate modeling efforts by providing access to massive computing resources for running complex climate simulations. Researchers can use cloud-based platforms to analyze environmental data, predict weather patterns, study climate change, and develop mitigation strategies.

5. Drug Discovery and Molecular Modeling: Pharmaceutical companies and research institutions leverage cloud computing for drug discovery and molecular modeling tasks. Cloud platforms offer scalable computing resources for virtual screening, molecular dynamics

simulations, and other drug discovery workflows, helping accelerate the development of new therapies and treatments.

6. Machine Learning and AI: Cloud computing facilitates the training and deployment of machine learning models for scientific applications such as image analysis, natural language processing, and predictive modeling. Researchers can leverage cloud-based machine learning services like Google Cloud AI Platform, AWS SageMaker, and Azure Machine Learning to develop AI-driven solutions for various scientific challenges.

7. Remote Sensing and Earth Observation: Satellite imagery and remote sensing data are essential for monitoring environmental changes, natural disasters, and agricultural activities. Cloud computing enables researchers to store, process, and analyze large volumes of satellite data efficiently, supporting applications such as land cover mapping, deforestation monitoring, and urban planning.

8. Collaborative Research and Data Sharing: Cloud-based collaboration tools and data sharing platforms facilitate collaboration among scientists working in different locations. Researchers can use cloud storage, version control systems, and project management tools to share data, code, and research findings, enhancing transparency, reproducibility, and knowledge exchange within the scientific community.

Business and computer application: CRM & ERP in cloud computing

Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP) systems are crucial for businesses to manage their interactions with customers and optimize internal processes. Cloud computing has transformed CRM and ERP systems by offering scalable, flexible, and cost-effective solutions. Here's how CRM and ERP in cloud computing benefit businesses:

CRM in Cloud Computing:

1. Scalability: Cloud-based CRM solutions allow businesses to scale their CRM infrastructure according to their needs. They can easily add or reduce resources as their customer base grows or shrinks, ensuring optimal performance and cost efficiency.

2. Accessibility: Cloud CRM systems can be accessed from anywhere with an internet connection, enabling remote work and facilitating collaboration among sales, marketing, and

customer support teams. This accessibility enhances productivity and responsiveness to customer inquiries.

3. Cost-effectiveness: Cloud CRM solutions typically operate on a subscription-based model, eliminating the need for upfront hardware and software investments. Businesses can pay for only the resources they use, reducing capital expenditures and operational costs.

4. Data Centralization: Cloud CRM platforms centralize customer data in a secure, centralized repository accessible to authorized users across the organization. This unified view of customer information enables personalized marketing, targeted sales efforts, and improved customer service.

5. Integration: Cloud CRM systems often offer seamless integration with other business applications, such as email marketing tools, e-commerce platforms, and social media channels. This integration streamlines workflows, eliminates data silos, and enhances the overall efficiency of customer engagement processes.

6. Scalable Analytics: Cloud CRM platforms provide built-in analytics and reporting capabilities, allowing businesses to gain insights into customer behavior, preferences, and trends. Advanced analytics features enable predictive modeling, customer segmentation, and forecasting, empowering businesses to make data-driven decisions.

ERP in Cloud Computing:

1. Flexibility: Cloud-based ERP systems offer greater flexibility compared to traditional on-premises solutions. Businesses can easily customize and configure their ERP modules to align with evolving business requirements, industry regulations, and best practices.

2. Scalability: Cloud ERP solutions can scale up or down based on business needs, accommodating fluctuations in transaction volumes, user counts, and data storage requirements. This scalability ensures optimal performance and resource utilization, even during peak periods.

3. Cost-effectiveness: Cloud ERP implementations typically involve lower upfront costs and predictable monthly subscription fees, making them more affordable for small and medium-sized businesses. Additionally, businesses can avoid expenses related to hardware procurement, maintenance, and upgrades.

4. Accessibility: Cloud ERP systems enable anytime, anywhere access to critical business data and applications through web browsers or mobile devices. Remote employees, distributed teams, and mobile workforce can collaborate effectively and stay productive, regardless of their location.

5. Data Security and Compliance: Cloud ERP vendors adhere to stringent security standards and compliance regulations to protect sensitive business data. They implement robust encryption, access controls, and disaster recovery measures to ensure data integrity, confidentiality, and availability.

6. Integration: Cloud ERP solutions support seamless integration with third-party applications, legacy systems, and external data sources through APIs and middleware. This integration facilitates data exchange, process automation, and real-time synchronization across different business functions, such as finance, supply chain, and human resources.

7. Upgrades and Maintenance: Cloud ERP vendors handle software updates, patches, and maintenance tasks, relieving businesses of the burden of managing IT infrastructure and system administration. This allows businesses to focus on core competencies and strategic initiatives rather than routine IT operations.

Cloud Computing Platforms and Technologies

Cloud computing applications develop by leveraging platforms and frameworks. Various types of services are provided from the bare metal infrastructure to customizable applications serving specific purposes.



Amazon Web Services (AWS) –

AWS provides different wide-ranging clouds IaaS services, which ranges from virtual compute, storage, and networking to complete computing stacks. AWS is well known for its storage and compute on demand services, named as Elastic Compute Cloud (EC2) and Simple Storage Service (S3). EC2 offers customizable virtual hardware to the end user which can be utilized as the base infrastructure for deploying computing systems on the cloud. It is likely to choose from a large variety of virtual hardware configurations including GPU and cluster instances. Either the AWS console, which is a wide-ranged Web portal for retrieving AWS services, or the web services API available for several programming language is used to deploy the EC2 instances. EC2 also offers the capability of saving an explicit running instance as image, thus allowing users to create their own templates for deploying system. S3 stores these templates and delivers persistent storage on demand. S3 is well ordered into buckets which contains objects that are stored in binary form and can be grow with attributes. End users can store objects of any size, from basic file to full disk images and have them retrieval from anywhere. In addition, EC2 and S3, a wide range of services can be leveraged to build virtual computing system including: networking support, caching system, DNS, database support, and others.

Google

AppEngine

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Google AppEngine is a scalable runtime environment frequently dedicated to executing web applications. These utilize benefits of the large computing infrastructure of Google to dynamically scale as per the demand. AppEngine offers both a secure execution environment and a collection of which simplifies the development if scalable and high-performance Web applications. These services include: in-memory caching, scalable data store, job queues, messaging, and cron tasks. Developers and Engineers can build and test applications on their own systems by using the AppEngine SDK, which replicates the production runtime environment, and helps test and profile applications. On completion of development, Developers can easily move their applications to AppEngine, set quotas to containing the cost generated, and make it available to the world. Currently, the supported programming languages are Python, Java, and Go.

Microsoft Azure –

Microsoft Azure is a Cloud operating system and a platform in which user can develop the applications in the cloud. Generally, a scalable runtime environment for web applications and distributed applications is provided. Application in Azure are organized around the fact of roles, which identify a distribution unit for applications and express the application's logic. Azure provides a set of additional services that complement application execution such as support for storage, networking, caching, content delivery, and others.

Hadoop –

Apache Hadoop is an open source framework that is appropriate for processing large data sets on commodity hardware. Hadoop is an implementation of MapReduce, an application programming model which is developed by Google. This model provides two fundamental operations for data processing: map and reduce. Yahoo! Is the sponsor of the Apache Hadoop project, and has put considerable effort in transforming the project to an enterprise-ready cloud computing platform for data processing. Hadoop is an integral part of the Yahoo! Cloud infrastructure and it supports many business processes of the corporates. Currently, Yahoo! Manges the world's largest Hadoop cluster, which is also available to academic institutions.

Force.com and Salesforce.com –

Force.com is a Cloud computing platform at which user can develop social enterprise applications. The platform is the basis of SalesForce.com – a Software-as-a-Service solution for customer relationship management. Force.com allows creating applications by composing ready-to-use blocks: a complete set of components supporting all the activities of an enterprise are available. From the design of the data layout to the definition of business rules and user interface is provided by Force.com as a support. This platform is completely hostel in the Cloud, and provides complete access to its functionalities, and those implemented in the hosted applications through Web services technologies.

Introduction to Amazon Web Services

Amazon Web Services (AWS) is a leading top platform in providing the web services of various domains. AWS follows the trends of digital IT and comes up needy services with optimized performances covering a wide range of services from Compute to Storage. It covers a wider range of customers of different domains to expand their business operations.

What Is AWS And Why Is It Used?

AWS stands for Amazon Web Services, It is an expanded **cloud computing platform** provided by Amazon Company. AWS provides a wide range of services with a **pay-as-per-use pricing model** over the Internet such as Storage, Computing power, Databases, Machine Learning services, and much more. AWS facilitates for both

businesses and individual users with effectively hosting the applications, storing the data securely, and making use of a wide variety of tools and services improving management flexibility for IT resources.

How AWS Works?

AWS comes up with its own network infrastructure on establishing the datacenters in different regions mostly all over the world. Its global Infrastructure acts as a backbone for operations and services provided by AWS. It facilitates the users on creating secure environments using Amazon VPCs (Virtual Private Clouds). Essential services like Amazon EC2 and Amazon S3 for utilizing the compute and storage service with elastic scaling. It supports the dynamic scaling of the applications with the services such as Auto Scaling and Elastic Load Balancing (AWS ELB). It provides a good user-friendly AWS Management Console facilitating seamless configuration and management of AWS services to the Users. Its Architecture ensures high availability , fault tolerance making AWS as a versatile powerful Cloud Computing Platform.

AWS Fundamentals

In the Journey of AWS, understanding the key concepts such as Regions, Availability Zones, Global Network Infrastructure, etc is crucial. The fundamentals of AWS keep on maintaining the applications reliable and scalable with services globally with coming to a strategic deployment of resources for optimal performance and resilience. The following are the some of the main fundamentals of AWS:

- **Regions:** AWS provide the services with respective division of regions. The regions are divided based on geographical areas/locations and will establish data centers. Based on need and traffic of users, the scale of data centers is depended to facilitate users with low-latencies of services.
- **Availability Zones (AZ):** To prevent the Data centers for the Natural Calamities or any other disasters. The Datacenters are established as sub sections with isolated locations to enhance fault tolerance and disaster recovery management.
- **Global Network Infrastructure:** AWS ensures the reliability and scalability of services through setting up its own AWS Network Infrastructure globally. It helps in better management of data transmissions for optimized performance and security reliance.

Top AWS Services

In the rapid revolution of Cloud Computing, AWS facilitates with wide variety of services respect to the fields and needs. The following are the top AWS services that are in wide usage:

- **Amazon EC2(Elastic Compute Cloud) :** It provides the Scalable computing power via cloud allowing the users to run applications and manage the workloads over their remotely.
- **Amazon S3 (Simple Storage Service):** It offers scalable object Storage as a Service with high durability for storing and retrieving any amount of data.
- **AWS Lambda:** It is a service in Serverless Architecture with Function as a Service facilitating serverless computing i.e., running the code on response to the events, the

background environment management of servers is handled by aws automatically. It helps the developers to completely focus on the logic of code build.

- **Amazon RDS (Relational Database Service):** This is an aws service that simplifies the management of database providing high available relational databases in the cloud.
- **Amazon VPC (Virtual Private Cloud):** It enables the users to create isolated networks with option of public and private expose within the AWS cloud, providing safe and adaptable configurations of their resources.

Advantages Of Amazon Web Services

- AWS allows you to easily scale your resources up or down as your needs change, helping you to save money and ensure that your application always has the resources it needs.
- AWS provides a highly reliable and secure infrastructure, with multiple data centers and a commitment to 99.99% availability for many of its services.
- AWS offers a wide range of services and tools that can be easily combined to build and deploy a variety of applications, making it highly flexible.
- AWS offers a pay-as-you-go pricing model, allowing you to only pay for the resources you actually use and avoid upfront costs and long-term commitments.

Disadvantages Of Amazon Web Services

- AWS can be complex, with a wide range of services and features that may be difficult to understand and use, especially for new users.
- AWS can be expensive, especially if you have a high-traffic application or need to run multiple services. Additionally, the cost of services can increase over time, so you need to regularly monitor your spending.
- While AWS provides many security features and tools, securing your resources on AWS can still be challenging, and you may need to implement additional security measures to meet your specific requirements.
- AWS manages many aspects of the infrastructure, which can limit your control over certain parts of your application and environment.

Applications Of AWS

The AWS services are using by both startup and MNC companies as per their usecase. The startup companies are using overcome hardware infrasture cost and applications deployments effectively with cost and performance. Whereas large scale companies are using AWS cloud services for the management of their Infrastructure to completely focus on the development of products widely. The following the Real-world industrial use-cases of AWS services:

- **Netflix:** The Large streaming gaint using AWS for the storage and scaing of the applications for ensuring seamless content delivery with low latency without interruptions to millions of users globally.

- **Airbnb:** By utilizing AWS, Airbnb manages the various workloads and provides insurable and expandable infrastructure for its virtual marketplace and lodging offerings.
- **NASA's Jet Propulsion Laboratory:** It takes the help of AWS services to handle and analyze large-scale volumes of data related to vital scientific research missions and space exploration.
- **Capital One:** A financial Company that is utilizing AWS for its security and compliance while delivering innovative banking services to its customers.

AWS Global Infrastructure

The AWS global infrastructure is massive and is divided into geographical regions. The geographical regions are then divided into separate availability zones. While selecting the geographical regions for AWS, three factors come into play

- Optimizing Latency
- Reducing cost
- Government regulations (Some services are not available for some regions)

Each region is divided into at least two availability zones that are physically isolated from each other, which provides business continuity for the infrastructure as in a distributed system. If one zone fails to function, the infrastructure in other availability zones remains operational. The largest region North Virginia (US-East), has six availability zones. These availability zones are connected by high-speed fiber-optic networking.

There are over 100 edge locations distributed all over the globe that are used for the CloudFront (content delivery network). CloudFront can cache frequently used content such as images and videos(live streaming videos also) at edge locations and distribute it to edge locations across the globe for high-speed delivery and low latency for end-users. It also protects from DDOS attacks.

AWS Cloud Computing Models

There are three cloud computing models available on AWS.

1. **Infrastructure as a Service (IaaS):** It is the basic building block of cloud IT. It generally provides access to data storage space, networking features, and computer hardware(virtual or dedicated hardware). It is highly flexible and gives management controls over the IT resources to the developer. For example, VPC, EC2, EBS.
2. **Platform as a Service (PaaS):** This is a type of service where AWS manages the underlying infrastructure (usually operating system and hardware). This helps the developer to be more efficient as they do not have to worry about undifferentiated heavy lifting required for running the applications such as capacity planning, software maintenance, resource procurement, patching, etc., and focus more on deployment and management of the applications. For example, RDS, EMR, ElasticSearch.
3. **Software as a Service(SaaS):** It is a complete product that usually runs on a browser. It primarily refers to end-user applications. It is run and managed by the service provider. The

end-user only has to worry about the application of the software suitable to its needs. For example, Salesforce.com, Web-based email, Office 365 .

Google App Engine - Architecture, Features, Advantages and Limitations

Google App Engine is a cloud computing Platform as a Service (PaaS) which provides Web app developers and businesses with access to Google's scalable hosting in Google managed data centers and tier 1 Internet service. It enables developers to take full advantage of its serverless platform. These applications are required to be written in, namely: **Java, Python, PHP, Go, Node.JS, . NET, and Ruby**. Applications in the Google App Engine require the use of Google query language and store data in Google Bigtable.

How is GAE used?

Users can create an account under GAE section, set up an SDK and write an application source code. They can use this to test and deploy code in the cloud. One way to use GAE is building scalable application back ends that adapt to workloads as needed. Another way to use GAE is for Application Testing. Users can route traffic to different app versions to A/B testing (It is a research methodology applicable in determining user experience. It is a randomized experiment with two variants A and B. Also known as split testing or bucket testing, it is used to compare two versions of a webapp against each other to determine which one performs better.) and see which version performs better under various workloads.

Google App Engine Environments

Google Cloud provides two environments:

1) Standard Environment with constrained environments and support for languages such as Python, Go, node.js

Features of Standard Environment:

- Persistent storage with queries, sorting, and transactions.
- Auto-scaling and load balancing.
- Asynchronous task queues for performing work.
- Scheduled tasks for triggering events at regular or specific time intervals.
- Integration with other GCP services and APIs.

2) Flexible Environment where developers have more flexibility such as running custom runtimes using Docker, longer request & response timeout, ability to install custom dependencies/software and SSH into the virtual machine.

Features of Flexible Environment:

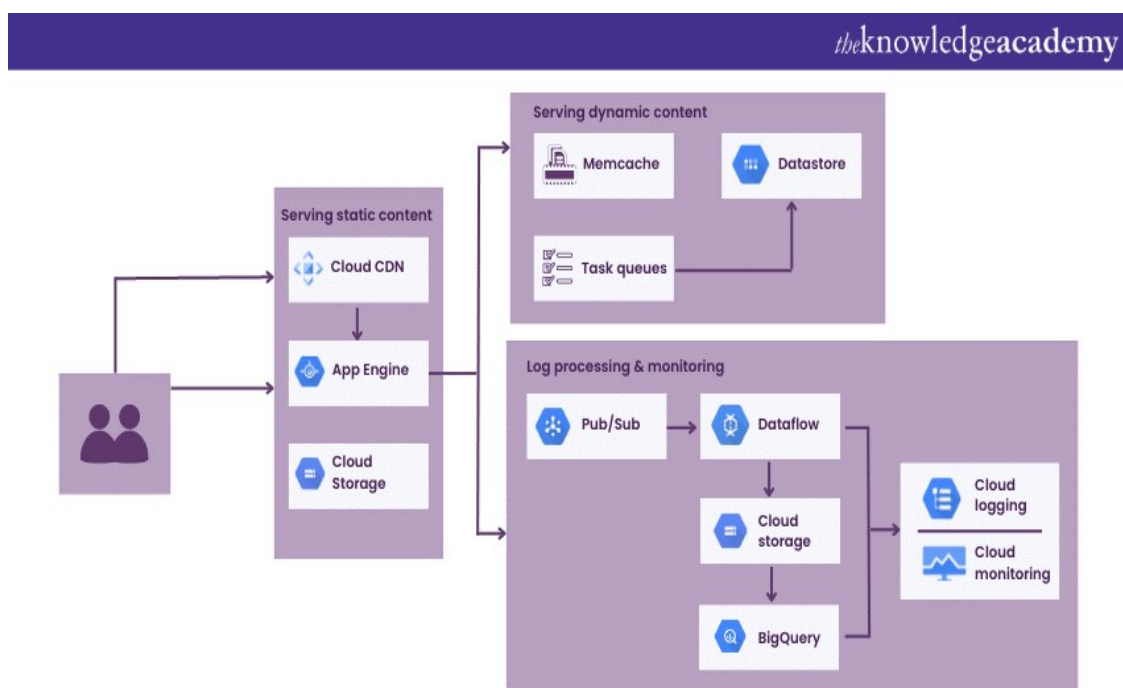
- *Infrastructure Customization*: GAE flexible environment instances are Compute Engine VMs, which implies that users can take benefits of custom libraries, use SSH for debugging and deploy their own Docker Containers.
- It's an open-source community.
- *Native feature support*: Features such as microservices, authorization, databases, traffic-splitting, logging, etc are supported.
- *Performance*: Users can use a wider CPU and memory setting.

GAE Architecture

App Engine is created under Google Cloud Platform project when an application resource is created. The Application part of GAE is a top-level container that includes the service, version and instance-resources that make up the app. When you create App Engine application, all your resources are created in the user defined region, including app code and collection of settings, credentials and your app's metadata.

Each GAE application includes at least one service, the default service, which can hold many versions, depends on your app's billing status.

The following diagram shows the hierarchy of a GAE application running with two services. In this diagram, the app has 2 services that contain different versions, and two of those versions are actively running on different instances:



Services

Services used in GAE is to constitute our large apps into logical components that can securely share the features of App Engine and communicate with each other. Generally, App Engine services behave like microservices. Therefore, we can run our app in a single service or we can deploy multiple services to run as a microservice-set.

Ex: An app which handles customer requests may include distinct services, each handle different tasks, such as:

- Internal or administration-type requests
- Backend processing (billing pipelines and data analysis)
- API requests from mobile devices

Each service in GAE consists of the source code from our app and the corresponding App Engine configuration files. The set of files that we deploy to a service represent a single *version* of that service and each time when we deploy the set of files to that service, we are creating different versions within that same service.

Versions

Having different versions of the app within each service allows us to quickly switch between different versions of that app for rollbacks, testing, or other temporary events. We can route traffic to specific or different versions of our app by migrating or splitting traffic.

Instances

The versions within our services run over one or more *instances*. By default, App Engine scales our app with respect to the load accordingly. GAE will scale up the number of instances that are running to provide a uniform performance, or scale down to minimize idle instances and reduce the overall costs.

Major Features of Google App Engine

Some of the prominent GAE features that user can take advantage of include:

- **Language support:**

Google App Engine lets users' environment to build applications in some of the most popular languages, including Java, Python, Ruby, Golang, Node.js, C#, and PHP.

- **Flexibility:**

Google App Engine offers the flexibility to import libraries & frameworks through Docker containers.

- **Diagnostics:**

Google App Engine uses cloud monitoring and logging to monitor health and performance of an application which helps to diagnose and fix bugs quickly. The error reporting document helps developers fix bugs on an immediate basis.

- **Traffic splitting:**

Google App Engine automatically routes the incoming traffic to different application versions as a part of A/B testing. This enables users to easily create environments for developing, staging, production and testing.

- **Security:**

Google App Engine enables users to define access rules in Engine's firewall and utilize SSL/TLS certificates on custom domains for free.

Google App Engine Pricing

GAE offers a usage-based plan for its users with free quota to trial out the service without costs.

GAE pricing is subdivided into Standard and Flexible models to cater users' differing needs. Two pricing Environments are mentioned below:

- **Standard Environment**

Pricing for the Standard Env. starts with the free quota. Users are charged when they go beyond the limited resources which fall under the free quota. There are diverse hour-based billing rates depending upon the instance classes, and there are two types of scaling: basic scaling and manual scaling.

- **Flexible Environment**

Pricing plan for Flexible Env. does not have any free quota. Under this, the applications of users have virtual machine deployments. The virtual machine's billing is on a per-second basis with a minimum usage cost of 1 minute. Overall Cost is mainly depending upon the following variables:

- V-CPU
- Memory
- Outbound Network
- Persistent Disk

Advantages of Google App Engine

- **Easy to build and use the platform:**

GAE is fully managed which lets developers lay focus on writing code with zero configuration and server management. It handles traffic management by automatic monitoring, patching and provisioning.

- **Scalability:**

Google App Engine handles the workload fluctuations through scaling the infrastructure, by adding or removing instances or application resources as needed.

- **Various API sets:**

Google App Engine has many built-in APIs and services which allows developers to build robust and versatile apps. These features include:

- 1) Application log Accessibility
- 2) Blobstore- serve large data objects
- 3) GAE Cloud Storage
- 4) SSL Support
- 5) Google Cloud Endpoint for mobile application
- 6) URL Fetch API, User API, Memcache API, File API, etc

Limitations of Google App Engine

- **Lack of control:**

Although it's a managed infrastructure which has its own advantages, if a problem occurs in the back-end, the users are then dependent on Google to fix it.

- **Limited access:**

Developers have read-only access to the filesystem on GAE.

- **Java Limits:**

Java apps. may only use a subset of the JRE standard edition classes and can't create new threads.

- **Performance Limits:**

CPU-intensive operations in GAE are slow and expensive to perform because one physical server may be serving several discreet, unrelated app engine users at once who need to share the CPU.

- **Language and frameworks Restrictions:**

GAE does not support various widely-used programming languages and frameworks. Users have to depend on the custom runtimes to utilize other languages.

- GAE can only execute code from an **HTTP request**.

Introduction to Microsoft Azure | A cloud computing service

Designed by Microsoft in 2010, Microsoft Azure is one of the widely used cloud computing platforms. Azure provides a wide variety of services such as cloud storage, compute services, network services, cognitive services, databases, analytics, and IoT. It makes building, deploying, and managing applications very easy. All the Microsoft Azure fundamentals are also described for a better understanding of readers.

What is Azure?

Azure is Microsoft's cloud platform, just like Google has its Google Cloud and Amazon has its Amazon Web Service or AWS.⁰⁰⁰. Generally, it is a platform through which we can use Microsoft's resources. For example, to set up a huge server, we will require huge investment, effort, physical space, and so on. In such situations, Microsoft Azure comes to our rescue. It will provide us with virtual machines, fast processing of data, analytical and monitoring tools, and so on to make our work simpler. The pricing of Azure is also simpler and cost-effective. Popularly termed as *"Pay As You Go"*, which means how much you use, pay only for that.

How Does Microsoft Azure Work?

It is a private and public cloud platform that helps developers and IT professionals to build, deploy, and manage the application. It uses the technology known as virtualization. Virtualization separates the tight coupling between the hardware and the operating system using an abstraction layer called a hypervisor. Hypervisor emulates all the functions of a computer in the virtual machine; it can run multiple virtual machines at the same time, and each virtual machine can run any operating system such as Windows or Linux. Azure takes this virtualization technique and repeats it on a massive scale in the data center owned by Microsoft. Each data center has many racks filled with servers, and each server includes a hypervisor to run multiple virtual machines. The network switch provides connectivity to all those servers.

Azure will provide the Microsoft Azure is a cloud computing platform which offers

- Infrastructure as a service (IaaS).
- Platform as a service (PaaS).
- Software as a service (SaaS).

Infrastructure as a service (IaaS)

Virtual machines, storage, and networking will come under the category of infrastructure as a service but the users have to do manually the build and deploy of the applications. Azure will support a wide range of operating systems because of its Hyper-hypervisor.

Platform as a service (PaaS)

Azure app service, Azure functions, and logic apps are some services that are offered by Azure under the platform as a service. This service will provide autoscaling and load balancing and also there will be a pre-configured environment for the application.

Software as a service (SaaS)

Office 365, Dynamics 365, and Azure Active Directory are some of the services provided by Microsoft Azure under Software as a Service (SaaS) the complete application will be managed by the Microsoft azure including deploying, scaling and load balancing.

What is a public cloud? Everything you need to know

Computing in which service provider makes all resources public over the internet. It is connected to the public Internet. Service provider serves resources such as virtual machines, applications, storage, etc to the general public over the internet. It may be free of cost or with minimal pay-per-usage. It is available for public display, Google uses the cloud to run some of its applications like google docs, google drive or YouTube, etc. It is the most common way of implementing cloud computing. The external cloud service provider owns, operates, and delivers it over the public network. It is best for the companies which need an infrastructure to accommodate a large number of customers and work on projects which have diverse organizations i.e. research institutions and NGOs etc.

Key Characteristics of Public Clouds:

- Accessibility
- Scalability
- Cost-effectiveness
- Security
- Reliability

What Is Microsoft Azure Used For?

Following are the some the use cases that Microsoft Azure Used.

- **Deployment Of applications:** You can develop and deploy the application in the azure cloud by using the service called Azure App Service and Azure Functions after deploying the applications end users can access it.
- **Identity and Access Managment:** The application and data which is deployed and stored in the Microsoft Azure can be secured with the help of Identity and Access Managment. It's commonly used for single sign-on, multi-factor authentication, and identity governance.

- **Data Storage and Databases:** You can store the data in Microsoft Azure in service like blob storage for unstructured data, table storage for NoSQL data, file storage, and Azure SQL Database for relational databases. The service can be scaled depending on the amount of data we are getting.
- **DevOps and Continuous Integration/Continuous Deployment (CI/CD):** Azure DevOps will provide some tools like including version control, build automation, release management, and application monitoring.

Azure for DR and Backup

A full range of disaster recovery (DR) and backup services are available from Microsoft Azure to help shield your vital data and apps from interruptions. With the help of these services, you may quickly restore your data and applications in the event of a disaster by replicating them to a secondary cloud site. Azure backup services also protect your data from ransomware attacks, unintentional deletion, and corruption.

Key Azure DR and Backup Services

- **Azure Site Recovery:** Your on-premises virtual machines (VMs) can be replicated to Azure more easily with the help of this solution. You may easily failover your virtual machines (VMs) to Azure in the event of a disaster and keep your business running. Azure VM replication to an alternative Azure region is also supported by Azure Site Recovery.
- **Azure Backup:** If you want to protect the data which is present in the cloud then you need to use the Azure Backup service. It offers a single area to monitor backup jobs, manage backup policies, and recover data. Azure pricing and costs.

Azure competition

Following are some of the competitors of Microsoft Azure:

- Amazon Web Services (AWS).
- Google Cloud Platform (GCP).
- IBM Cloud.
- Alibaba Cloud.
- Oracle Cloud Infrastructure (OCI).

How Azure can help in business?

Azure can help our business in the following ways-

- **Capital less:** We don't have to worry about the capital as Azure cuts out the high cost of hardware. You simply pay as you go and enjoy a subscription-based model that's kind to your cash flow. Also, setting up an Azure account is very easy. You simply register in Azure Portal and select your required subscription and get going.

- **Less Operational Cost:** Azure has a low operational cost because it runs on its servers whose only job is to make the cloud functional and bug-free, it's usually a whole lot more reliable than your own, on-location server.
- **Cost Effective:** If we set up a server on our own, we need to hire a tech support team to monitor them and make sure things are working fine. Also, there might be a situation where the tech support team is taking too much time to solve the issue incurred in the server. So, in this regard is way too pocket-friendly.
- **Easy Back-Up and Recovery options:** Azure keeps backups of all your valuable data. In disaster situations, you can recover all your data in a single click without your business getting affected. Cloud-based backup and recovery solutions save time, avoid large up-front investments and roll up third-party expertise as part of the deal.
- **Easy to implement:** It is very easy to implement your business models in Azure. With a couple of on-click activities, you are good to go. Even there are several tutorials to make you learn and deploy faster.
- **Better Security:** Azure provides more security than local servers. Be carefree about your critical data and business applications. As it stays safe in the Azure Cloud. Even, in natural disasters, where the resources can be harmed, Azure is a rescue. The cloud is always on.
- **Work from anywhere:** Azure gives you the freedom to work from anywhere and everywhere. It just requires a network connection and credentials. And with most serious Azure cloud services offering mobile apps, you're not restricted to which device you've got to hand.
- **Increased collaboration:** With Azure, teams can access, edit and share documents anytime, from anywhere. They can work and achieve future goals hand in hand. Another advantage of Azure is that it preserves records of activity and data. Timestamps are one example of Azure's record-keeping. Timestamps improve team collaboration by establishing transparency and increasing accountability.

What are the Various Azure Services and How does Azure Work?

Following are some of the services Microsoft Azure offers:

1. **Compute:** Includes Virtual Machines, Virtual Machine Scale Sets, Functions for serverless computing, Batch for containerized batch workloads, Service Fabric for microservices and container orchestration, and Cloud Services for building cloud-based apps and APIs.
2. **Networking:** With Azure, you can use a variety of networking tools, like the Virtual Network, which can connect to on-premise data centers; Load Balancer; Application Gateway; VPN Gateway; Azure DNS for domain hosting, Content Delivery Network, Traffic Manager, ExpressRoute dedicated private network fiber connections; and Network Watcher monitoring and diagnostics
3. **Storage:** Includes Blob, Queue, File, and Disk Storage, as well as a Data Lake Store, Backup, and Site Recovery, among others.
4. **Web + Mobile:** Creating Web + Mobile applications is very easy as it includes several services for building and deploying applications.

5. **Containers:** Azure has a property that includes Container Service, which supports Kubernetes, DC/OS or Docker Swarm, and Container Registry, as well as tools for microservices.
6. **Databases:** Azure also included several SQL-based databases and related tools.
7. **Data + Analytics:** Azure has some big data tools like HDInsight for Hadoop Spark, R Server, HBase, and Storm clusters
8. **AI + Cognitive Services:** With Azure developing applications with artificial intelligence capabilities, like the Computer Vision API, Face API, Bing Web Search, Video Indexer, and Language Understanding Intelligent.
9. **Internet of Things:** Includes IoT Hub and IoT Edge services that can be combined with a variety of machine learning, analytics, and communications services.
10. **Security + Identity:** Includes Security Center, Azure Active Directory, Key Vault, and Multi-Factor Authentication Services.
11. **Developer Tools:** Includes cloud development services like Visual Studio Team Services, Azure DevTest Labs, HockeyApp mobile app deployment and monitoring, Xamarin cross-platform mobile development, and more.

Difference between AWS (Amazon Web Services), Google Cloud, and Azure

	AWS	Google Cloud	Azure
Technology	EC2 (Elastic Compute Cloud)	Google Compute Engine(GCE)	VHD (Virtual Hard Disk)
Databases Supported	AWS fully supports relational and NoSQL databases and Big Data.	Technologies pioneered by Google, like Big Query, Big Table, and Hadoop, are databases, and Big Data,naturally fully supported.	Azure supports both relational and NoSQL through Windows AzureTable and HDInsight.
Pricing	Per hour — rounded up.	Per minute — rounded up	Per minute — rounded up.
Models	On demand, reserved spot.	On demand — sustained use.	Per minute- rounded up commitments(Pre-paid or monthly)
Difficulties	Many enterprises find it difficult to	Fewer features and services.	Less “Enterprise-ready.

	AWS	Google Cloud	Azure
	understand the company structure. cost		
Storage Services	<ul style="list-style-type: none"> • Simple Storage Service(S3) • Elastic Block Storage. • Elastic File storage. 	<ul style="list-style-type: none"> • Blob Storage • Queue Storage. • File Storage • Disk Storage. • Data Lake Store 	<ul style="list-style-type: none"> • Cloud storage. • Persistent Disk • Transfer appliance.
Machine Learning	<ul style="list-style-type: none"> • Sage maker. • Lex. • polly.And many more 	<ul style="list-style-type: none"> • Machine learning • Azure Bot service • Cognitive service 	<ul style="list-style-type: none"> • Cloud speech AI • Cloud Video Intelligence. • Cloud Machine learning engine.