UNIT 3

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(1) WHAT IS GOOGLE CLOUD PLATFORM?

Google Cloud Platform (GCP) is a suite of cloud computing services provided by Google.

It is a public cloud computing platform consisting of a variety of services like compute, storage, networking, application development, Big Data, and more, which run on the same cloud infrastructure that Google uses internally for its end-user products, such as Google Search, Photos, Gmail and YouTube, etc.

The services of GCP can be accessed by software developers, cloud administrators and IT professionals over the Internet or through a dedicated network connection.

WHY GOOGLE CLOUD PLATFORM?

Google Cloud Platform is known as one of the leading cloud providers in the IT field. The services and features can be easily accessed and used by the software developers and users with little technical knowledge. Google has been on top amongst its competitors, offering the highly scalable and most reliable platform for building, testing and deploying the applications in the real-time environment.

Apart from this, GCP was announced as the leading cloud platform in the Gartner's IaaS Magic Quadrant in 2018. Gartner is one of the leading research and advisory company. Gartner organized a campaign where Google Cloud Platform was compared with other cloud providers, and GCP was selected as one of the top three providers in the market.

Most companies use data centers because of the availability of cost forecasting, hardware certainty, and advanced control. However, they lack the necessary features to run and maintain resources in the data center. GCP, on the other side, is a fully-featured cloud platform that includes:

- **Capacity**: Sufficient resources for easy scaling whenever required. Also, effective management of those resources for optimum performance.
- **Security**: Multi-level security options to protect resources, such as assets, network and OS -components.
- **Network Infrastructure**: Number of physical, logistical, and human-resource-related components, such as wiring, routers, switches, firewalls, load balancers, etc.
- **Support**: Skilled professionals for installation, maintenance, and support.
- **Bandwidth**: Suitable amount of bandwidth for peak load.
- **Facilities**: Other infrastructure components, including physical equipment and power resources.

Therefore, Google Cloud Platform is a viable option for businesses, especially when the businesses require an extensive catalog of services with global recognition.

BENEFITS OF GOOGLE CLOUD PLATFORM

Some of the main benefits of Google Cloud Platform are explained below:

Best Pricing: Google enables users to get Google Cloud hosting at the cheapest rates. The hosting plans are not only cheaper than other hosting platforms but also offer better features than others. GCP provides a pay-as-you-go option to the users where users can pay separately only for the services and resources they want to use.

Work from Anywhere: Once the account is configured on GCP, it can be accessed from anywhere. That means that the user can use GCP across different devices from different places. It is possible because Google provides web-based applications that allow users to have complete access to GCP.

Private Network: Google has its own network that enables users to have more control over GCP functions. Due to this, users achieve smooth performance and increased efficiency over the network.

Scalable: Users are getting a more scalable platform over the private network. Because Google uses fiber-optic cables to extend its network range, it is likely to have more scalability. Google is always working to scale its network because there can be any amount of traffic at any time.

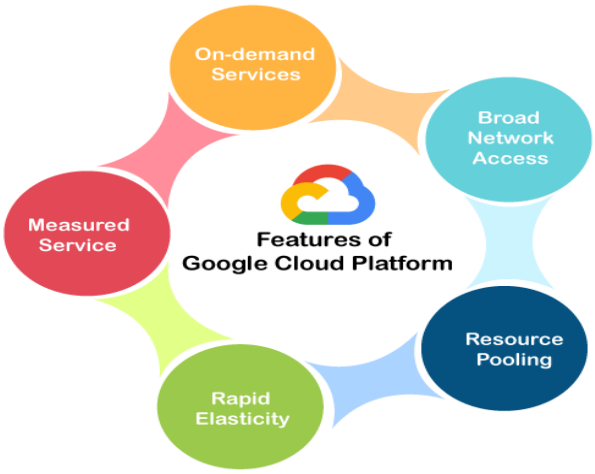
Security: There is a high number of security professionals working at Google. They always keep trying to secure the network and protect the data stored on servers. Additionally, Google uses an algorithm that encrypts all the data on the Cloud platform. This gives assurance to the users that their data is completely safe and secure from unauthorized sources.

Redundant Backup: Google always keeps backup of user's data with built-in redundant backup integration. In case a user has lost the stored data, it's not a big problem. Google always has a copy of the users' data unless the data is deleted forcefully. This adds data integrity, reliability and durability with GCP.

KEY FEATURES OF GOOGLE CLOUD PLATFORM

The following are some key features of Google Cloud Platform:

- **On-demand services**: Automated environment with web-based tools. Therefore, no human intervention is required to access the resources.
- **Broad network access**: The resources and the information can be accessed from anywhere.
- **Resource pooling**: On-demand availability of a shared pool of computing resources to the users.
- **Rapid elasticity**: The availability of more resources whenever required.
- **Measured service**: Easy-to-pay feature enables users to pay only for consumed services.



GOOGLE CLOUD PLATFORM SERVICES

Google provides a considerable number of services with several unique features. That is the reason why Google Cloud Platform is continually expanding across the globe. Some of the significant services of GCP are:

- Compute Services
- Networking
- Storage Services
- Big Data
- Security and Identity Management
- Management Tools
- Cloud AI
- IoT (Internet of Things)

STORAGE SERVICES

GCP has the following storage services:

- **Google Cloud Storage**: It is an online data storage web service that Google provides to its users to store and access data from anywhere. The service also includes a wide range of features like maximum performance, scalability, security and sharing.
- **Cloud SQL**: It is a web-service that enables users to create, manage, and use relational databases stored on Google Cloud servers. The service itself maintains and protects the databases, which helps users focus on their applications and other operations.
- **Cloud Bigtable**: It is known for its fast performance and highly manageable feature. It is a highly scalable NoSQL database service that allows collecting and retaining data from as low as 1 TB to hundreds of PB.

ADVANTAGES OF GOOGLE CLOUD PLATFORM

There are several advantages of using Google Cloud Platform, such as:

- **Google Cloud Offers Quick and Easy Collaboration**: Multiple users can access the data and simultaneously contribute their information. This is possible because the data is stored on the cloud servers, not on the user's personal computers.

- **Higher Productivity with Continuous Development**: Google is always working on adding new features and functionalities to provide higher productivity to the customers. Therefore, Google delivers frequent updates to its products and services.
- **Less Disruption with Adopting New Features**: Instead of pushing huge disruptive updates of changes, Google provides small updates weekly. This helps users to understand and adopt new features easily.
- **Least or Minimal Data is stored on Vulnerable Devices**: Google does not store data on local devices unless a user explicitly tries to do it. This is because the data stored on local devices may get compromised compared to the cloud's data.
- **Users can access Google Cloud from Anywhere**: The best thing is that a user can easily access the information stored on Google cloud from anywhere because it is operated through web-based applications.
- **Google provides Maximum Security with its Robust Structure**: Google hires leading security professionals to protect user's data. Users get process-based and physical security features made by Google.
- **Users have Full Control over their Data**: Users gain full control over services and the data stored in Google Cloud. If a user does not want to use Google services any longer and wants to delete the cloud data, it can be easily performed.
- **Google provides Higher Uptime and Reliability**: Google uses several resources to provide higher and reliable up-time servers. If a data center is not working for technical issues, the system will automatically communicate with the secondary center without interruption visible to users.

Google Cloud	AWS	Azure
It uses GCE (Google Compute Engine) for computing purposes.	AWS EC2 offers core compute services.	It uses virtual machines for computation purposes.
It uses Google Cloud Storage for storage purposes.	It uses Amazon S3 for storing the data.	It uses a storage block bob that comprises blocks for storing the data.
It offers the lowest price to the customers to beat other cloud providers.	AWS pricing is generally keen to have inscrutable. The overall structure of granular pricing is a bit complex.	Like AWS, Azure pricing structure is also difficult to understand unless you have considerable experience.
It uses Cloud Test labs for App Testing purposes.	It uses a device farm for App Testing purposes.	It uses DevTest labs for App Testing purposes.
It uses Subnet as a virtual network.	It uses VPC as a virtual network.	It uses VNet as a virtual Network.
It follows the Cloud Load Balancing configuration.	It follows the Elastic Load Balancing configuration.	It follows the Load-Balancer Application Gateway configuration.

(2) GOOGLE APPLICATION PORTFOLIO

https://www.studocu.com/in/document/apj-abdul-kalam-technological-university/cloud-computing/google-application-portfolio/24210754

https://developers.google.com/search/docs/fundamentals/how-search-works#crawling

(a) INDEXED SEARCH

- ✓ Content on pages is scanned up to a certain number of words and placed into an index.
- ✓ Google also caches copies of certain web pages and stores copies of documents such as DOC or PDF files in its cache.
- ✓ Its algorithm determine the importance of a particular page based on the number of quality links to that page from other sites the use of keywords how long the site has been available, and traffic to the site or page. The factor is called the PageRank.
- ✓ Google is always improving the algorithm to prevent Search Engine Optimization strategies for gaining the system.
- ✓ Based on this algorithm Google returns what is called the Search Engine Results Page (SERP) for a query that is parsed for its keywords.

Introducing the three stages of Google Search : Google Search works in three stages, and not all pages make it through each stage:

1. **Crawling:** Google downloads text, images, and videos from pages it found on the internet with automated programs called crawlers.
2. **Indexing:** Google analyzes the text, images, and video files on the page, and stores the information in the Google index, which is a large database.
3. **Serving search results:** When a user searches on Google, Google returns information that's relevant to the user's query.

(b) THE DARK WEB

Deep web : Sites whose online content that isn't indexed by search engines. This hides the content of the world wide web(WWW).

Any site that suppresses web crawlers from indexing it is part of the Deep web example Facebook .

Entire network exists that are not searchable particularly peer-to-peer networks.

THE DEEP WEB INCLUDES:

- Database generated web pages or dynamic content
- Pages without links
- Private on limited access web pages and sites
- Information contained in sources available through executable code searcher javascript
- Document send files that aren't in a form that can we search which includes media files and information in non standard file formats.

(c) AGGREGATION

- ✓ Display of information from various sites for easy access.
- ✓ Even through a great user service it sometimes violates copyright laws and damages content providers

(d) DISINTERMEDIATION

- ✓ Disintermediation is the removal of intermediaries such as distributor, agent, broker or some similar functionary from a supply chain.
- ✓ This connects producers directly with consumers which in many cases is a very good thing.
- ✓ But it impacted organisations such as news collection Agencies publishers retail outlets and many other businesses which played a positive role in the transactions they were involved in.

(3) GOOGLE ANALYTICS

- ✓ Google Analytics is a web analytics service offered by Google that tracks and reports website traffic, currently as a platform inside the Google Marketing Platform brand.
- ✓ Google launched the service in November 2005 after acquiring Urchin.
- ✓ Google Analytics is a platform that collects data from your websites and apps to create reports that provide insights into your business.
- ✓ Google Analytics gives you the tools, free of charge, to understand the customer journey and improve marketing ROI.
- ✓ Google Analytics' tracking code (or ID) is a unique identifier that allows Google Analytics to collect data when inserted into a website.
- ✓ This data includes the time users spend on a webpage, search terms used, and how they came to the site.
- ✓ The tracking code is the mechanism by which Google Analytics compiles data.

(4) GOOGLE TRANSLATE

- ✓ Google Translate is a multilingual neural machine translation service developed by Google to translate text, documents and websites from one language into another.
- ✓ It offers a website interface, a mobile app for Android and iOS, and an API that helps developers build browser extensions and software applications.
- ✓ Google Translate is a free tool that is available on most devices. Google Translate can be used to translate text, handwriting, speech, and websites in over 100 different languages.
- ✓ Google Translate is great for quick translations that do not need to be perfect. If you want to translate a piece of text to see what it says in your own language, Google Translate will translate well enough that you can piece together the general meaning of the text.
- ✓ The idea for Google Translate was first planted in 2004, when co-founder Sergey Brin became frustrated with a translation program the company was licensing after it translated a Korean email into "The sliced raw fish shoes it wishes.

(5) GOOGLE WEB TOOLKIT (GWT)

- ✓ Google Web Toolkit (GWT) is an open source Java software development framework that makes writing AJAX applications easy. With GWT, you can develop and debug AJAX applications in the Java language using the Java development tools of your choice.
- ✓ Google Web Toolkit (GWT) is an open-source set of tools that allows web developers to create and maintain JavaScript front-end applications in Java. It is licensed under the Apache License 2.0.
- ✓ Google Web Toolkit (GWT) is a development toolkit for building and optimizing complex browser-based applications.
- ✓ GWT is used by many products at Google, including Google AdWords and Orkut.
- ✓ GWT is an open source, completely free, and used by thousands of developers around the world.

(6) MAJOR FEATURES OF GOOGLE APP ENGINE IN CLOUD COMPUTING

https://www.netsolutions.com/insights/what-is-google-app-engine-its-advantages-and-how-it-can-benefit-your-business/

These prominent features enable GAE to be a hassle-free service platform.

1. **Collection of Development Languages and Tools :** The App Engine supports numerous programming languages for developers and offers the flexibility to import libraries and frameworks through docker containers. You can develop and test an app locally using the SDK tools for deploying apps. Every language has its SDK and runtime.
2. **Fully Managed** : Google allows you to add your web application code to the platform while managing the infrastructure for you. The engine ensures that your web apps are secure and running and saves them from malware and threats by enabling the firewall.
3. **Pay-as-you-Go** : The app engine works on a pay-as-you-go model, i.e., you only pay for what you use. The app engine automatically scales up resources when the application traffic picks up and vice-versa.
4. **Effective Diagnostic & Security Services** : Cloud Monitoring and Cloud Logging help run app scans to identify bugs. Further, app reporting documents help developers fix bugs on an immediate basis. GAE also sets up rules for access, SSL certificates on custom domains, and TSL certificates without any extra charge to create user firewall systems.
5. **Traffic Splitting** : The app engine automatically routes the incoming traffic to different versions of the apps as a part of A/B testing. You can plan the consecutive increments based on the app's best version.

WHAT ARE THE BENEFITS OF GOOGLE APP ENGINE?

Adopting the App Engine is a smart decision for your organization — It extends the benefits of cloud computing to application development & hosting. GAE allows businesses to innovate and stay focused on their core functions. Here's why it is preferred as an app-building platform:

1. **All-Time Availability :** When you develop and deploy your web applications on the cloud, you enable remote access for your applications. Considering the impact of COVID-19 on businesses, Google App Engine is the right choice that lets the developers develop applications remotely while the cloud service manages the infrastructure needs.
2. **Ensure Faster Time to Market :** For your web applications to succeed, ensuring faster time to market is imperative as the requirements will likely change if the launch time is extended. Using Google App Engine is as easy as it can get for developers. The diverse tool repository and other functionalities reduce the Google Cloud application development and testing time, ensuring a faster launch time for Minimum Viable Product (MVP) and consecutive launches.
3. **Easy to Use Platform** : The developers are only required to write code. You eliminate all the burdens of managing and deploying the code with zero configuration and server management. Google App Engine makes it easy to use the platform, which offers the flexibility to focus on other concurrent web applications and processes. The best part is that GAE automatically handles the traffic increase through patching, provisioning, and monitoring.
4. **Diverse Set of APIs** : Google App Engine has several built-in APIs and services that allow developers to build robust and feature-rich apps. These features include Access to the application log
    - Blobstore, serve large data objects
    - Google App Engine Cloud Storage
    - SSL Support
    - Page Speed Services
    - Google Cloud Endpoint, for mobile application
    - URL, Fetch API, User API, Memcache API, Channel API, XXMP API, File API

5. **Increased Scalability** : Scalability is synonymous with growth — an essential factor that assures success and competitive advantage. The good news is that the Google App Engine cloud development platform is automatically scalable. Whenever the traffic to the web application increases, GAE automatically scales up the resources and vice-versa.
6. **Improved Savings** : With Google App Engine, you do not have to spend extra on server management of the app. The Google Cloud service is good at handling the backend process. Also, Google App Engine pricing is flexible as the resources can scale up/down based on the app's usage. The resources automatically scale up/down based on how the app performs in the market, thus ensuring honest pricing.
7. **Smart Pricing** : The major concern of organizations revolves around how much does Google App Engine cost? For your convenience, Google App Engine has a daily and a monthly billing cycle, i.e.,
    - Daily: You will be charged daily for the resources you use
    - Monthly: All the daily charges are calculated and added to the taxes (if applicable) and debited from your payment method

Also, the App Engine has a dedicated billing dashboard, "App Engine Dashboard" to view and manage your account and subsequent billings.

(7) AMAZON WEB SERVICES (AWS)

- ✓ Amazon Web Services, Inc. is a subsidiary of Amazon that provides on-demand cloud computing platforms and APIs to individuals, companies, and governments, on a metered pay-as-you-go basis. These cloud computing web services provide distributed computing processing capacity and software tools via AWS server farms.
- ✓ AWS is designed to allow application providers, ISVs, and vendors to quickly and securely host your applications – whether an existing application or a new SaaS-based application. You can use the AWS Management Console or well-documented web services APIs to access AWS's application hosting platform.
- ✓ AWS (Amazon Web Services) is a comprehensive, evolving cloud computing platform provided by Amazon that includes a mixture of infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS) and packaged-software-as-a-service (SaaS) offerings.
- ✓ Amazon web service is an online platform that provides scalable and cost-effective cloud computing solutions. AWS is a broadly adopted cloud platform that offers several on-demand operations like compute power, database storage, content delivery, etc., to help corporates scale and grow.

BENEFITS OF AWS

1. **Easy to use** : AWS is designed to allow application providers, ISVs, and vendors to quickly and securely host your applications – whether an existing application or a new SaaS-based application. You can use the AWS Management Console or well-documented web services APIs to access AWS's application hosting platform.
2. **Flexible** : AWS enables you to select the operating system, programming language, web application platform, database, and other services you need. With AWS, you receive a virtual environment that lets you load the software and services your application requires. This eases the migration process for existing applications while preserving options for building new solutions.
3. **Cost-Effective** : You pay only for the compute power, storage, and other resources you use, with no long-term contracts or up-front commitments. For more information on comparing the costs of other hosting alternatives with AWS, see the AWS Economics Center.
4. **Reliable** : With AWS, you take advantage of a scalable, reliable, and secure global computing infrastructure, the virtual backbone of Amazon.com's multi-billion dollar online business that has been honed for over a decade.
5. **Scalable and high-performance** : Using AWS tools, Auto Scaling, and Elastic Load Balancing, your application can scale up or down based on demand. Backed by Amazon's massive infrastructure, you have access to compute and storage resources when you need them.
6. **Secure**. : AWS utilizes an end-to-end approach to secure and harden our infrastructure, including physical, operational, and software measures. For more information, see the AWS Security Center.

(8) AMAZON ELASTIC COMPUTE CLOUD (EC2)

https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/concepts.html

- ✓ Amazon Elastic Compute Cloud is a part of Amazon.com's cloud-computing platform, Amazon Web Services, that allows users to rent virtual computers on which to run their own computer applications.
- ✓ Amazon Elastic Compute Cloud (Amazon EC2) is a **web-based service** that allows businesses to run application programs in the Amazon Web Services (AWS) public cloud.
- ✓ Amazon Elastic Compute Cloud (Amazon EC2) provides scalable computing capacity in the Amazon Web Services (AWS) Cloud.
- ✓ Using Amazon EC2 eliminates your need to invest in hardware up front, so you can develop and deploy applications faster.
- ✓ You can use Amazon EC2 to launch as many or as few virtual servers as you need, configure security and networking, and manage storage.
- ✓ Amazon EC2 enables you to scale up or down to handle changes in requirements or spikes in popularity, reducing your need to forecast traffic.

FEATURES OF AMAZON EC2

Amazon EC2 provides the following features:

- ✓ Virtual computing environments, known as *instances*
- ✓ Preconfigured templates for your instances, known as *Amazon Machine Images (AMIs)*, that package the bits you need for your server (including the operating system and additional software)
- ✓ Various configurations of CPU, memory, storage, and networking capacity for your instances, known as *instance types*
- ✓ Secure login information for your instances using *key pairs* (AWS stores the public key, and you store the private key in a secure place)
- ✓ Storage volumes for temporary data that's deleted when you stop, hibernate, or terminate your instance, known as *instance store volumes*
- ✓ Persistent storage volumes for your data using Amazon Elastic Block Store (Amazon EBS), known as *Amazon EBS volumes*
- ✓ Multiple physical locations for your resources, such as instances and Amazon EBS volumes, known as *Regions* and *Availability Zones*
- ✓ A firewall that enables you to specify the protocols, ports, and source IP ranges that can reach your instances using *security groups*
- ✓ Static IPv4 addresses for dynamic cloud computing, known as *Elastic IP addresses*
- ✓ Metadata, known as *tags*, that you can create and assign to your Amazon EC2 resources

- ✓ Virtual networks you can create that are logically isolated from the rest of the AWS Cloud, and that you can optionally connect to your own network, known as *virtual private clouds* (VPCs)

(9) AWS SIMPLE STORAGE SERVICE (AWS S3)

AWS STORAGE SERVICES:

- ✓ AWS offers a wide range of storage services that can be provisioned depending on our project requirements and use case.
- ✓ AWS storage services have different provisions for highly confidential data, frequently accessed data, and the not so frequently accessed data.
- ✓ We can choose from various storage types namely, *object storage, file storage, block storage services, backups,* and *data migration* options. All of which fall under the AWS Storage Services list.

AWS SIMPLE STORAGE SERVICE (S3):

- ✓ It is probably the most commonly used, go-to storage service for AWS users given the features like extremely high availability, security, and simple connection to other AWS Services.
- ✓ AWS S3 can be used by people with all kinds of use cases like mobile/web applications, big data, machine learning and many more.

AWS S3 TERMINOLOGY:

1. **Bucket:** Data, in S3, is stored in containers called *buckets*.
    a. Each bucket will have its own set of policies and configuration. This enables users to have more control over their data.
    b. Bucket Names must be unique.
    c. Can be thought of as a parent folder of data.
    d. There is a limit of 100 buckets per AWS accounts. But it can be increased if requested from AWS support.
2. **Bucket Owner:** The person or organization that owns a particular bucket is its *bucket owner*.
3. **Import/Export Station:** A machine that uploads or downloads data to/from S3.
4. **Key:** Key, in S3, is a unique identifier for an object in a bucket.
    a. It is important to note that 'bucketName+key' is unique for all objects.
    b. This also means that there can be only one object for a key in a bucket. If you upload 2 files with the same key. The file uploaded latest will overwrite the previously contained file.
5. **Versioning:** Versioning means to always keep a record of previously uploaded files in S3. Points to note:
    a. Versioning is not enabled by default. Once enabled, it is enabled for all objects in a bucket.
    b. Versioning keeps all the copies of your file, so, it adds cost for storing multiple copies of your data. For example, 10 copies of a file of size 1GB will have you charged for using 10GBs for S3 space.
    c. Versioning is helpful to prevent unintended overwrites and deletions.

    d. Note that objects with the same key can be stored in a bucket if versioning is enabled (since they have a unique version ID).
6. **null Object:** Version ID for objects in a bucket where versioning is suspended is null. Such objects may be referred to as null objects.
    a. For buckets with versioning enabled, each version of a file has a specific version ID.
7. **Object:** Fundamental entity type stored in AWS S3.
8. **Access Control Lists (ACL):** A document for verifying the access to S3 buckets from outside your AWS account. Each bucket has its own ACL.
9. **Bucket Policies:** A document for verifying the access to S3 buckets from within your AWS account, this controls which services and users have what kind of access to your S3 bucket. Each bucket has its own Bucket Policies.
10. **Lifecycle Rules:** This is a cost-saving practice that can move your files to AWS Glacier (The AWS Data Archive Service) or to some other S3 storage class for cheaper storage of old data or completely delete the data after the specified time.

FEATURES OF AWS S3:

1. **Durability:** AWS claims Amazon S3 to have a 99.999999999% of durability (11 9's). This means the possibility of losing your data stored on S3 is one in a billion.
2. **Availability:** AWS ensures that the up-time of AWS S3 is 99.99% for standard access. Note that availability is related to being able to access data and durability is related to losing data altogether.
3. **Server-Side-Encryption (SSE):** AWS S3 supports three types of SSE models:
   SSE-S3: AWS S3 manages encryption keys.
   SSE-C: The customer manages encryption keys.
   SSE-KMS: The AWS Key Management Service (KMS) manages the encryption keys.
4. **File Size support:** AWS S3 can hold files of size ranging from 0 bytes to 5 terabytes. A 5TB limit on file size should not be a blocker for most of the applications in the world.
5. **Infinite storage space:** Theoretically AWS S3 is supposed to have infinite storage space. This makes S3 infinitely scalable for all kinds of use cases.
6. **Pay as you use:** The users are charged according to the S3 storage they hold.
7. **AWS-S3** is region-specific.

S3 STORAGE CLASSES:

AWS S3 provides multiple storage types that offer different performance and features and different cost structure.

1. **Standard:** Suitable for frequently accessed data, that needs to be highly available and durable.
2. **Standard Infrequent Access (Standard IA):** This is a cheaper data-storage class and as the name suggests, this class is best suited for storing infrequently accessed data like log files or data archives. Note that there may be a per GB data retrieval fee associated with Standard IA class.
3. **Intelligent Tiering:** This service class classifies your files automatically into frequently accessed and infrequently accessed and stores the infrequently accessed data in infrequent access storage to save costs. This is useful for unpredictable data access to an S3 bucket.
4. **One Zone Infrequent Access (One Zone IA):** All the files on your S3 have their copies stored in a minimum of 3 Availability Zones. One Zone IA stores this data in a

single availability zone. It is only recommended to use this storage class for infrequently accessed, non-essential data. There may be a per GB cost for data retrieval.

5. **Reduced Redundancy Storage (RRS):** All the other S3 classes ensure the durability of 99.999999999%. RRS only ensures a 99.99% durability. AWS no longer recommends RRS due to its less durability. However, it can be used to store non-essential data.

(10) AMAZON ELASTIC BLOCK STORE

https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/AmazonEBS.html

- ✓ Amazon Elastic Block Store provides raw block-level storage that can be attached to Amazon EC2 instances and is used by Amazon Relational Database Service. It is one of the two block-storage options offered by AWS, with the other being the EC2 Instance Store.
- ✓ Amazon Elastic Block Store (Amazon EBS) is an easy-to-use, scalable, high-performance block-storage service designed for Amazon Elastic Compute Cloud (Amazon EC2).
- ✓ Amazon Elastic Block Store (Amazon EBS) provides block level storage volumes for use with EC2 instances.
- ✓ EBS volumes behave like raw, unformatted block devices.
- ✓ We can mount these volumes as devices on your instances. EBS volumes that are attached to an instance are exposed as storage volumes that persist independently from the life of the instance.
- ✓ We can create a file system on top of these volumes, or use them in any way you would use a block device (such as a hard drive).
- ✓ We can dynamically change the configuration of a volume attached to an instance.