

## Unit 2

# Dockers and DevOps

<https://aws.amazon.com/devops/>

# What is Docker?



Docker is an operating system for containers.

Similar to how a virtual machine virtualizes server hardware, containers virtualize the operating system of a server.

Docker is installed on each server and provides simple commands used to build, start, or stop containers.

Docker is a software platform that allows you to build, test, and deploy applications quickly.

Docker packages software into standardized units called **containers** that have everything the software needs to run including libraries, system tools, code, and runtime.

# Docker ...

Docker is a software platform that allows you to build, test, and deploy applications quickly.

Docker packages software into standardized units called containers that have everything the software needs to run including libraries, system tools, code, and runtime.

# Benefits of Microservices architecture

Microservices-based architecture is a popular option for development teams that embrace a **DevOps** philosophy. Breaking an application into individual components facilitates agile development with rapid and more frequent deployments.

# DevOps ...

The DevOps is the combination of two words, one is Development and other is Operations. It is a culture to promote the development and operation process collectively.

DevOps is a practice or methodology of making "Developers" and "Operations" folks work together.

various DevOps : [Git](#), [Ansible](#), [Docker](#), [Puppet](#), [Jenkins](#), [Chef](#), [Nagios](#), and [Kubernetes](#).

Allows a single team to handle the entire application lifecycle, from development to testing, deployment, and operations.

DevOps helps you to reduce the disconnection between software developers, quality assurance (QA) engineers, and system administrators.

# DevOps ...

DevOps promotes collaboration between Development and Operations team to deploy code to production faster in an automated & repeatable way.

DevOps helps to increase organization speed to deliver applications and services. It also allows organizations to serve their customers better and compete more strongly in the market.

DevOps can also be defined as a sequence of development and IT operations with better communication and collaboration.

DevOps has become one of the most valuable business disciplines for enterprises or organizations.

With the help of DevOps, quality, and speed of the application delivery has improved to a great extent.

# DevOps ...

DevOps is all about the integration of the operations and development process.

The Development team works on code which is then sent to the testing team for validation against requirements. Operation team comes in toward the end of the process, where handover of release is given. DevOps aims to break these silos enabling better collaboration and performance.

Organizations that have adopted DevOps noticed a 22% improvement in software quality and a 17% improvement in application deployment frequency and achieve a 22% hike in customer satisfaction. 19% of revenue hikes as a result of the successful DevOps implementation.

# Why DevOps?

The operation and development team worked in complete isolation.

After the design-build, the testing and deployment are performed (consumed more time than actual build cycles)

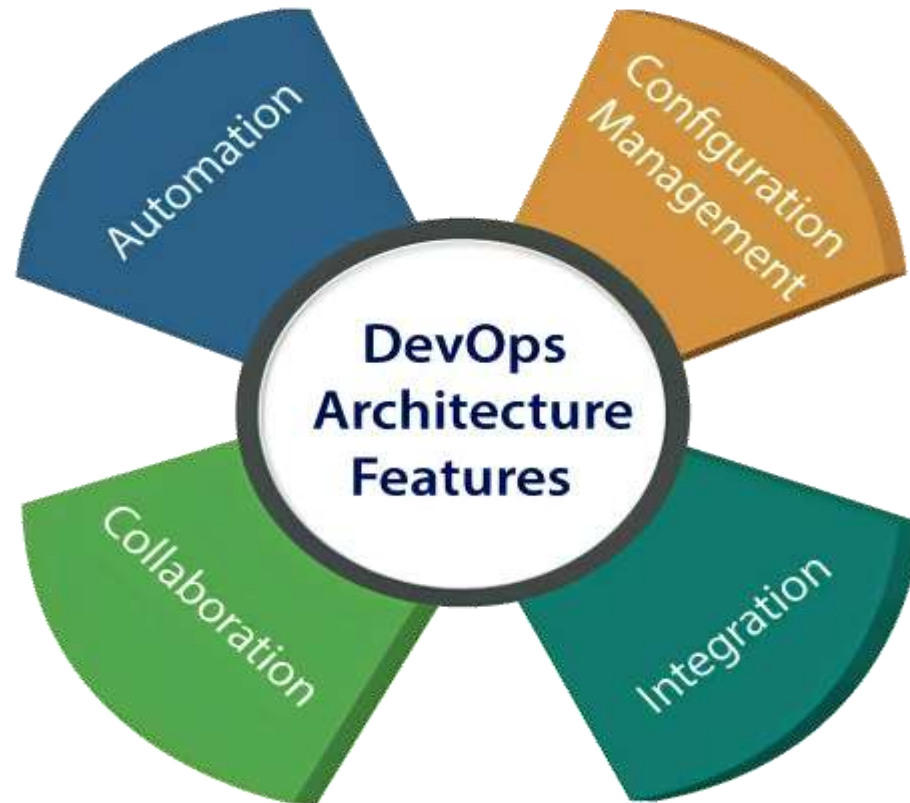
Without the use of DevOps, the team members are spending a large amount of time on designing, testing, and deploying instead of building the project.

Manual code deployment leads to human errors in production

Coding and operation teams have their separate timelines and are not in synch, causing further delays.



# DevOps Architecture Features



# 1. Automation

Automation can reduce time consumption, especially during the testing and deployment phase.

The productivity increases, and releases are made quicker by automation. This will lead in catching bugs quickly so that it can be fixed easily.

For contiguous delivery, each code is defined through automated tests, cloud-based services, and builds.

This promotes production using automated deploys.

## 2. Collaboration

The Development and Operations team collaborates as a DevOps team, which improves the cultural model as the teams become more productive with their productivity, which strengthens accountability and ownership.

The teams share their responsibilities and work closely in sync, which in turn makes the deployment to production faster.

# 3. Integration

Applications need to be integrated with other components in the environment.

The integration phase is where the existing code is combined with new functionality and then tested.

Continuous integration and testing enable continuous development. The frequency in the releases and micro-services leads to significant operational challenges.

To overcome such problems, continuous integration and delivery are implemented to deliver in a quicker, safer, and reliable manner.

## 4. Configuration management

It ensures the application to interact with only those resources that are concerned with the environment in which it runs.

The configuration files are not created where the external configuration to the application is separated from the source code.

The configuration file can be written during deployment, or they can be loaded at the run time, depending on the environment in which it is running.

# Advantages

1. DevOps is an excellent approach for quick development and deployment of applications.
2. It responds faster to the market changes to improve business growth.
3. DevOps escalate business profit by decreasing software delivery time and transportation costs.
4. DevOps clears the descriptive process, which gives clarity on product development and delivery.
5. It improves customer experience and satisfaction.
6. DevOps simplifies collaboration and places all tools in the cloud for customers to access.
7. DevOps means collective responsibility, which leads to better team engagement and productivity.

# Disadvantages

1. DevOps professional or expert's developers are less available.
2. Developing with DevOps is so expensive.
3. Adopting new DevOps technology into the industries is hard to manage in short time.
4. Lack of DevOps knowledge can be a problem in the continuous integration of automation projects.

## Unit II



# Amazon Web Services (AWS)







# AWS Cloud

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**

Amazon Web Services (AWS) is a comprehensive cloud computing platform that **includes infrastructure as a service (IaaS)** and **platform as a service (PaaS)** offerings.

AWS services offer scalable solutions for compute, storage, databases, analytics, and more.

# AWS

Amazon Web Services offers a broad set of global cloud-based products including compute, storage, databases, analytics, networking, mobile, developer tools, management tools, IoT, security, and enterprise applications: on-demand, available in seconds, with pay-as-you-go pricing.

From data warehousing to deployment tools, directories to content delivery, over 200 AWS services are available.

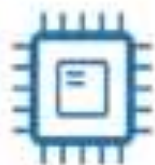
New services can be provisioned quickly, without the upfront fixed expense. This allows enterprises, start-ups, small and medium-sized businesses, and customers in the public sector to access the building blocks they need to respond quickly to changing business requirements.

# AWS easy to learn !

Learning and using AWS is a rather simple process.

The platform includes a wide range of tools and features that make it simple to get up and running, and there are lots of support and community resources.

**Python** is used extensively in the AWS Cloud and is natively supported by AWS Lambda. This is a great language to use for developing serverless applications on Amazon Web Services.



Compute



Migration



Security & Identity,  
Compliance



Storage



Networking and  
Content  
Delivery



Messaging



Database



Management  
Tools

# Amazon Web Services Cloud

- AWS Management Console, AWS Command Line Interface,
- Software Development Kits, Analytics, Application Integration,
- **AR and VR, Blockchain**, Business Applications,
- Cloud Financial Management, Compute Services,
- Contact Center, **Containers**, Database Developer Tools, End User Computing,
- Front-End Web & Mobile Services, Game Tech, **Internet of Things (IoT)**,
- Machine Learning, Management and Governance, Media Services,
- Migration and Transfer, Networking and Content Delivery,
- **Quantum Technologies, Robotics**, Satellite, Security, Identity, and Compliance, Storage.

# Amazon Managed Blockchain

Amazon Managed Blockchain is a fully managed service that makes it easy to create and manage scalable blockchain networks using the popular open source frameworks **Hyperledger Fabric and Ethereum**.



Amazon EC2

# Amazon EC2

Amazon Elastic Compute Cloud (Amazon EC2) **provides scalable computing capacity in the Amazon Web Services (AWS) Cloud.**

Users can launch virtual servers, configure security and networking, and manage cookies from an intuitive dashboard.

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.

# AWS EC2

What is Amazon EC2 used for?

EC2 is used to create and run virtual machines in the cloud

EC2 is a web service that provides secure, resizable compute capacity in the cloud.

It is designed to make web-scale cloud computing easier for developers.

Allows you to obtain and configure capacity with minimal friction.





# Amazon S3- Amazon Simple Storage Service

Amazon Simple Storage Service or Amazon S3 to store and retrieve data from the cloud.

S3 allows the user to store, upload, retrieve large files up to 5 TB from the cloud.

It is a scalable, low-cost and high-speed web-based service designed for archival and online backup of application programs and data.

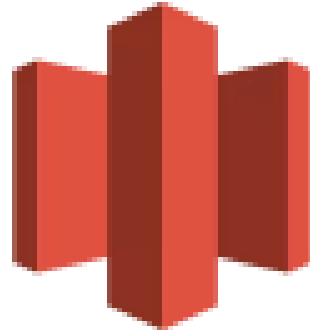
Using S3, the user can access the same system that Amazon uses to run its website. Users have control over the public or private accessibility of the data.

# AWS Lambda



Amazon Lambda is a service that allows the user to run code without any server.

# Amazon Glacier



Amazon Glacier is an online web storage service that provides with low cost and effective storage with security features for archival and data backup.

# Amazon SNS



Amazon **S**imple **N**otification **S**ervice manages and delivers the messages or notifications to the users and clients from any cloud platform.

# Amazon Cloud Front



Speeds up the sharing of dynamic and static web content such as .css , .html, and image files to users.

It securely delivers images, videos, data, and applications to users and clients with high transfer speed and low latency, all within a developer-friendly environment.

# Amazon EBS [Elastic Block Store]



- EBS is used to store persistent data, and it is block-level storage to use EC2 instances.
- You can use EBS service, to move the data from one instance to another instance without losing the stored data at EBS ( data is kept on the EBS servers even when the EBS servers are shutdown)
- You can mount multiple volumes on the same instance, but each volume can be attached to a single instance at a time.
- Highly dependable cloud service , guarentees 99.999% availability

# Amazon Kinesis



Amazon Kinesis service to handle big data in real-time

It allows developers to take any large volume of data from any source that can run on EC2 instances

# Amazon VPC



The data is secured, only authorized people can view the data. Information is not exposed to outside people or networks.



# Amazon SQS



Amazon SQS (Simple Queue Service) manages the message queue service.

SQS sends messages between multiple services, including S3, DynamoDB, EC2 Instance, and also it uses the Java message queue service to deliver the information.

The maximum visibility timeout of a message is 12 hours in the SQS queue

# Amazon Cloudwatch



CloudWatch collects monitoring and operational data in the form of logs, metrics, and events, and visualizes it using automated dashboards so you can get a unified view of your AWS resources, applications, and services that run on AWS and on premises

# Cloud Infrastructure

Cloud computing has a core component of a modern ecosystem and application integration strategy.

Instead of investing in costly hardware while having to manage and maintain a data center in-house, companies are turning to cloud providers like Amazon Web Services, Google Cloud, and Microsoft Azure for flexible cloud infrastructure to provide modernized computing, networking, and storage resources.

# Cloud Infrastructure

A cloud-based infrastructure has several key components, including :

- Servers
- Software
- Network devices, and
- Other storage resources

All are necessary to create applications that are then accessed via the cloud. These apps can be retrieved remotely over the internet, telecom services, WANs (wide area networks), and other network means.

- Ex: ?

# How is Cloud Infrastructure Categorized?

Cloud infrastructure generally is categorized into three parts that all collaborate to create a cloud service:

1. **Computing**: The computing portion of the infrastructure is delivered by server racks in order to deliver cloud services for various services and partners.
2. **Networking**: To transfer data externally as well as between computer and storage systems, this part of the infrastructure relies on routers and switches.
3. **Storage**: A cloud infrastructure will need considerable storage often using a combination of hard disks and flash storage.

# Types of clouds

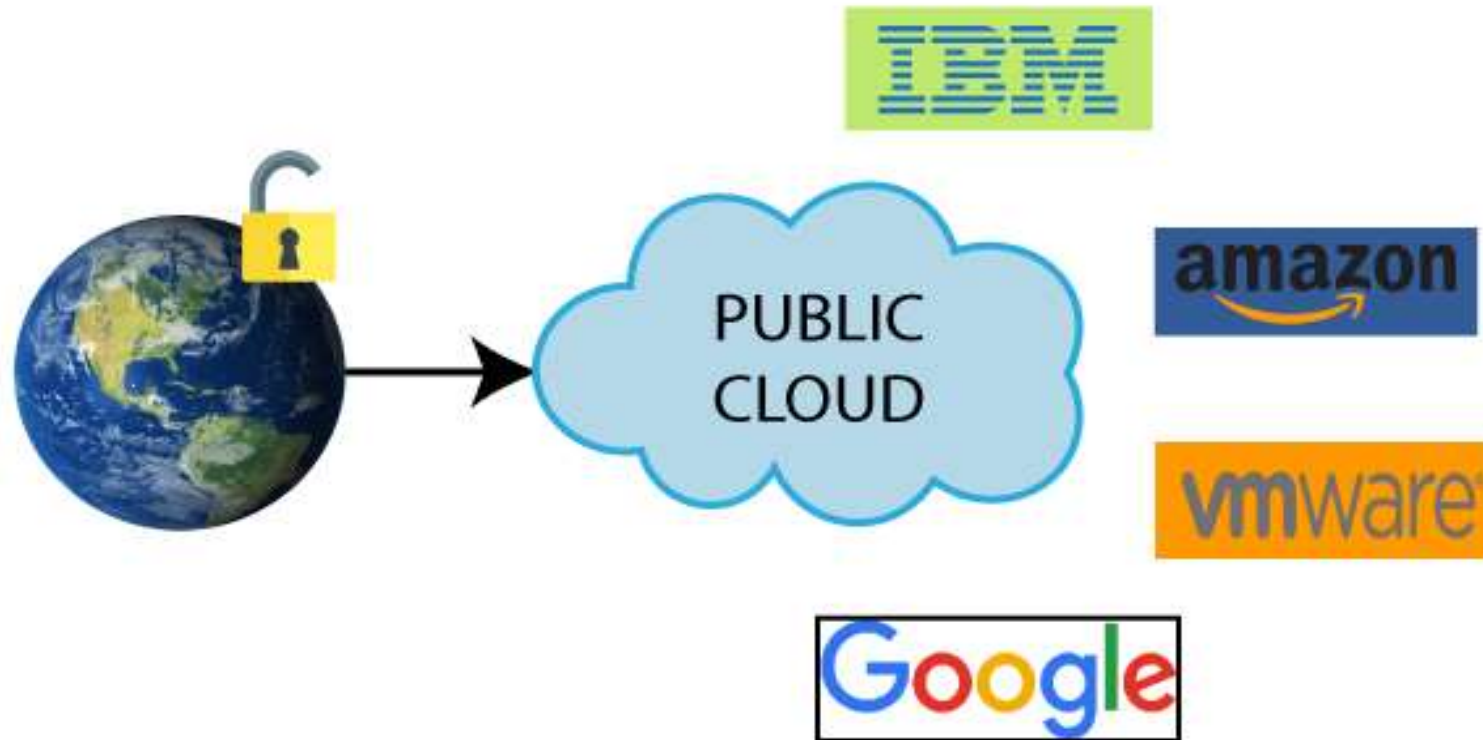
- Public clouds constitute the first expression of cloud computing.
- Public clouds. The cloud is open to the wider public. The services offered are made available to anyone, from anywhere, and at anytime through the Internet.
- Private clouds. The cloud is implemented within the private premises of an institution and generally made accessible to the members of the institution or a subset of them.
- Hybrid or heterogeneous clouds. The cloud is a combination of the two previous solutions and most likely identifies a private cloud that has been augmented with resources or services hosted in a public cloud.
- Community clouds. The cloud is characterized by a multi-administrative domain involving different deployment models(public, private, and hybrid), and it is specifically designed to address the needs of a specific industry.
- Each offers a varying amount of security, control, and management.

# Public Cloud Architecture

Is a distributed system, most likely composed of one or more data centers connected together, on top of which the specific services offered by the cloud are implemented.

Any customer can easily sign in with the cloud provider, enter his / her credential and billing details, and use the services offered.

# Public Cloud





# Public Cloud - Features

- The cloud is open to the wider public.
- Public Cloud provides a shared platform that is accessible to the general public through an Internet connection.
- Public cloud is cloud computing that's delivered via the internet and shared across organizations
- On-demand computing services and infrastructure are managed by a third-party provider and shared with multiple organizations using the public Internet.
- A fundamental characteristic of public clouds is multitenancy.

Amazon Web Services

Microsoft Azure

IBM Cloud

Google Cloud Platform

Oracle Cloud

Dropbox

# Public Cloud

1. Public cloud operated on the pay-as-per-use model and administrated by the third party, i.e., Cloud service provider.
2. In the Public cloud, the same storage is being used by multiple users at the same time.
3. Public cloud is owned, managed, and operated by businesses, universities, government organizations, or a combination of them.

# Public Cloud ...

- The clients don't own the gigabytes of storage their data they use
- Don't manage operations at the server farm where the hardware lives
- Don't determine how their cloud-based platforms, applications, or services are secured or maintained.
- Public cloud users simply make an agreement, use the resources, and pay for what's used.
- It can help streamline workflows and collaboration on applications with many users (email, for example), making sharing resources more efficient.
- There is a **higher risk of vulnerability** with a public offering.

# Advantages of Public Cloud

1. Low Cost
2. Location Independent
3. Save Time
4. Quickly and easily set up
5. Business Agility
6. Scalability and reliability

# Disadvantages of Public Cloud

- Low Security

Public Cloud is less secure because resources are shared publicly.

- Performance

In the public cloud, performance depends upon the speed of internet connectivity.

- Less customizable

Public cloud is less customizable than the private cloud.

Is pure mobile websites are same as pure mobile apps?

Is WhatsApp web same as WhatsApp app on mobile?

.....

# Web Application

In computer system, a web application is a client-side and server-side software application in which the client runs or request to a web browser.

Common web applications include email, online retail sales, online auctions, wikis, instant messaging services and more.

Many companies are shifting their focus to web applications that can be delivered as Software-as-a-Service (SaaS), such as moving to Microsoft 365.

# Web Application (Web app) ...

- A Web application (Web app) is an application program that is stored on a remote server and delivered over the Internet through a browser interface.
- Web services are Web apps
- Commonly used Web applications can include webmail, online calculators, or e-commerce shops.
- Ex: webmail, word processors and spreadsheets. Video and photo editing, file conversion, and file scanning, online retail sales, online auctions, instant messaging services
- Yahoo and Gmail, and instant messaging services are web applications



# How does a web application work?

**Step 1:** The user accesses a web application via a **web browser** or **mobile application**, triggering a request to the web server over the Internet. Note that there may be security measures (i.e. firewalls or cloud access security brokers) and load balancers.

**Step 2:** **The web server** forwards the request to the **web application server**. The web application server performs the requested task – such as querying the database or processing the data – then generates the results of the requested data.

**Step 3:** The web application server sends the results back to the **web server**.

**Step 4:** the web server delivers the requested information to the client (desktop, mobile device, tablet, etc.) and the information appears on the user's display.

# Web Application (Web app) ...

Web applications typically have short development cycles

Most Web apps are written in JavaScript, HTML5, or Cascading Style Sheets (CSS). Client-side programming typically utilizes these languages, which help build an applications front-end.

Server-side programming is done to create the scripts a Web app will use. Languages such as Python, Java, and Ruby are commonly used in server-side programming.

# Benefits ...

Some common benefits of Web apps include:

- Allowing multiple users access to the same version of an application.
- Web apps don't need to be installed.
- Web apps can be accessed through various platforms such as a desktop, laptop, or mobile.
- Can be accessed through multiple browsers.

# Web application deployment using public cloud services

## 1. Build a Basic Web Application

- <https://aws.amazon.com/getting-started/hands-on/build-web-app-s3-lambda-api-gateway-dynamodb/>
- <https://aws.amazon.com/getting-started/hands-on/build-web-app-s3-lambda-api-gateway-dynamodb/module-one/?e=gs2020&p=build-a-web-app-intro>

## 2. Deploy a Web Application on Amazon EC2

- <https://aws.amazon.com/getting-started/guides/deploy-webapp-ec2/>

# Public Cloud...

- A public cloud can offer any kind of service: **infrastructure, platform, or applications.**
- **Amazon EC2** is a public cloud that provides infrastructure as a service
- **Google AppEngine** is a public cloud that provides an application development platform as a service
- **SalesForce.com** is a public cloud that provides software as a service.
- They are available to everyone and are generally architected to support a large quantity of users.
- Able to scale on demand and sustain peak loads.

# Architectural Point of View - Public Cloud

- Is a distributed system
- one or more data centers constitute the physical infrastructure on top of which the services are implemented and delivered
- Public clouds can be composed of geographically dispersed data centers to share the load of users and better serve them according to their locations
- Amazon Web Services has data centers installed in the United States, Europe, Singapore, and Australia; they allow their customers to choose between three different regions: [us-west-1](#), [us-east-1](#), or [eu-west-1](#)
- Regions are priced differently and are further divided into availability zones, which map to specific data centers
- According to the specific class of services delivered by the cloud, a different software stack is installed to manage the infrastructure: [virtual machine managers](#), [distributed middleware](#), or [distributed applications](#).

# Virtual Machine Manager

The Red Hat Virtual Machine Manager, also known as **virt-manager**, is a desktop virtual machine monitor for **Linux**

Virtual Machine Manager allows users to:

1. create, edit, start and stop VMs
2. view and control each VM's console
3. see performance and utilization statistics for each VM
4. view all running VMs and hosts, and their live performance or resource utilization statistics.
5. use KVM, Xen or QEMU virtual machines, running either locally or remotely.
6. use LXC containers

**System Center Virtual Machine Manager** (SCVMM) forms part of **Microsoft's** System Centre line of virtual machine management

# Middleware

In distributed systems, middleware is a software component that provides services between two or more applications and can be used by them. Middleware can be thought of as an application that sits between two separate applications and provides service to both.

examples:

database middleware, application server middleware, message-oriented middleware, web middleware, and transaction-processing monitors.

The role of middleware is to enable and ease access to those back-end resources.

Java DataBase Connectivity (JDBC) is the middleware that allows Java programs to access data from a relational database. JDBC provides a standard SQL database access interface.

Node.js, Express.js and React.js, MongoDB

Tomcat, Apache, Router



# Node.js

Node.js is a JavaScript runtime environment, which enables developing web apps with a single programming language (rather than use different languages for server- and client-side scripts) and serving multiple concurrent events in a single thread (thanks to non-blocking I/O (Input/Output), among other things).

This, in turn, makes Node.js fast, scalable and efficient in handling both data- and I/O-heavy workloads that are typical for various types of apps.

Examples: Netflix, LinkedIn, Paypal, Rupay, Walmart, eBay, Alibaba

# ReactJS

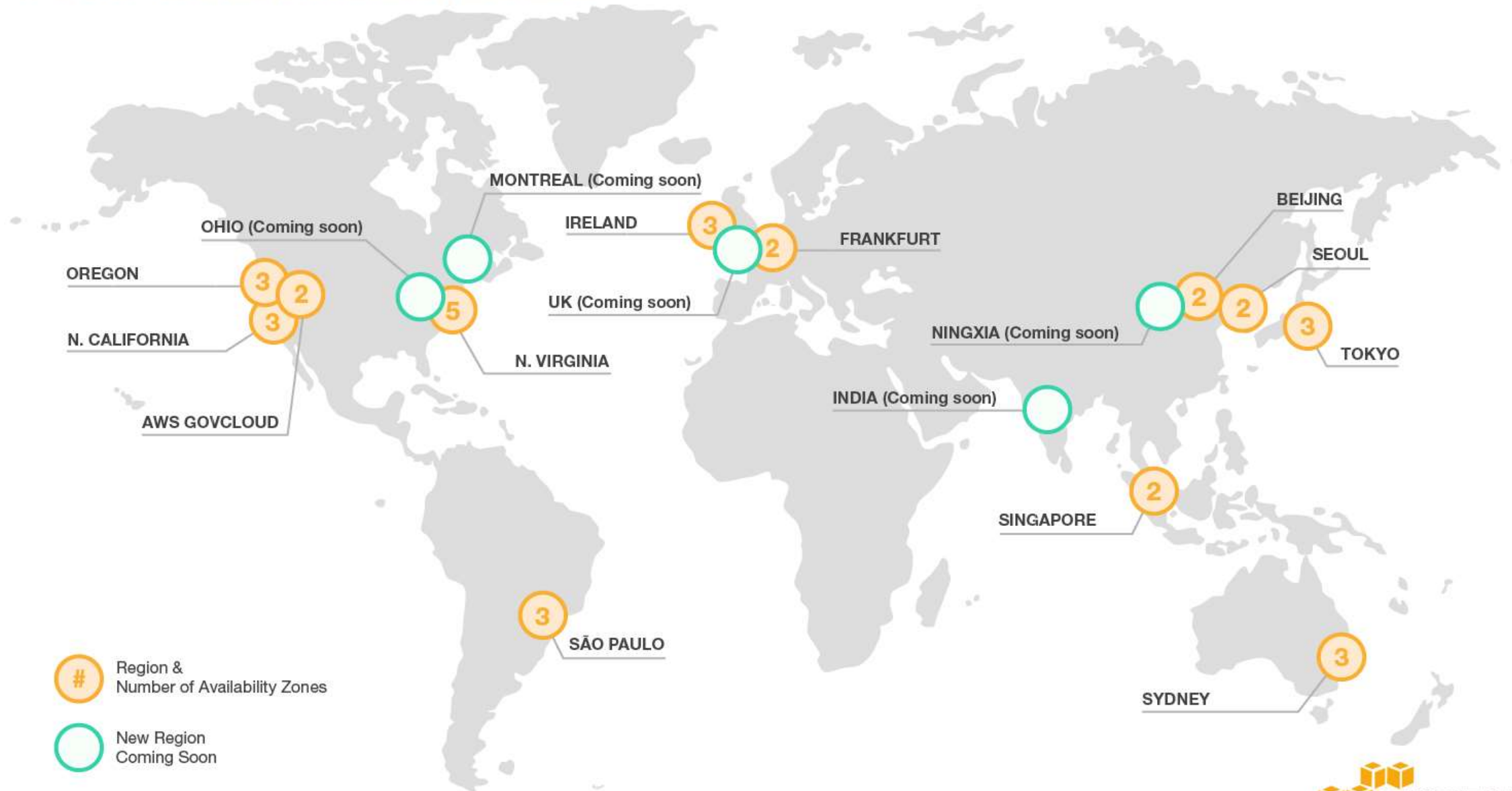
React is a JavaScript library for building user interfaces. React is used to build single-page applications. React allows us to create reusable UI components.

ReactJS has an in-built JSX (JavaScript XML) function that helps to create components based on the project requirements. These components usually work with HTML quoting, rendering subcomponents becomes easier using this mechanism.

ReactJS tops the list of frameworks businesses use to develop their applications. Moreover, over 40% of the developers worldwide choose ReactJS as their preferred platform to design mobile and web apps.

Instagram, Whatsapp, Github,

# AWS Global Infrastructure



# Cognitive Services

Cognitive Services are a set of machine learning algorithms, developed to solve problems in the field of Artificial Intelligence (AI).

The goal is to democratize AI by packaging it into discrete components that are easy for developers to use in their own apps

Cognitive services include platforms and APIs to build intelligent, machine learning-based applications to focus on [vision](#), [speech](#), [language](#), and [knowledge](#)

Web and Universal Windows Platform developers can use these algorithms over the Internet to the Cognitive Services APIs.

Deploying machine learning models as serverless APIs

Azure Cognitive Services are cloud-based artificial intelligence (AI) services that help developers build cognitive intelligence into applications without having direct AI or data science skills or knowledge

# Cognitive Services - AWS (Easily add intelligence to applications)

AWS **pre-trained AI Services** provide ready-made intelligence for users' applications and workflows.

AI Services easily integrate with applications to address common use cases such as personalized recommendations, modernizing your contact center, improving safety and security, and increasing customer engagement.

AI Services on AWS don't require machine learning experience

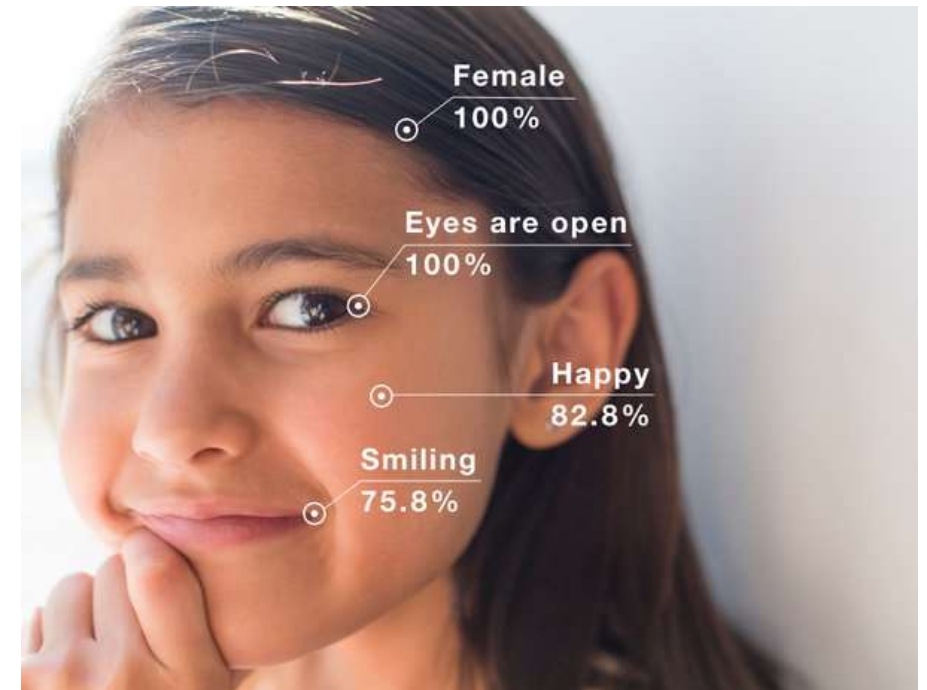
# Amazon three cognitive services

Amazon has launched three cognitive services

1. Computer Vision ( **Amazon Rekognition** )
2. Text into Speech ( **Amazon Polly** )
3. Chatbot ( **Amazon Lex** )

# Amazon Rekognition (Deep Learning powered video/image analysis service)

Amazon Rekognition is a service makes it easy to add image analysis to your applications.



Object and Scene detection: Rekognition identifies various interesting objects such as vehicles, pets, or furniture, and provides a confidence score.

# Amazon cognitive services ...

1. Amazon Rekognition
2. Amazon Polly : a service that turns text into speech
3. Amazon Lex is a service for building conversational interfaces into any application using voice and text.



# Cognitive services in healthcare

Cognitive services means non-invasive diagnostic, therapeutic, or preventive office visits, hospital visits, therapy, and related nonsurgical services.

# Containers

Containers are packages of software that contain all of the necessary elements to run in any environment.

Thus containers virtualize the operating system and run anywhere, from a private data center to the public cloud or even on a developer's personal laptop.

From Gmail to YouTube to Search, everything at Google runs in containers.

Containerization allows development teams to move fast, deploy software efficiently, and operate at an unprecedented scale

# Containers ...

Containers are lightweight packages of application code together with dependencies such as specific versions of programming language runtimes and libraries required to run your software services.

Containers make it easy to **share CPU, memory, storage, and network resources** at the operating systems level and offer a logical packaging mechanism in which applications can be abstracted from the environment in which they actually run.

# Benefits of Containers

1. Separation of responsibility
2. Workload portability
3. Application isolation