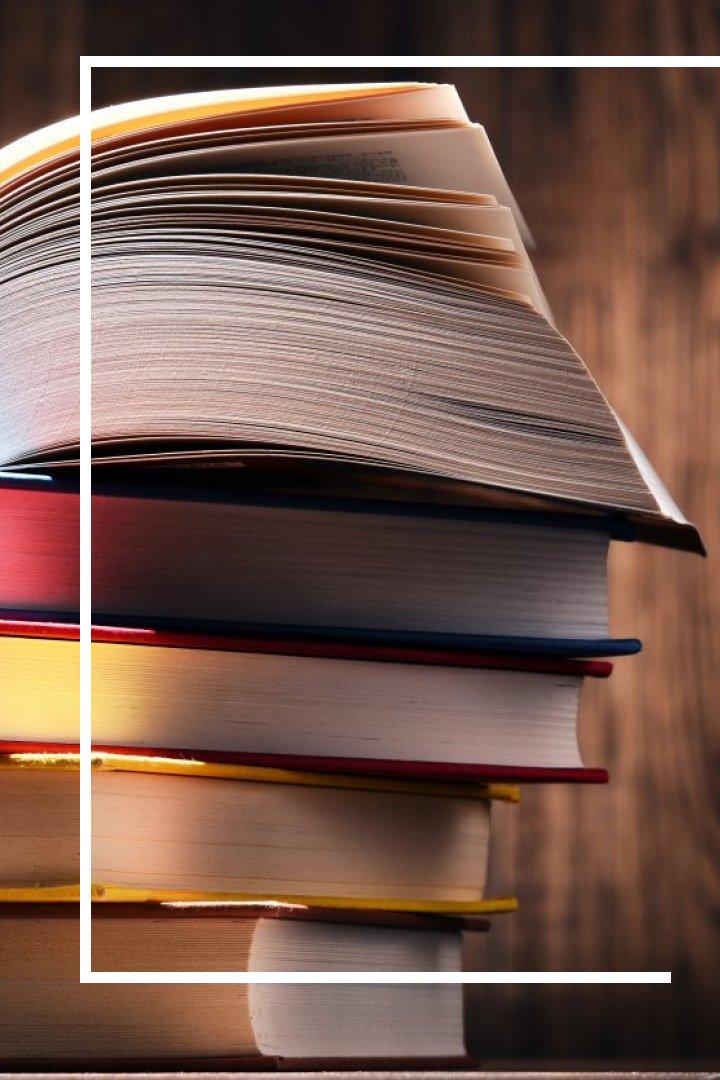




# AWS ESSENTIALS

Tham Yong Hao





MLDA@EEE

AY2022/23



# What we do



## Listen to our workshops

A stack of various workshop promotional cards from MLDA, including:

- Neural Network**: Introduction to neural networks.
- Robot Operating System**: MLDA PROUDLY PRESENTS.
- EE0005 CRASH REVISION**: Crash revision for EE0005 course.
- Transfer Learning: How to use state-of-the-art**: Workshop on transfer learning.
- Deep Learning Week INTRODUCTION TO CNNs**: Introduction to Convolutional Neural Networks (CNNs).
- Reinforcement Learning**: Workshop on reinforcement learning.
- NVIDIA Multiple Datatype Workshop**: Workshop on NVIDIA multiple datatype.

## Do projects that belong to yourselves

A collage of various AI-related event posters and banners, including:

- AI TOURNAMENT BATTLES**: A competition poster.
- ARSC 2021**: AI Research Student Conference 2021.
- MLDA AI Football Cup 2021**: AI football competition.
- LEARN REINFORCE LEARNING ALG THROUGH CHILDREN BOMBER**: Reinforcement learning workshop.

## Hear from the industry

Two main banners for industry events:

- MLDA Deep Learning Week 2021 Opening Ceremony**: Hosted by Nanyang Technological University, Monday 11 Oct 2021, 4 pm, Virtual Venue. Guests of Honour include Mrs Josephine Teo and Prof Suresh Govindarajan. Panel discussion on "AI-driven Future of Singapore".
- ARSC 2021**: AI Research Student Conference 2021. Keynote speeches by top professionals, panel discussions with top AI experts, and tutorials by outstanding professors. Companies attending include Shopee, Micron, and Jabil.

# What we have



## Academic facilities

- GPUs
  - RTX 3090, GTX 2080 Ti, GTX 1080 Ti
- Equipments
  - Robot Master \*2
  - 3D printer \*1
  - Drones \*1
  - ...



## Like-minded Students in NTU

- Project Partner / Research Partner
- Friends in similar path of personal development



## Industrial Connections

- Sponsors & Partners

# Follow us to stay tuned!



<https://www.ntu.edu.sg/eee/student-life/mlda>



Machine Learning and Data Analytics at EEE NTU



Machine Learning and Data Analytics Lab at NTU EEE



@mlda\_at\_eee\_ntu



MLDA-NTU

# Before we start...

\*\*\*A few things to take note



- For those that have not created your AWS account, you can do so now
- Note that you have to attach a payment method, you can just listen through if you are uncomfortable with it
- This is more of a sharing session rather than a licensed AWS workshop

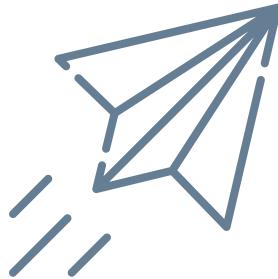
# TABLE OF CONTENTS

- 01 What is AWS?**
- 02 AWS Pricing**
- 03 Amazon Elastic Compute Cloud (EC2) + Hands-on**
- 04 Amazon Lambda + Hands-on**
- 05 Global Infrastructure and Reliability**
- 06 Interact with AWS Services**
- 07 Networking**
- 08 Storage**
- 09 AWS Identity and Access Management**

01

# What is AWS?

# What is cloud computing?



Access services on demand



Avoid large upfront investments



Provision computing resources as needed



Pay only for what you use

# Cloud computing deployment models



Cloud



On premises



Hybrid

# Cloud-based deployment

- Run all parts of the application in the cloud
- Migrate existing applications to the cloud
- Design and build new applications in the cloud



Cloud

# On-premises deployment

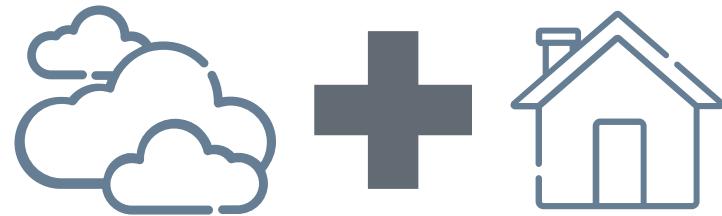
- Use virtualization and resource management tools to deploy resources
- Use application management and virtualization technologies to increase resource usage



On premises

# Hybrid deployment

- Connect cloud-based resources to on-premises infrastructure
- Integrate cloud-based resources with legacy IT applications
- AWS Hybrid Cloud



Hybrid

# Cloud computing benefits?



Variable expenses



Cost optimization



Capacity



Economies of  
Scale

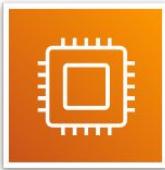


Speed and agility



Global in minutes

# AWS core service categories



Compute



Networking and  
Content Delivery



Storage



Database



Security, Identity,  
and Compliance



Management  
and Governance

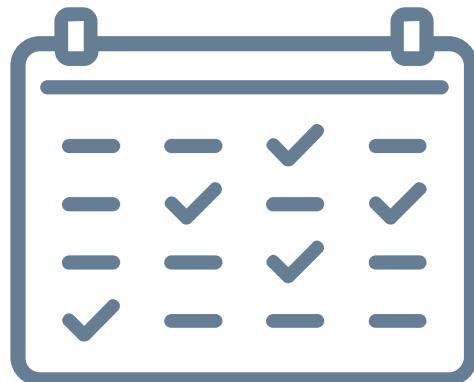
02

# AWS Pricing

# Amazon Free Tier Categories



Always free



12 months free



Trials

# Amazon Pricing Models

## Pay as you go

Pay only for the resources that you use without provisioning capacity in advance

## Save when you commit

Savings Plans offer savings over On-Demand in exchange for a commitment to use a specific amount (measured in \$/hour) of an AWS service or a category of services, for a one- or three-year period.

## Pay less by using more

Receive savings through volume-based discounts as your usage increases. Pricing is tiered, meaning the more you use, the less you pay per GB.

# AWS Pricing Calculator

aws pricing calculator

Feedback English Contact Sales

AWS Pricing Calculator > My Estimate > Add service

Step 1 Select service [Info](#)

Step 2 Configure service

Select service [Info](#)

AWS services (148)

Cancel

Q ec2

Amazon EC2

Amazon EC2 offers the broadest and deepest compute platform with choice of processor, storage, networking, operating system, and purchase model.

[Product page](#) [Configure](#)

Amazon EC2 Dedicated Hosts

Amazon EC2 Dedicated Hosts allow you to use your eligible software licenses on Amazon EC2, so that you get the flexibility and cost effectiveness of using your own licenses, but with the resiliency, simplicity and elasticity of AWS. Includes support for EC2 High Memory and EC2 Mac instances.

[Product page](#) [Configure](#)

Windows Server and SQL Server on Amazon EC2

The Windows Server and SQL Server on Amazon EC2 calculator provides a pricing estimate for specific workloads. It recommends suitable cloud deployment options and cost-saving pricing models based on licensing and infrastructure inputs.

[Product page](#) [Configure](#)

AWS Outposts

AWS Outposts is a fully managed service that offers the same AWS infrastructure, AWS services, APIs,

Amazon Carrier IP

A Carrier IP address is the address that you assign to a network interface, which resides in a subnet in a

Amazon Elastic Block Store (EBS)

Amazon Elastic Block Storage (EBS) allows you to create persistent block storage volumes and attach

Upfront cost: 0.00 USD   Monthly cost: 0.00 USD   Total 12 months cost: 0.00 USD (Includes upfront cost)

[View summary](#)

Privacy | Site terms | Cookie preferences | © 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Be in the free zone

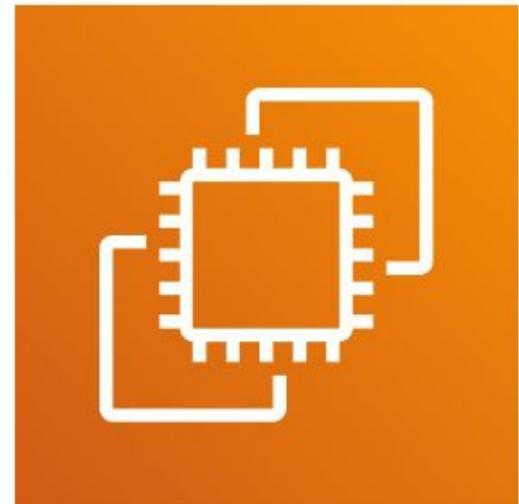
- Check for available [AWS Free Tier](#)
- Check how much free tier resources are currently used
  - Billing -> AWS Billing -> AWS Free Tier
- Set up alerts
  - Billing -> Preferences -> Receive Free Tier Usage Alerts
- Find and terminate resources when you're done using them

03

# Amazon Elastic Compute Cloud (EC2)

# Amazon EC2

- Use secure, sizeable compute capacity
- Boot server instances in minutes
- Pay only for what you use



Amazon EC2

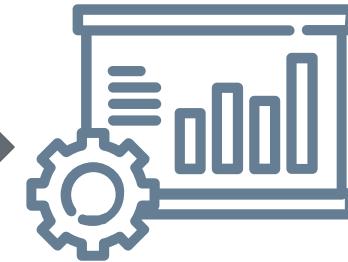
# How Amazon EC2 works



Launch an instance



Connect to the instance



Use the instance

# Amazon EC2 instance types

01

## General Purpose

- Balances compute, memory, and networking resources
- Suitable for a broad range of workloads
- Ideal for web servers

02

## Compute Optimized

- Offers high-performance processors
- Ideal for compute-intensive applications and batch processing workloads such as gaming, HPC, ML, simulations

03

## Memory Optimized

- Delivers fast performance for memory-intensive workloads
- Well suited for high-performance databases
- Real-time applications

04

## Accelerated Computing

- Uses hardware accelerators to expedite data processing
- Ideal for application streaming and graphics workloads (GPU based apps)

05

## Storage Optimized

- Offers low latency and high input/output operations per second (IOPS)
- Suitable for workloads such as distributed file systems and data warehousing applications

# Amazon EC2 Pricing

## On-Demand

- No upfront costs or minimum contracts
- Ideal for short-term, irregular workloads

## Spot

- Ideal for workloads with flexible start and end times
- Offers savings over On-Demand Prices

## Reserved

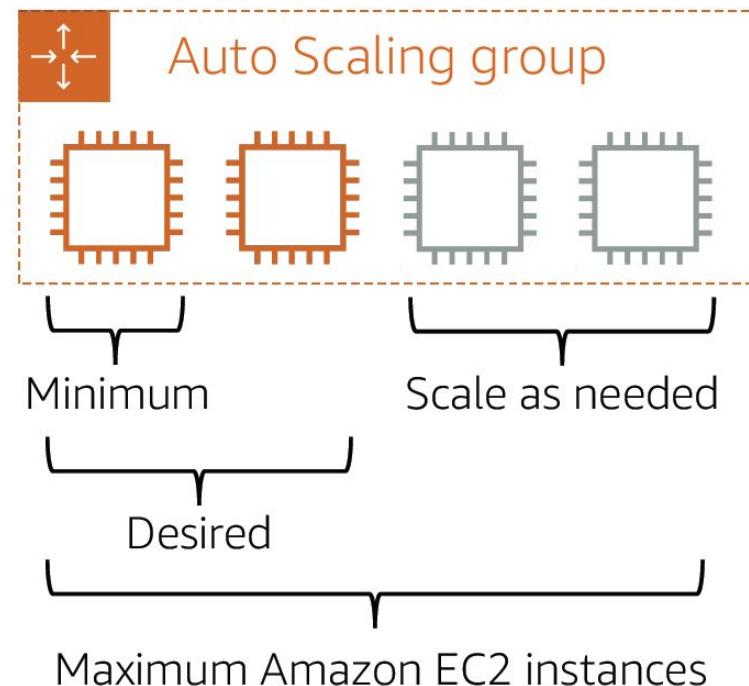
- Provides a billing discount over On-Demand pricing
- Requires a 1-year or 3-year term commitment

## Compute Savings Plans

- Offer up to 66% savings over On-Demand costs for a consistent amount of compute usage
- Require a 1-year or 3-year term commitment

# Amazon EC2 Auto Scaling

- Scale capacity as computing requirements change
- Use dynamic scaling and predictive scaling



# Elastic Load Balancing

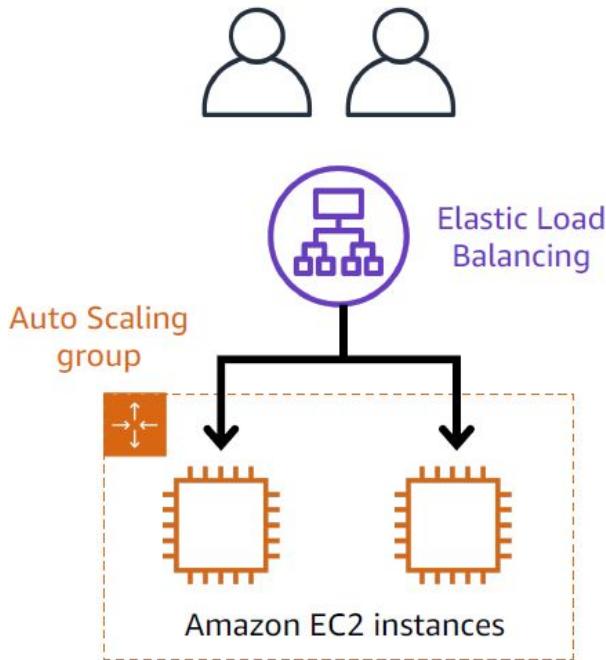
- Automatically distributes traffic across multiple resources
- Provides a single point of contact for your Auto Scaling group
- Managed load balancer: EC2 Load Balancer



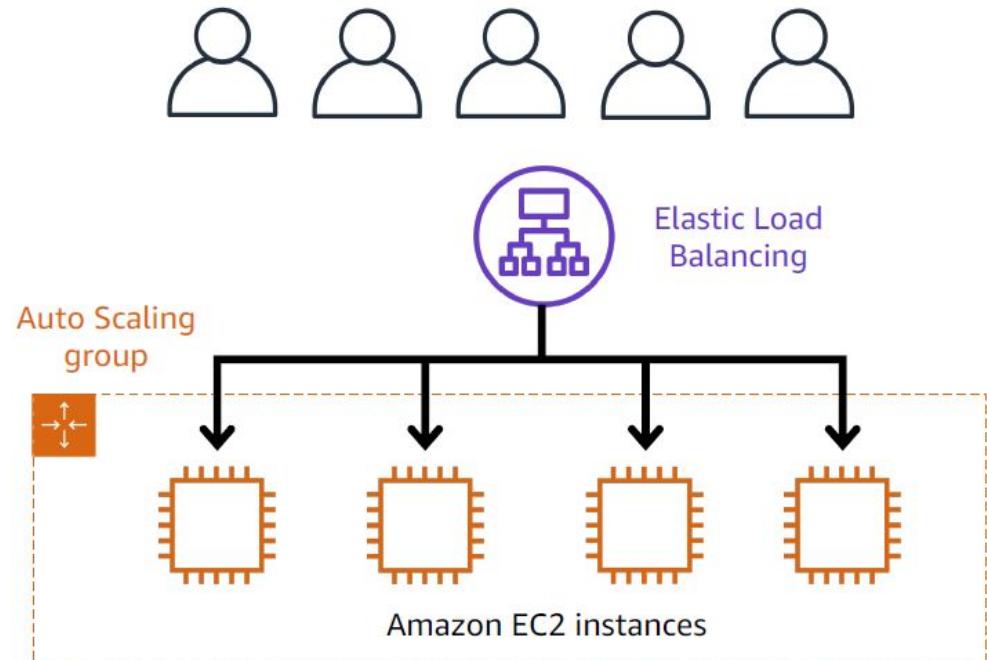
Elastic Load Balancing

# Scalability and load balancing

Low-demand period



High-demand period



# Hands-on Session



# 5 min break



# Be right back!

04

# Amazon Lambda

# AWS Lambda - Serverless Computing

- Run code without provisioning or managing servers
- Pay only for compute time while code is running
- Use other AWS services to automatically trigger code



AWS Lambda

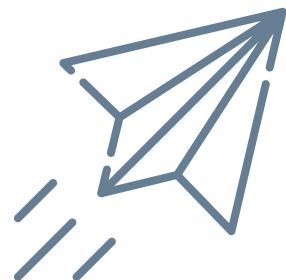
# AWS Lambda use cases

- Invoke a function in response to resource lifecycle events [Amazon S3]
- Respond to incoming HTTP requests [API Gateway]
- Consume events from a queue [Amazon SQS]
- Run a function on a schedule with [Amazon EventBridge (CloudWatch Events)]



AWS Lambda

# How AWS Lambda works



Upload code to Lambda



Set code to trigger from an event source



Code runs only when triggered



Pay only for the compute time you use

# Hands-on Session



05

# Global Infrastructure and Reliability

# Selecting a region



Compliance with  
data governance  
and legal  
requirements



Proximity to your customers

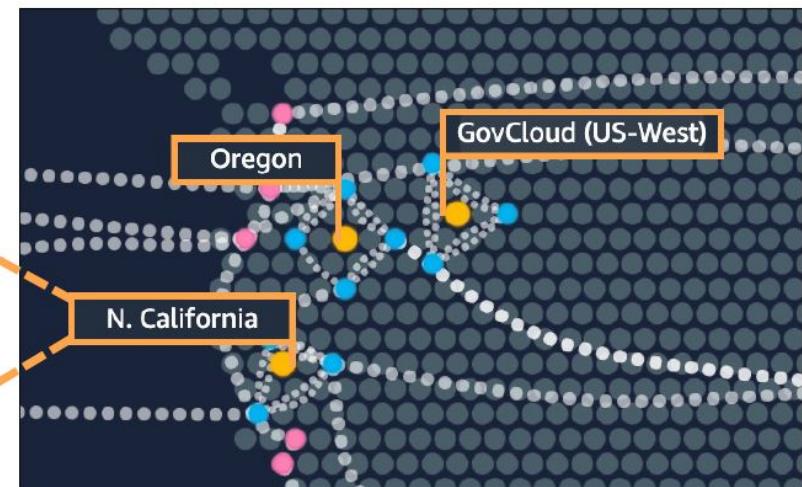
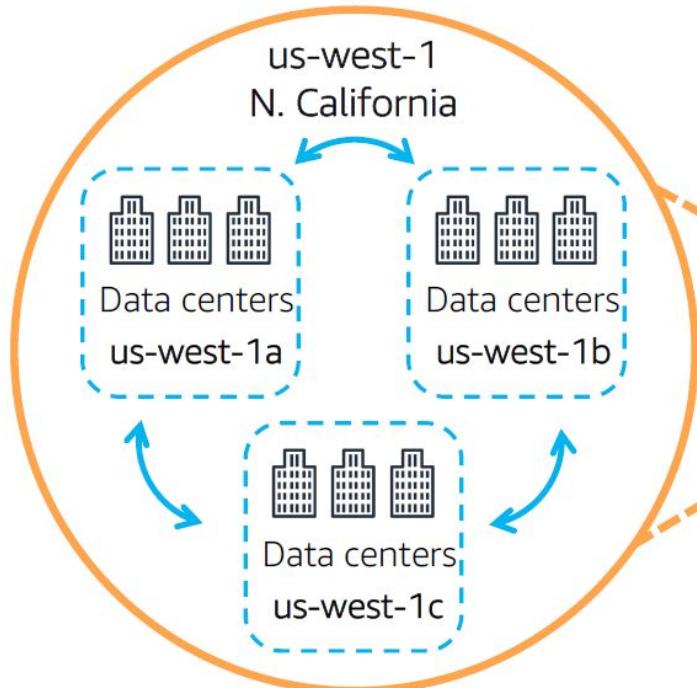


Available services within a  
region



Pricing

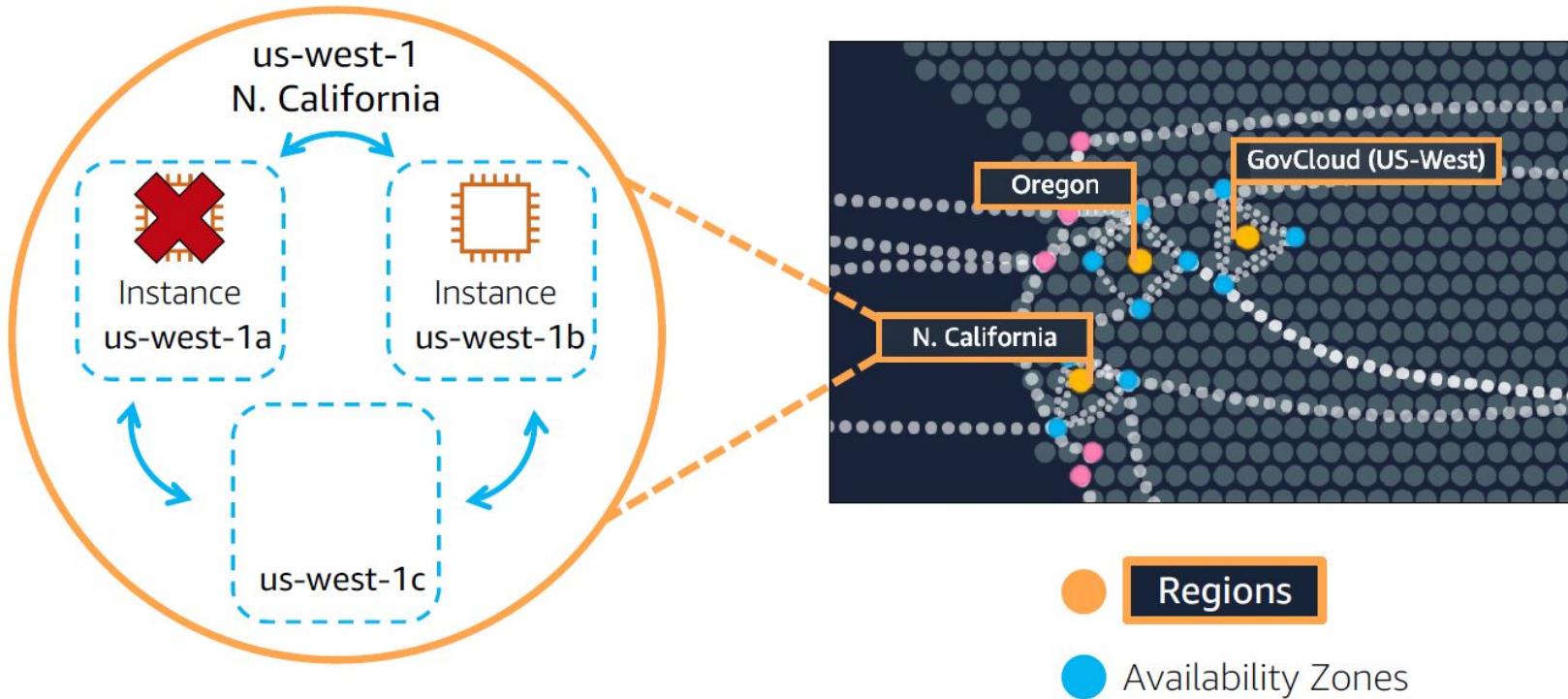
# Availability Zones



● Regions

● Availability Zones

# Amazon EC2 instances in multiple AZs



06

# Interact with AWS Services

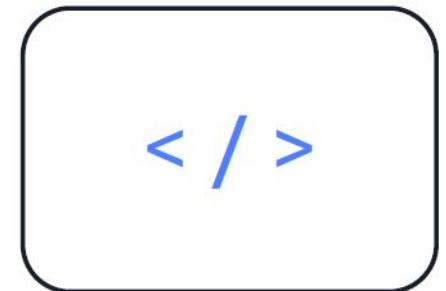
# Interact with AWS Services



AWS Management Console



AWS Command Line  
Interface (AWS CLI)



Software development kits  
(SDKs)

07

# Networking

# Amazon Virtual Private Cloud (VPC)

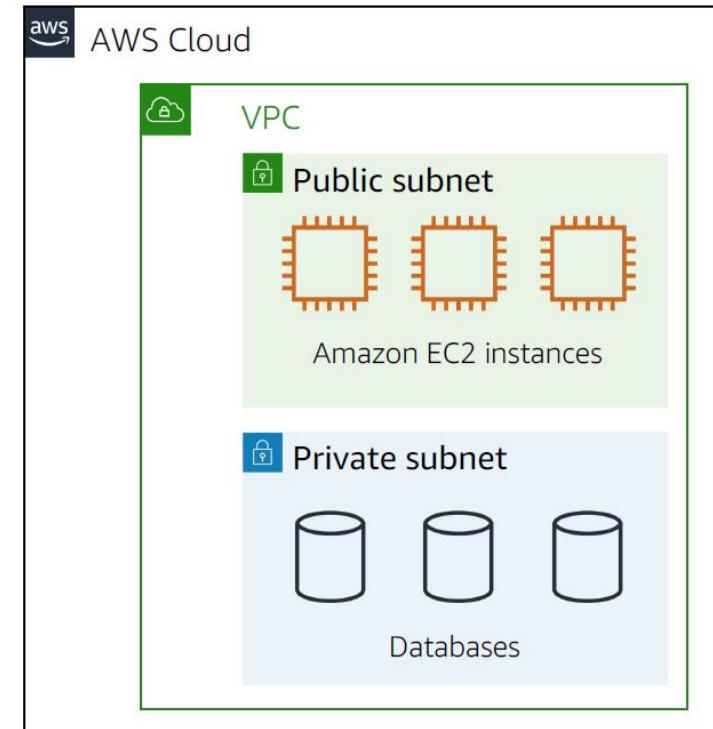
- Enables you to launch resources in a virtual network that you define
- Gives you full control over your virtual networking environment, including resource placement, connectivity, and security
- Define how your VPCs communicate with each other across accounts, Availability Zones, or AWS Regions



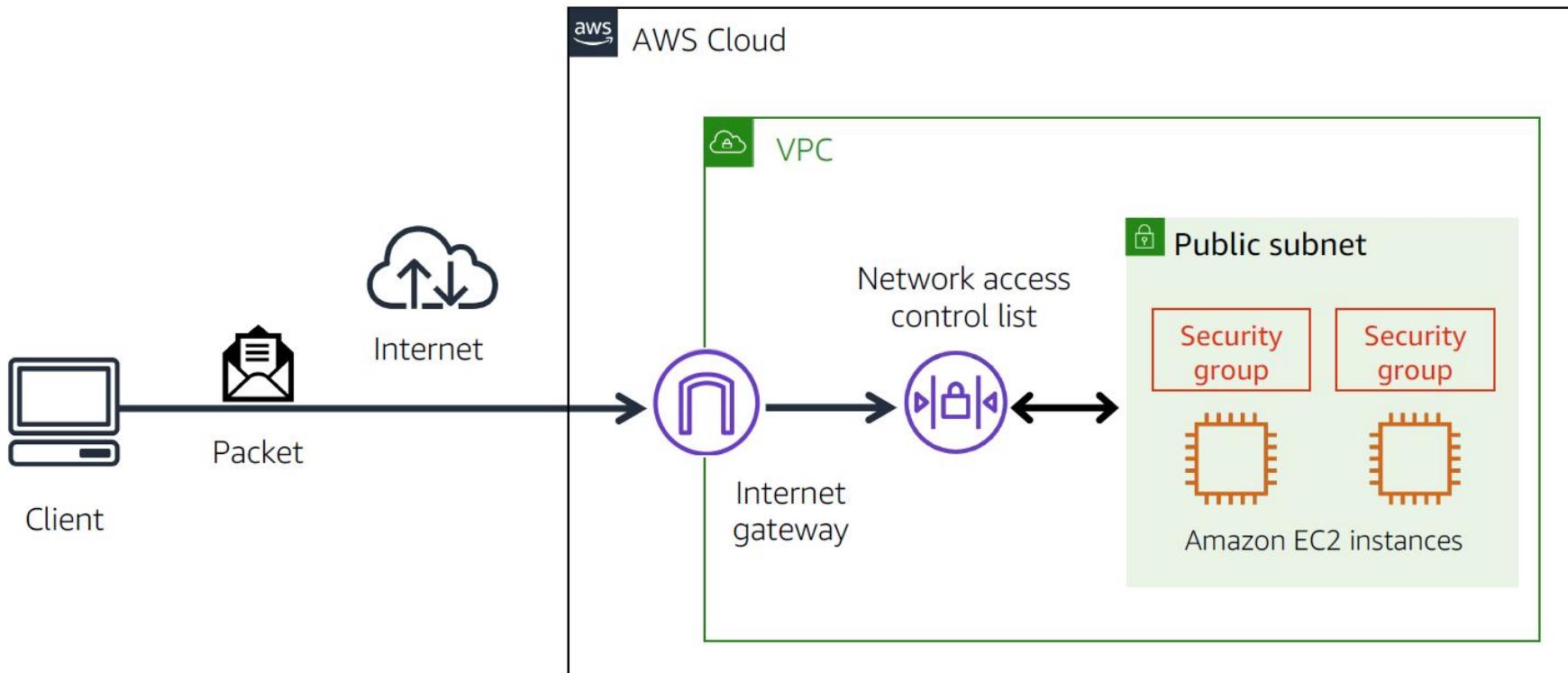
AWS VPC

# Subnets

- A subnet is a section in a VPC in which you can place isolated groups of resources
- It is a range of IP addresses in your VPC
- Each subnet must reside entirely within one Availability Zone and cannot span zones.
- Use a public subnet for resources that must be connected to the internet, and a private subnet for resources that won't be connected to the internet.



# Network traffic in a VPC



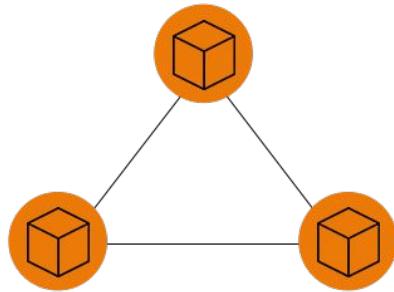
# Network Access Control Lists and Security Groups

Network Access Control Lists	Security Groups
<ul style="list-style-type: none"><li>Allows or denies specific inbound or outbound traffic at the subnet level</li><li>By default, it allows all inbound and outbound IPv4 traffic</li><li>By default, each custom network ACL denies all inbound and outbound traffic until you add rules.</li><li>Each subnet in your VPC must be associated with a network ACL</li><li>Stateless packet filtering</li></ul>	<ul style="list-style-type: none"><li>Controls the traffic that is allowed to reach and leave the resources that it is associated with</li><li>You can change the rules for a default security group but can't delete it</li><li>When you first create a security group, it has no inbound rules and it has an outbound rule that allows all outbound traffic</li><li>Stateful packet filtering</li></ul>

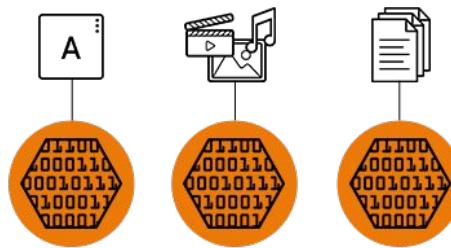
08

# Storage

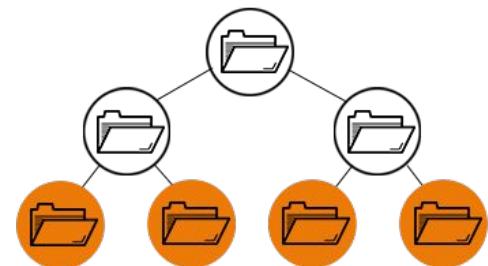
# AWS storage types



Block storage



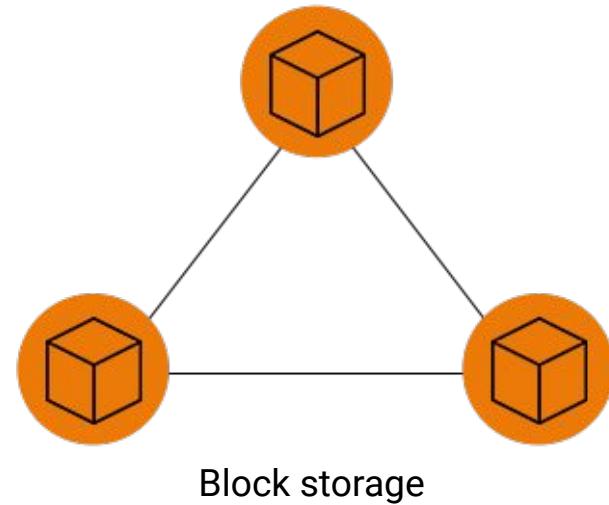
Object storage



File storage

# Block storage

- In block storage, files are separated into equal-sized pieces (blocks) of Data.
- Each block can be formatted with the file system required by the application.
- **Main advantage:** high performance and speed.
- **Applications:** mainly for file systems and databases
- Block storage is used for applications that run on Amazon EC2 instances.



# Instance store

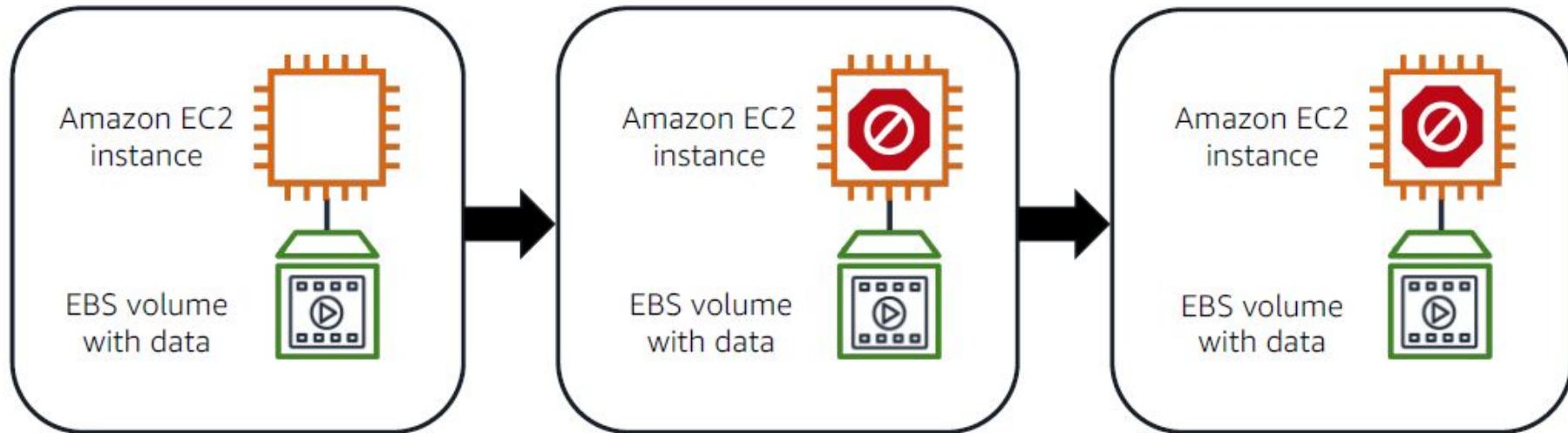


An Amazon EC2 instance with an attached instance store is running.

The instance is stopped or terminated.

All data on the attached instance store is deleted.

# Amazon EBS volumes



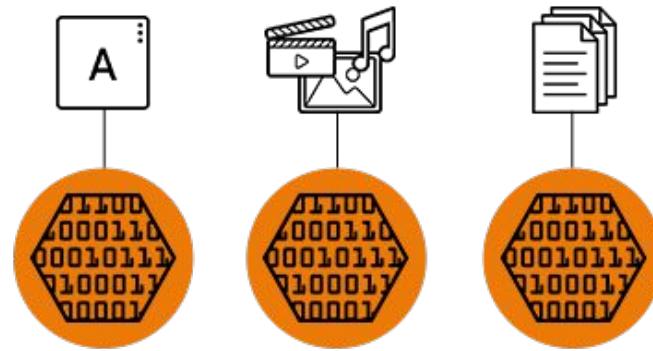
An Amazon EC2 instance with an attached EBS volume is running.

The instance is stopped or terminated. (If terminated, the EBS volume is removed by default.)

All data on the attached EBS volume remains available.

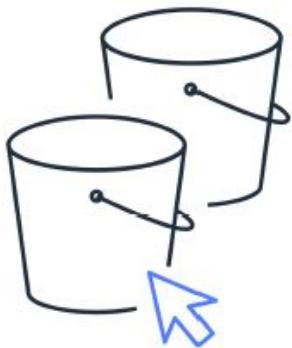
# Object storage

- Stores the files as a whole (object) and does not divide them
- In object storage, each object consists of **data, metadata and a key**
- Cannot edit only one part of the file, whole object has to be modified
- **Main advantage:** Cheap, highly available, highly durable, scalability
- **Applications:** mainly used to store the files like videos, music, pictures



Object storage

# Amazon Simple Storage Service (S3)



Store objects in buckets



Set permissions to control  
access to objects



Choose from a range of  
storage classes for  
different use cases

# Amazon s3 Storage Classes

## S3 Standard

- Designed for frequently accessed data
- Stores data in a minimum of three Availability Zones

## S3 Standard-IA

- Ideal for infrequently accessed data
- Similar to S3 Standard but has a lower storage price and higher retrieval price

## S3 One Zone-IA

- Stores data in a single Availability Zone
- Has a lower storage price than S3 Standard-IA

# Amazon s3 Storage Classes

## S3 Intelligent-Tiering

- Automatically moving data to the most cost-effective access tier based on access frequency
- Requires a small monthly monitoring and automation fee per object

## S3 Glacier

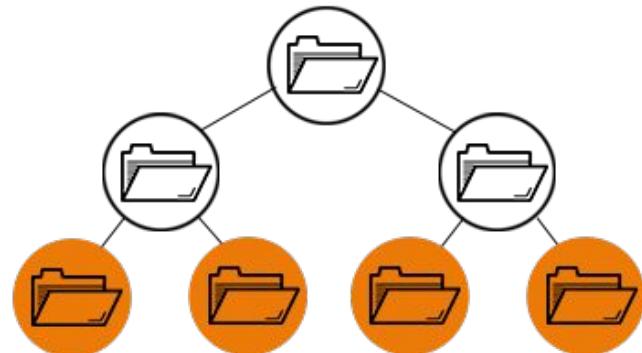
- Low-cost storage designed for data archiving
- Able to retrieve objects within a few minutes to hours

## S3 Glacier deep Archive

- Lowest-cost object storage class
- Able to retrieve objects within 12 hours

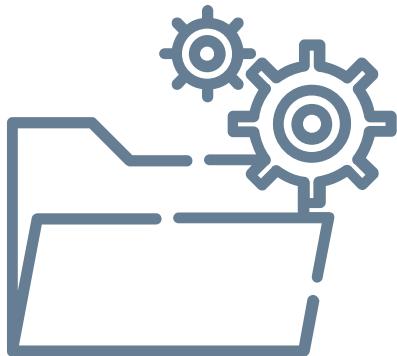
# File storage

- Data is stored in folders of hierarchical tree structure, and it can be retrieved through a path with reference to its metadata.
- Multiple clients can access data that is stored in shared file folders, which is useful for business applications

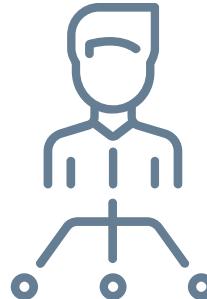


File storage

# Amazon Elastic File System



Store data in a  
scalable  
file system



Provide data to thousands  
of Amazon EC2 instances  
concurrently



Store data in and across  
multiple Availability  
Zones

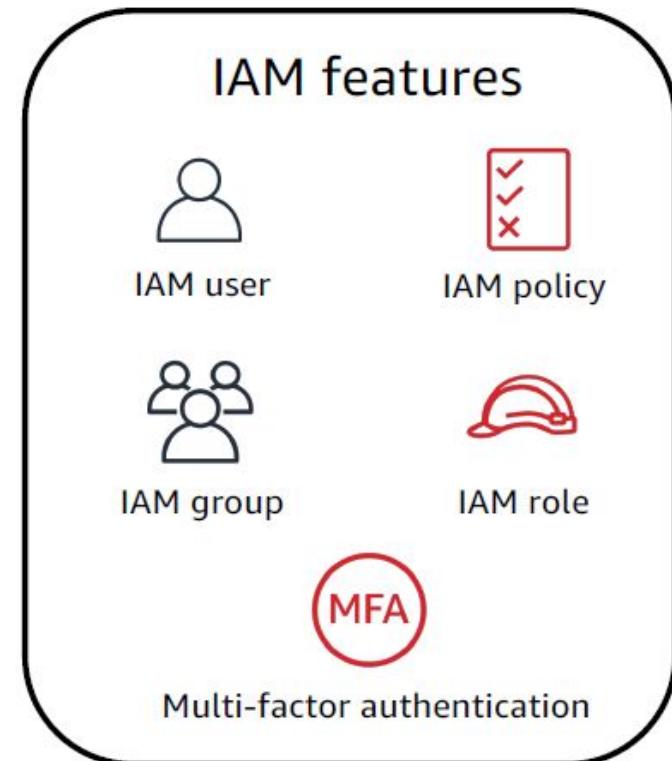
09

# AWS Identity and Access Management

# IAM



AWS Identity and Access Management (IAM) allows you to manage access to AWS services and resources.



# IAM user

An IAM user is an identity that represents a person or application that interacts with AWS services and resources.

Best practice: Create individual IAM users for each person who needs to access AWS.

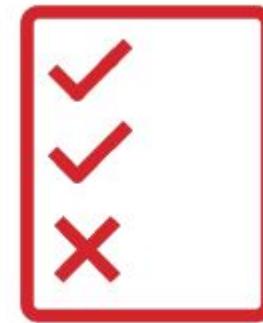


IAM user

# IAM policy

An IAM policy is a document that grants or denies permissions to AWS services and resources.

Best practice: Follow the security principle of least privilege.

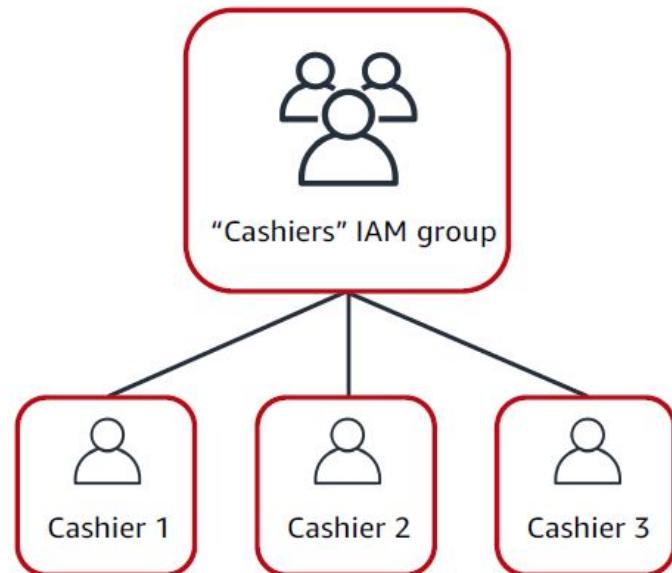


IAM policy

# IAM group

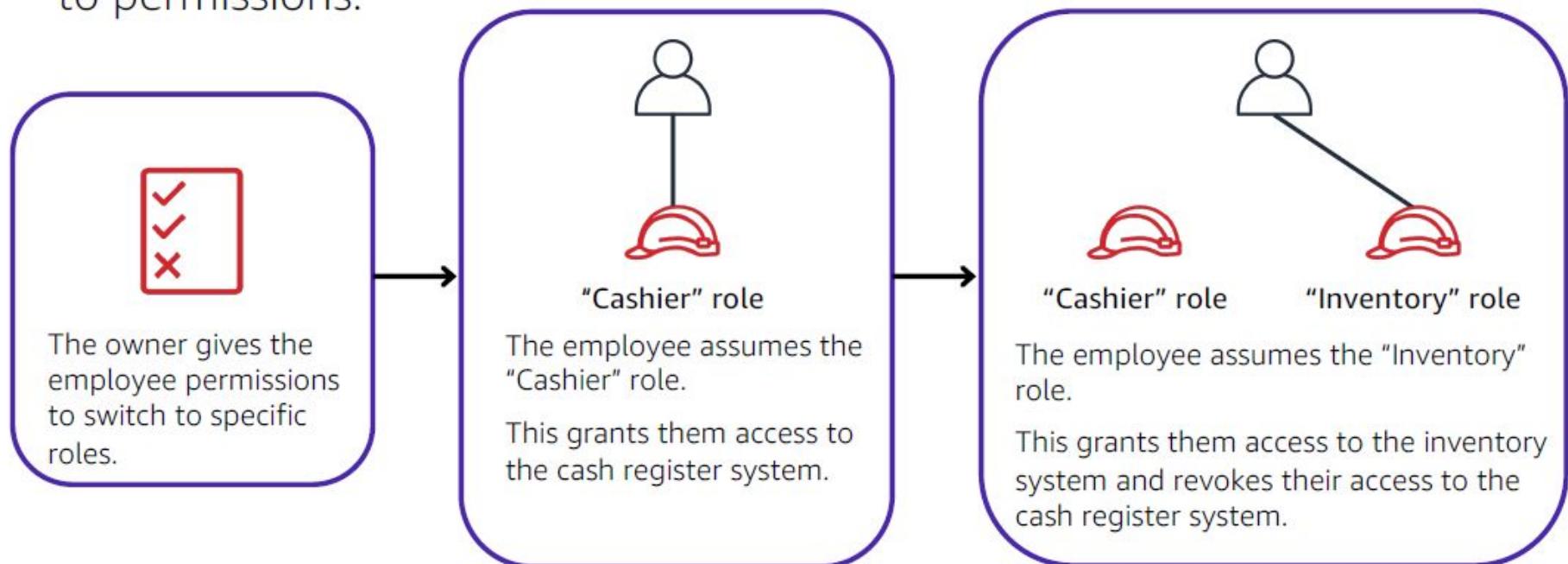
An IAM group is a collection of IAM users.

Best practice: Attach IAM policies to IAM groups, rather than to individual IAM users.  
Members inherit the policies assigned to the group.



# IAM role

An **IAM role** is an identity that you can assume to gain temporary access to permissions.



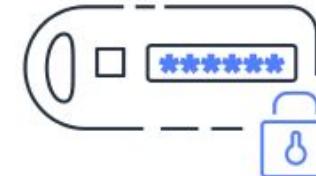
# Multi-factor authentication

Multi-factor authentication provides an extra layer of protection for your AWS account.

IAM user ID:

Password:

To sign in to an AWS website, a user enters their IAM user ID and password.



The user is prompted to provide an authentication response from their AWS MFA device.



The user is successfully authenticated and can access the requested AWS services or resources.

# THE END

Thanks for attending!

# Extra Resources

- [AWS Official Documentation](#)
- [AWS Training](#)
- [AWS Certification](#)

## Educational Icons



## Medical Icons



## Business Icons



## Teamwork Icons



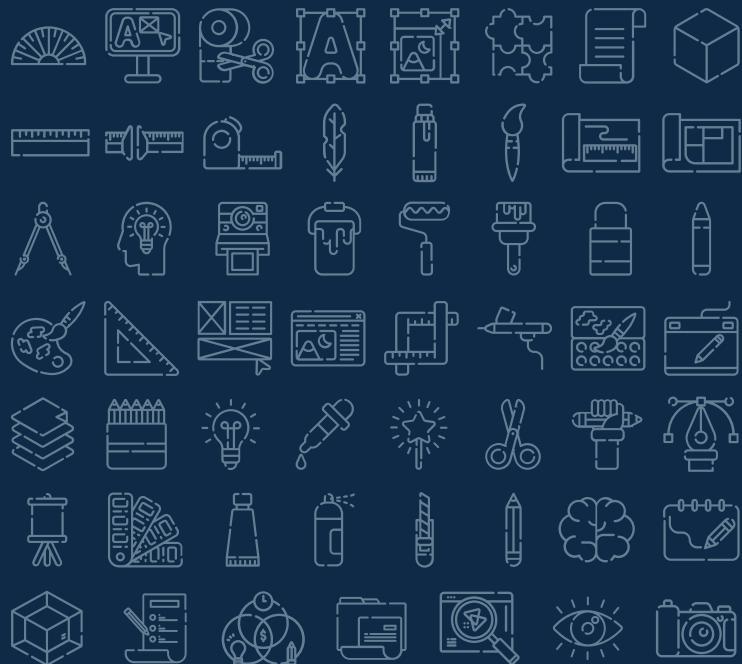
## Help & Support Icons



# Avatar Icons



## Creative Process Icons



## Performing Arts Icons



# Nature Icons



# SEO & Marketing Icons

