AWS Module 6 - Compute

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Lien de la note Hackmd

Section 1: Compute services overview

AWS compute services

- Amazon EC2:
  - resizable virtual machine
- Amazon EC2 auto-scaling:
  - define conditions to launch or terminate EC2 instances
- Amazon ECR:
  - store and retrieve Docker images
- Amazon ECS:
  - Container orchestration service that supports Docker
- VMWare Cloud on AWS:
  - hybrid cloud without custom hardware
- AWS Elastic Beanstalk:
  - run and manage web app
- AWS Lambda:
  - serverless compute solution
- Amazon EKS:
  - run managed kubernetes on AWS
- Amazon LightSail:
  - building app or website
- AWS Batch:
  - running batch job at any scale
- AWS Fargate:
  - run containers
- AWS Outpost:
  - run AWS services in your on-premises data center
- AWS Serverless Repository:

Categorizing compute services

Services	Key Concepts	Characteristics	Ease of Use
• Amazon EC2	• Infrastructure as a service (IaaS) • Instance-based • Virtual machines	• Provision virtual machines that you can manage as you choose	A familiar concept to many IT professionals.
• AWS Lambda	• Serverless computing • Function-based • Low-cost	• Write and deploy code that executes on a schedule or that can be triggered by events • Use when possible (architect for the cloud)	A relatively new concept for many IT staff members, but easy to use after you learn how.
• Amazon ECS • Amazon EKS • AWS Fargate • Amazon ECR	• Container-based computing • Instance-based	• Spin up and execute jobs more quickly	AWS Fargate reduces administrative overhead, but you can use options that give you more control.
• AWS Elastic Beanstalk	• Platform as a service (PaaS) • For web applications	• Focus on your code (building your application) • Can easily tie into other services—databases, Domain Name System (DNS), etc.	Fast and easy to get started.

Choosing the optimal compute service

- The optimal compute service or services that you use will depend on your use case
- Some aspects to consider
  - What is your application design ?
  - What are your usage pattern ?
  - Which configuration settings wll you want to manage ?
- Selecting the wrong compute solution for an architecture can lead to lower performance efficiency
  - A good starting place: understand the available compute options

Section 2: Amazon EC2

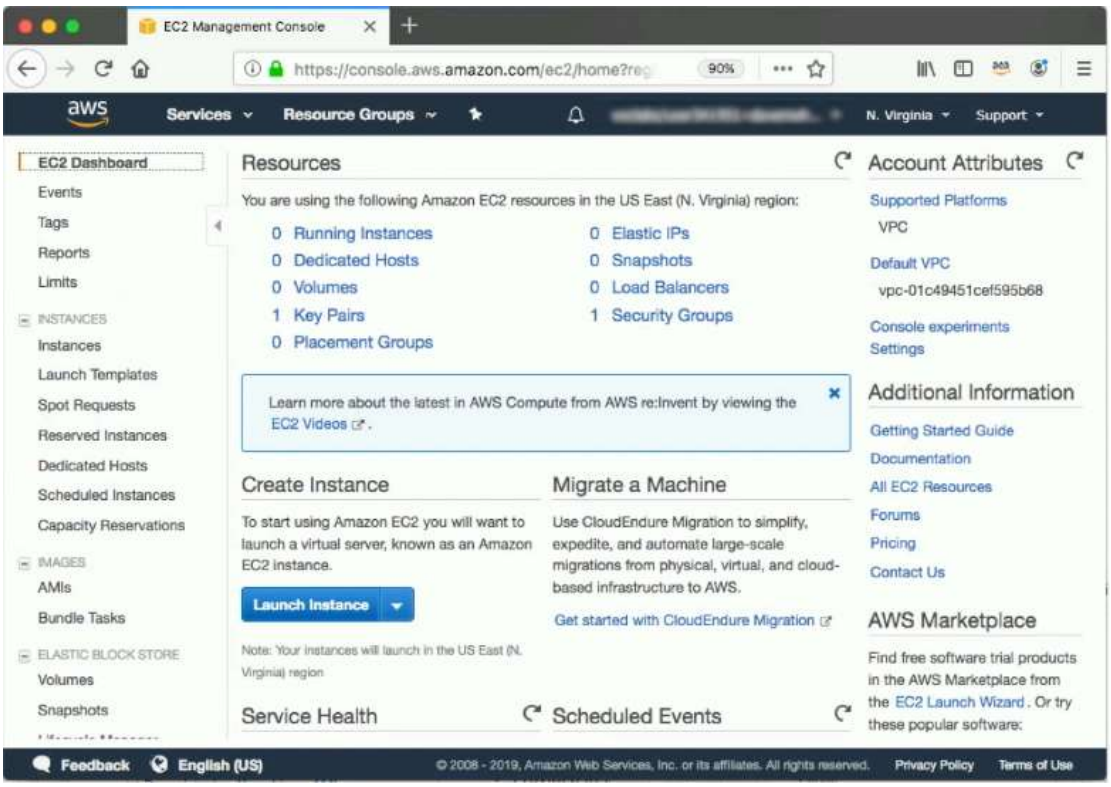
Amazon Elastic Compute Cloud (Amazon EC2)

Example uses of Amazon EC2 instances:

- App server
- web server
- Database server
- Game server
- Mail server
- Media server
- Catalog server
- File server
- Computing server
- Proxy server

- Amazon Elastic Compute Cloud (Amazon EC2)
  - Provides *virtual machines* (EC2 instance) in the cloud
  - Fives you *full control* over the guest operating system (Windows or Linux) on each instance
- You can launch instances of any size into and Availability Zone anywhere in the world
  - Launch instance from **Amazon Machine Images (AMIs)**
  - Launch instances with a few clicks or a line of code, and they are ready in minutes
- You can control traffic to and from instances

Launching an amazon EC2 instance

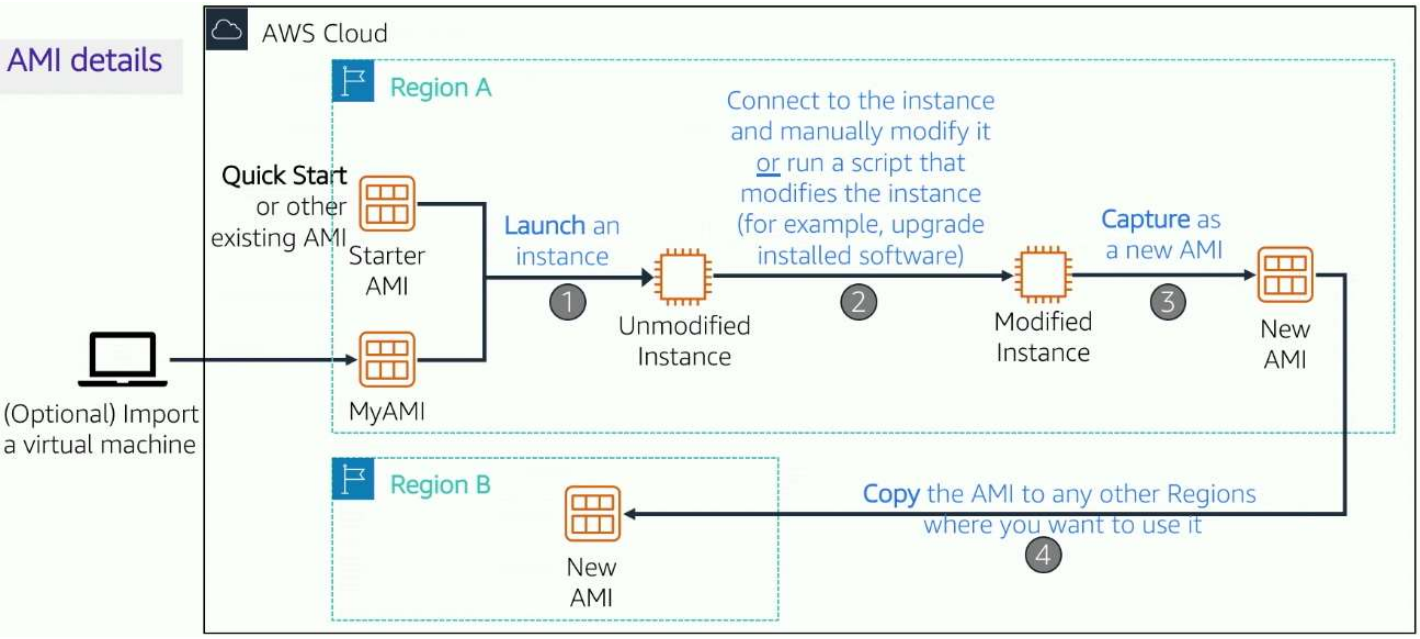


Nine key decisions when creating a EC2 instance.

1. Select an AMI

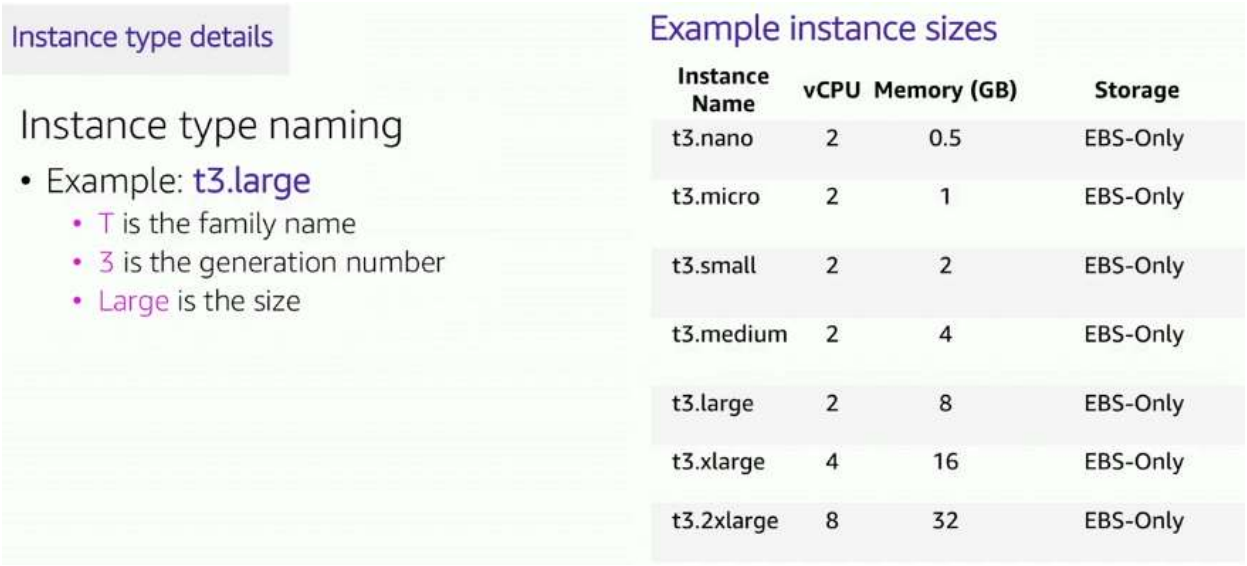
- Amazon Machine Image (AMI)
  - Is a template that is used to create an EC2 instance
  - Contains a *Windows* or *Linux* OS
  - Often has some software pre-installed
- AMI choices:
  - Quick Start
    - Linux and Windows AMIs provided by AWS
  - My AMIs
    - Any AMIs that you created

        - Pre-configured templates from third parties
    - Community AMIs
        - AMIs shared by others; use at you own risk

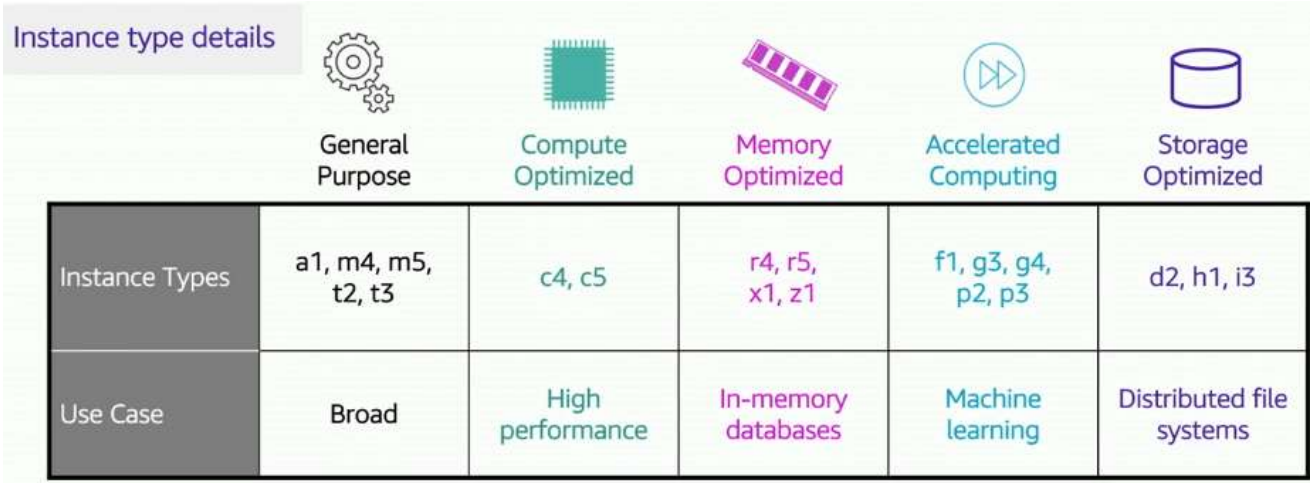


2. Select an instance type

- Consider you use case
    - How will the EC2 instance you create be used ?
- The **instance type** that you choose determines
    - Memory (RAM)
    - Processing power (CPU)
    - Disk space and disk type (Storage)
    - Network performance
- Instance type categories
    - General purpose
    - Compute optimized
    - Memory optimized
    - Storage optimized
    - Accelerated computed
- Instance types offer *family, generation* and *size*



Based on use case



Networking features

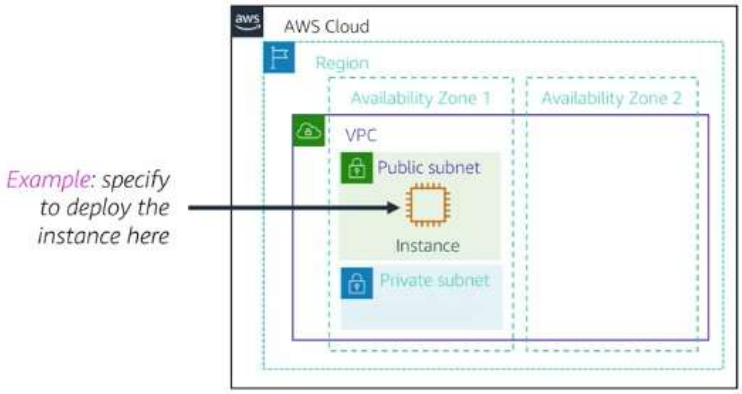
- The network bandwith (GBps) varies by instance type
- To maximize networking and bandwith performance of your instance type
  - If you have interdependent instances, launch them into a *cluster placement group*
  - Enable enhanced networking
- Enhanced networking types are supported on most instance types
- Enhanced networking types
  - Elastic Network Adapter (ENA): Supports network speeds of up to 100 Gpbds
  - Intel 82599 Virtual Function interface: Supports network speeds of up to 10 Gbps

Section 3: Amazon EC2 Part 2

3. Specify network settings

- Where should the instance be deployed ?

- Should a *public IP address* be automatically assigned ?
  - To make it internet-accessible

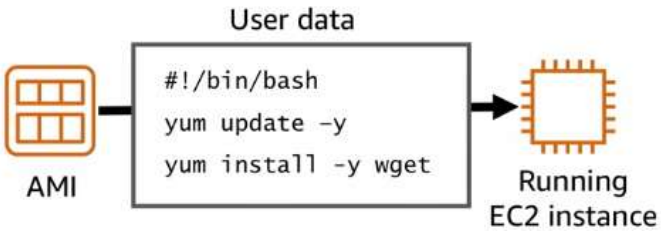


4. Attach IAM role (optional)

- Will software on the EC2 insrance need to interact with other AWS services ?
  - If yes, attach an appropriate IAM Role
- An AWS Identity and Access Management (IAM) role that is attache to an EC2 instance is kept in an **instance profile**
- You are *not* restricted to attaching a role only at instance launch
  - You can also attach a role to an instance that already exists

5. User data script (optional)

- Optionally specify a user data script at instance launch
- Use **user data** scripts to customize the runtime environment of your instance
  - Script executes the first time the instance starts
- Can be used strategically
  - Reduce the number of custom AMIs that you build and maintain



6. Specify storage

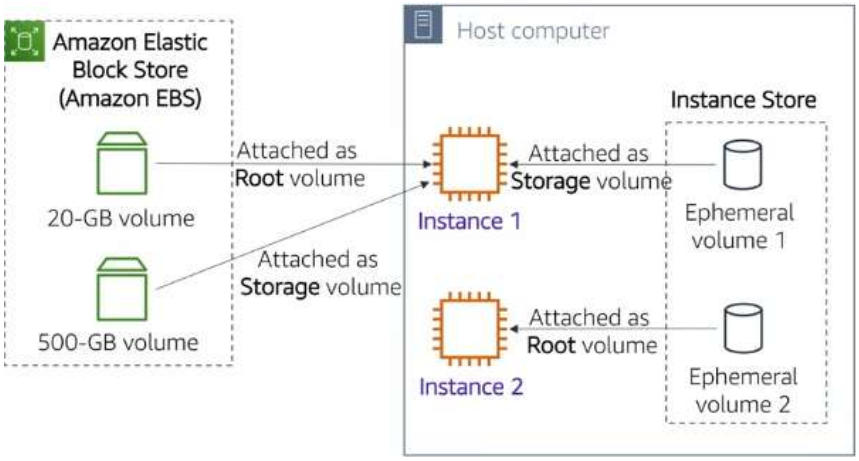
- Configure the *root volume*
  - Where the guest operating system is installed
- Attach *additional storage volumes* (optional)
  - AMI might already include more than one volume
- For each volume, specify:
  - The *size* of the disk (in GB)

        - Different types of SSDs and HDDs are available
    - If the volume will be deleted when the instance is terminated
    - If *encryption* should be used

Amazon EC2 storage options

- **Amazon Elastic Block Store (Amazon EBS)**
    - *Durable*, block-level storage volumes
    - You can stop the instance and start it again, and the data will still be there
- **Amazon Elastic Block Store**
    - Storage is provided on disls that are attached to the host computer where the EC2 instance is running
    - *If the instance stops, data stored here is deleted*
- Other options for storage (not for root volume)
    - Mount an **Amazon Elastic File System (Amazon EFS)** file system
    - Connect to **Amazon Simple Storage Service (Amazon S3)**

Example storage options



- **Instance 1** characteristics
    - It has an **Amazon EBS** *root volume* type for the operating system
    - What will happen if the instance is stopped and then started again ?
        - The OS volume would survive
        - Any data stored on Amazon EBS would remain intact
        - Any data stored in ephemeral volume 1 would be lost
- **Instance 2** characteristics
    - It has an **Instance Store** *root volume* type for the operating system
    - What will happen if the instance stops (because of user error or a system malfunction)?
        - All data stored in ephemeral volume 2 would be lost, including the OS

Section 4: Amazon EC2 Part 3

A **tag** is a label that you can assign to an AWS resource

- Consists of a *key* and an optional *value*

- Tagging is how you can attach **metadata** to an EC2 instance
- Potential benefits from tagging - Filtering, automation, cost allocation and access control

8. Security group settings

A **security group** is a *set of firewall rules* that control traffic to the instance.

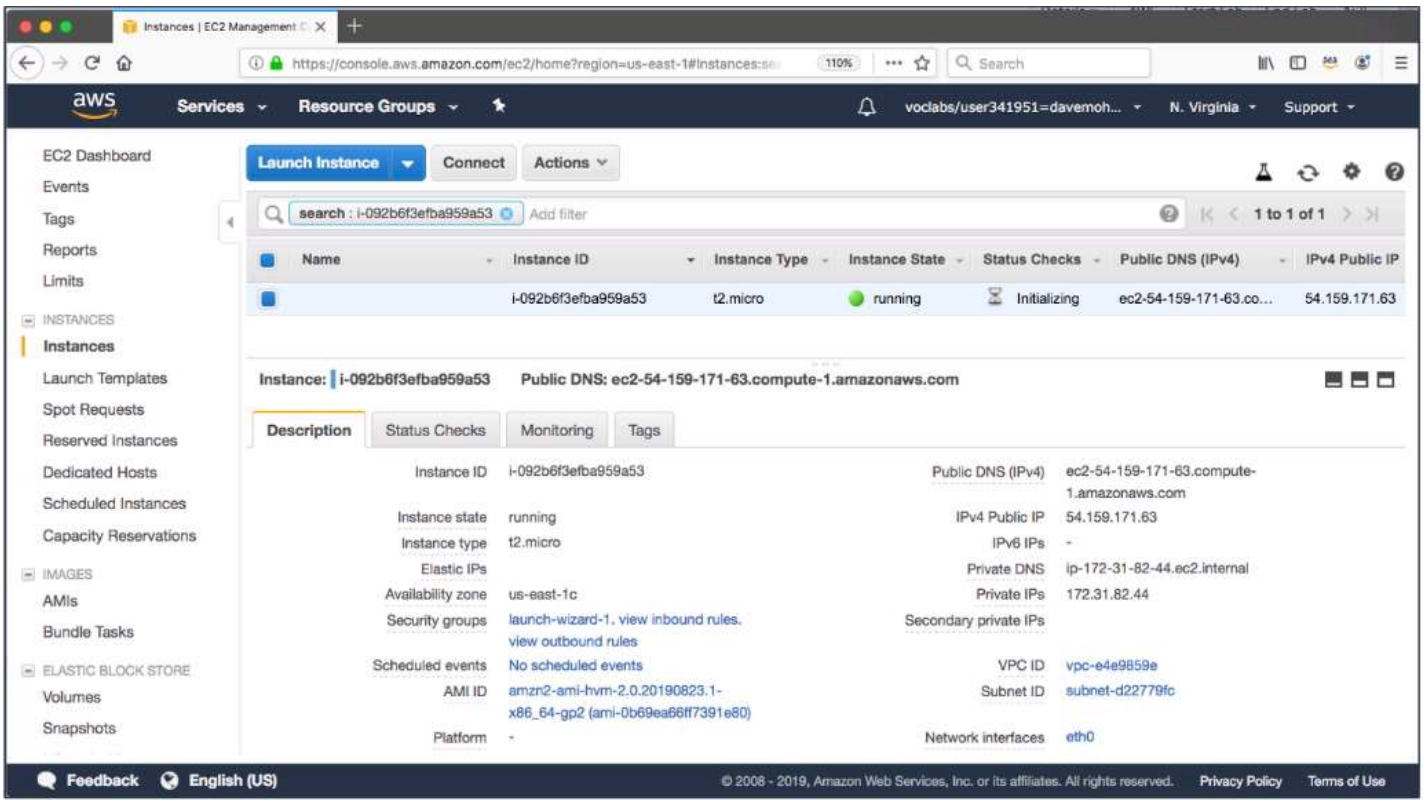
- It exsists *outside* of the instance's guest OS

Create **rules** that specify the **source** and which **ports** that network communications can use.

- Specify the **port** number and the **protocol**, such as TCP, UDP or ICMP
- Specify the **source** that is allowed to use the rule

9. Identify the key pair

- At instance launch, you specify an existing key pair *or* create a new key pair
- A **key pair** consists of
  - A *public key* that AWS stores
  - A *private key* file that you store
- It enables secure connections to the instance
- For **Windows AMIs**
  - Use the private key to obtain the administrator password that you need to log in to your instance
- For **Linux AMIs**
  - Use the private key to use SSH to securely connect to your instance



Another option: Launch an EC2 instance with the AWS CLI

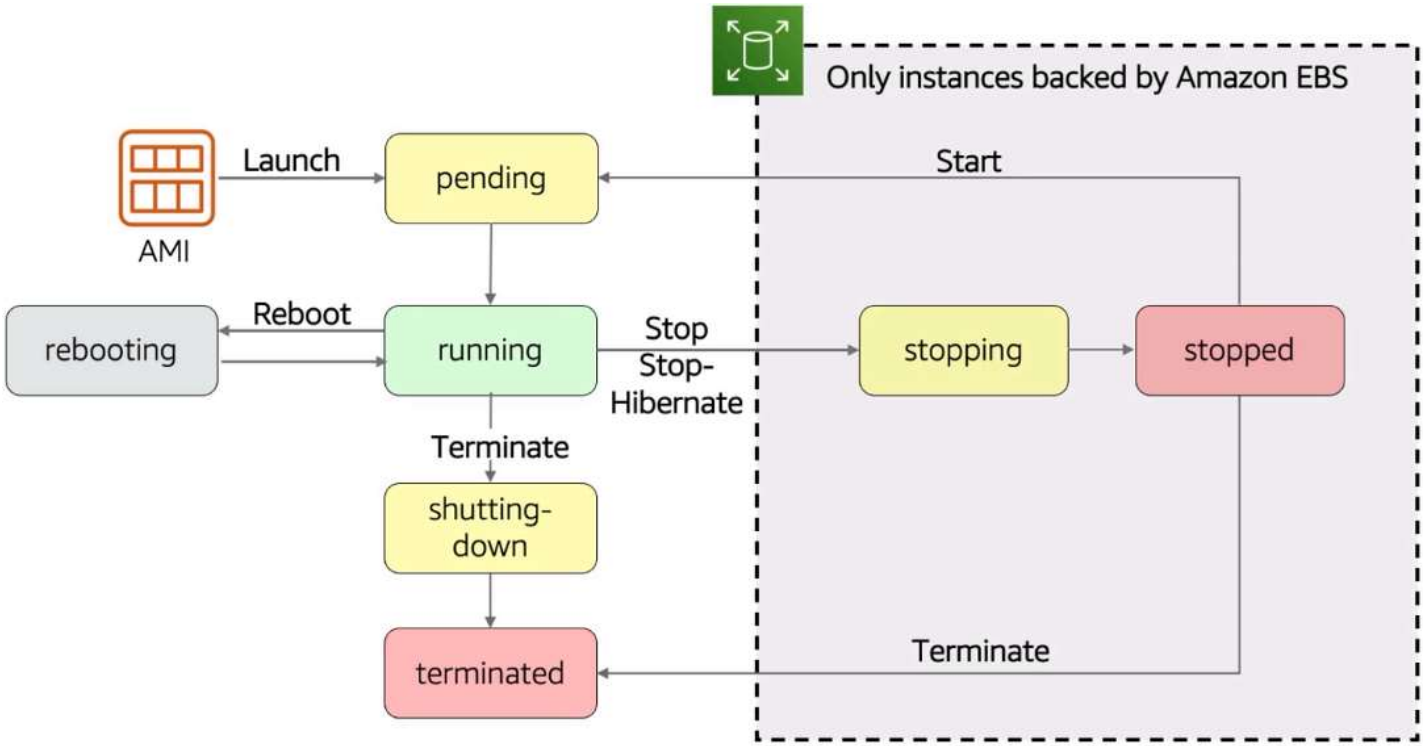
- EC2 instances can also be created programmatically

Shell

```
aws ec2 run-instances --image0id ami-1a2b3c4d --count 1 --instance-type c3.large \
--key-name MyKeyPair --security-groups MySecurityGroup --region us-east-1
```

This example shows how simple the command can be.

- This command assumes that the key pair and security group already exists
- More option could be specified



Consider using an Elastic IP address

- **Rebooting** an instanc will *not* change any IP addresses or DNS hostnames
- When an instance will *not* change any IP addresses or DNS hostnames
- When an instance is **stopped** and then **started** again
  - The *public* IPv4 address and *external* DNS hostname will change
  - The *private* IPv4 address and internal DNS hostname do *not* change
- If you require a persistent public IP address
  - Associate an *Elastic IP address* with the instance
- Elastic IP address characteristics
  - Can be associated with instances in the Region as needed
  - Remains allocated to your account until you choose to release it

EC2 instance metadata

> It is data about your instance

- While you are connected to the instance, you can view it
  - In a browser: `http://169.254.169.254/latest/meta-data/`
  - In a terminal window: `curl http://169.254.169.254/latest/meta-data/`
- Example retrievable values
  - Public IP address, private IP address, public hostname, instance ID, security groups, Region, Availability zone
  - Any user data specified at instance launch can also be accesse at: `http://169.254.169.254/latest/user-data/`
- It can be used to configure or manage a running instance

Amazon CloudWatch for monitoring

- Use **Amazon CloudWatch** to monitor EC2 instances
  - Provides near-real-time metrics
  - Provides charts in the Amazon EC2 console **Monitoring** tab
  - Maintains 15 months of historical data
- **Basic monitoring**
  - Default, no additional cost
  - Metric data sent to CloudWatch every 5 minutes
- **Detailed monitoring**
  - Fixed monthly rate for seven pre-selected metrics
  - Metric data delivered every 1 min

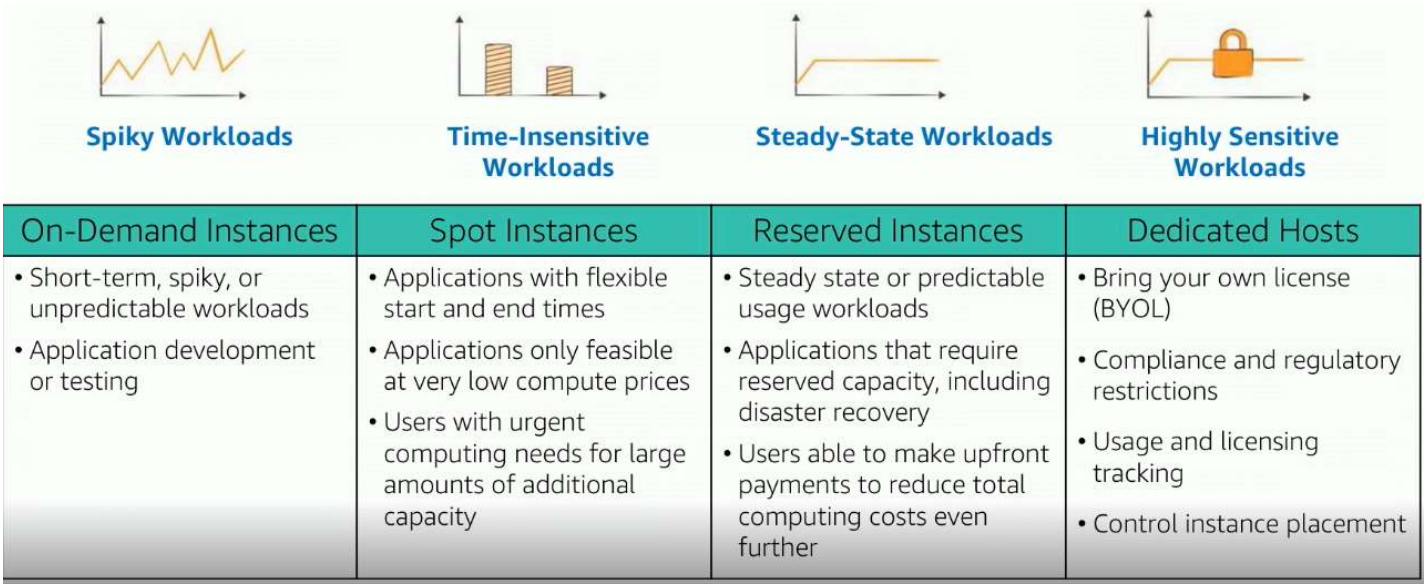
Section 5: Amazon EC2 Cost Optimization

Amazon EC2 pricing models

- **On-Demand Instances**
  - Pay by the hour
  - No long-term commitments
  - Elligible for the AWS Free Tier
- **Dedicated Hosts**
  - A physical server with EC2 instance capacity fully dedicated to your use
- **Dedicated instances**
  - Instances that run in a VPC on a hardware that is dedicated to a single customer
- **Reserverd Instances**
  - Full, partial, or no upfront payment for instance you reserve
  - Discount on hourly charge for that instance
  - 1-year or 3-year term
- **Scheduled Reserverd Instances**
  - Purchase a capacity reservation that is always available on a recurring schedule you specify
  - 1-year term
- **Spot Instances**
  - Instances run as long as they are available and your bid is above the Spot Instance price
  - They can be interrupted by AWS with a 2-minute notification
  - Interruption options include terminated, stopped or hibernated
  - Prices can be significantly less expensive compared to On-Demand Instances
  - Good choice when you have flexibility in when your applications can run

On-Demand Instances	Spot Instances	Reserved Instances	Dedicated
Low cost and flexibility	Large scale, dynamic workload	Predictability ensures compute capacity is available when needed	Save mone

Use cases



On-Demand Instances	Spot Instances	Reserved Instances	Dedicated Hosts
• Short-term, spiky, or unpredictable workloads • Application development or testing	• Applications with flexible start and end times • Applications only feasible at very low compute prices • Users with urgent computing needs for large amounts of additional capacity	• Steady state or predictable usage workloads • Applications that require reserved capacity, including disaster recovery • Users able to make upfront payments to reduce total computing costs even further	• Bring your own license (BYOL) • Compliance and regulatory restrictions • Usage and licensing tracking • Control instance placement

The 4 pillars of cost optimization

Pillar 1: Right size

- Provision instances to match the need
  - CPU, memory, storage and network throughput
  - Selct appropriate *instance types* for your use
- Use Amazon CloudWatch metrics
  - How idle are instances? When

- Best practice: right size, then reserve

Pillar 2: Increase elasticity

- **Stop** or **hibernate** amazon EBS-backed instances that are not actively in use
  - Example: non-production development or test instances
- Use **automatic scaling** to match needs base on usage
  - Automated and time-based elasticity

Pillar 3: Optimal pricing model

- Leverage the right pricing model for your use case
  - Consider your usage patterns
- Optimize and *combine* purchase types
- Examples:
  - Use *On-Demand Instance* and *Spot Instances* for variable workloads
  - Use *Reserved Instances* for predictable workloads
- Consider serverless solutions (AWS Lambda)

Pillar 4: Optimize storage choices

- Reduce cost while maintaining storage performance and availability
- Resixe EBS volumes
- Changes EBS volumes types
  - Can you meet performance requirements with less expensive storage ?
  - Example: *Amazon EBS Throughput Optimized HDD (st1)* storage typically costs half as much as the default *General Purpose SSD (gp2)* storage option
- Delete EBS snapshots that are no longer needed
- Identify the most appropriate destination for specific types of data
  - Does the app need the instance to reside on Amazon EBS ?
  - Amazon S3 storage options with lifecycle policies can reduce costs

Measure, monitor and improve

- Cost optimization is an ongoing process
- Recommendations
  - Define and enforce *cost allocation tagging*
  - Define metrics, set targets, and review regularly
  - Encourage teams to *architect for cost*
  - Assign the responsibility of optimization to an individual or to a team

Section 6: Container services

> **Containers** are a method of *operating system virtualization*

Benefits:

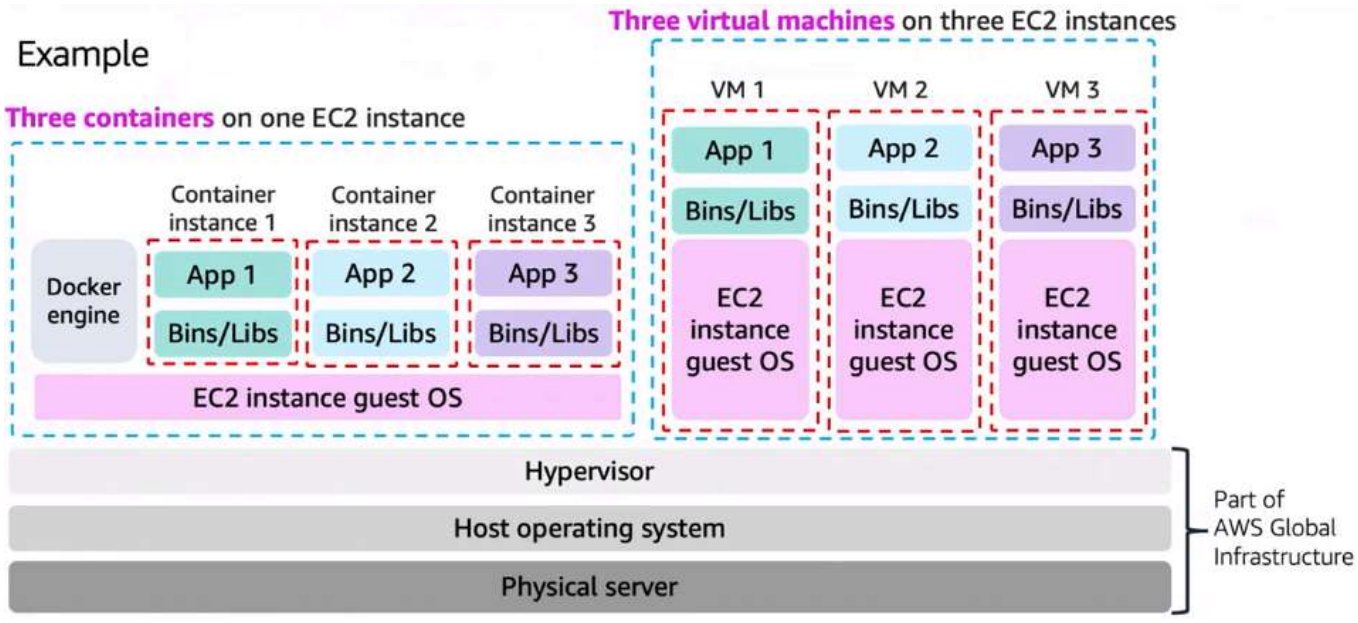
- Repeatable
- Self-contained environments
- Software runs the same in different environments
  - Developer's laptop, test, prod
- Faster to launch and stop or terminate than virtual machines

What is Docker ?

> **Docker** is a software platform that enables you to build, test, and deploy app quickly.

- You run containers on Docker
  - Containers are created from a template called an *image*
- A **container** has everything a software app needs to run

Containers vs VMs



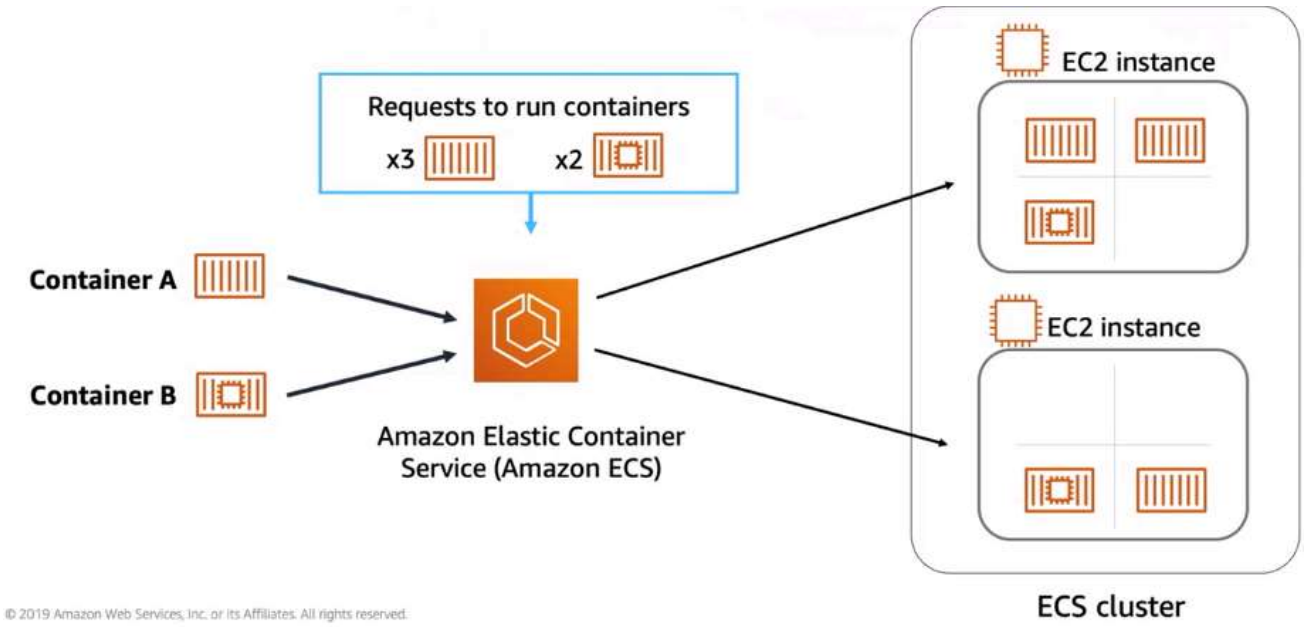
Amazon Elastic Container Service (Amazon ECS)

> A highly scalable, fast, **container management service**.

- Key benefit
  - Ocherstartes the running of Docker containers

- Removes the complexity of standing up the infrastructure
- Integrated with features that are familiar to Amazon EC2 service users
  - Elastic Load Balancing
  - Amazon EC2 security groups
  - Amazon EBS volumes
  - IAM roles

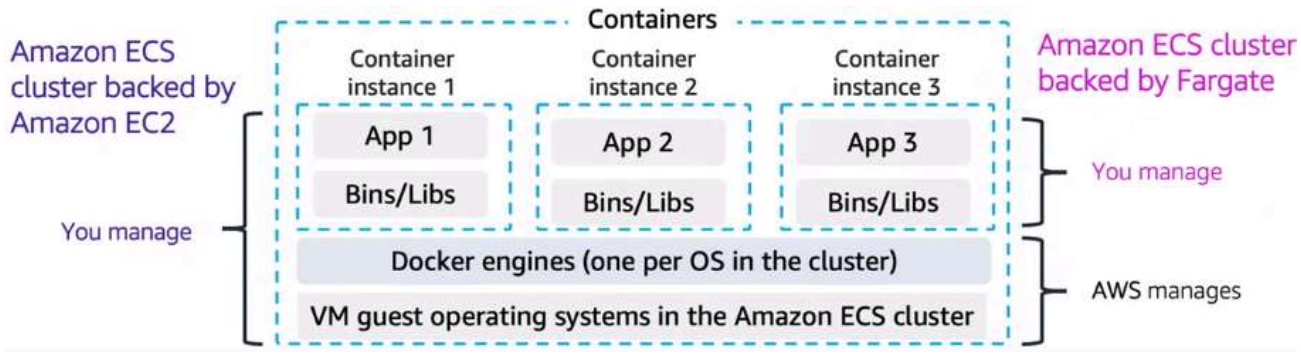
Amazon ECS orchestrates containers



Amazon ECS cluster options

Do you want to manage the Amazon ECS cluster that runs the containers ?

- Yes: create an **Amazon ECS cluster backed by Amazon EC2**
  - Provides more granular control over infrastructure
- No: create an **Amazon ECS cluster back by AWS Fargate**
  - Easier to maintain, focus on your app



What is Kubernetes ?

- Kubernetes is open source software for containers orchestration

- The same toolset can be used on premises and in the cloud
- Complements Docker
  - Docker enables you to run mutliple containers on a single OS host
  - Kubernetes **orchestrates** mutliple Docker hosts (nodes)
- Automates
  - Container provisioning
  - Networking
  - Load distribution
  - Scaling

Amazon Elastic Kubernetes Service (Amazon EKS)

- EKS
  - Enables you to run Kubernetes on AWS
  - Certified Kubernetes conformant
  - Supports Linux and Windows containers
  - Compatible with Kubernetes community tools and add-ons
- Use Amazon EKS to
  - Manage clusters of Amazon EC2 instances
  - Run containers that ar ochestrated by Kubernetes on those instances

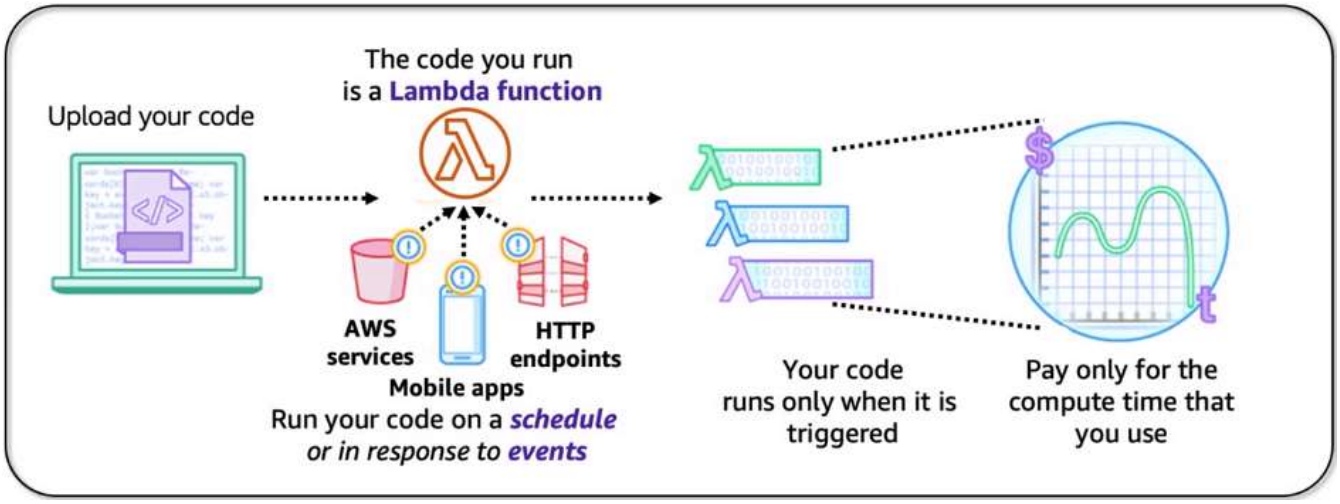
Amazon Elastic Container Registry (Amazon ECR)

> **Amazon ECR** is a fully managed Docker *container registry* that makes it easy for developpers to store, manage and deploy Docker container images.

- Supports
  - Team collab
  - Acces control
  - Third party integration
- Possible to use with Amazon EKS

Section 7: Introduction to AWS Lambda

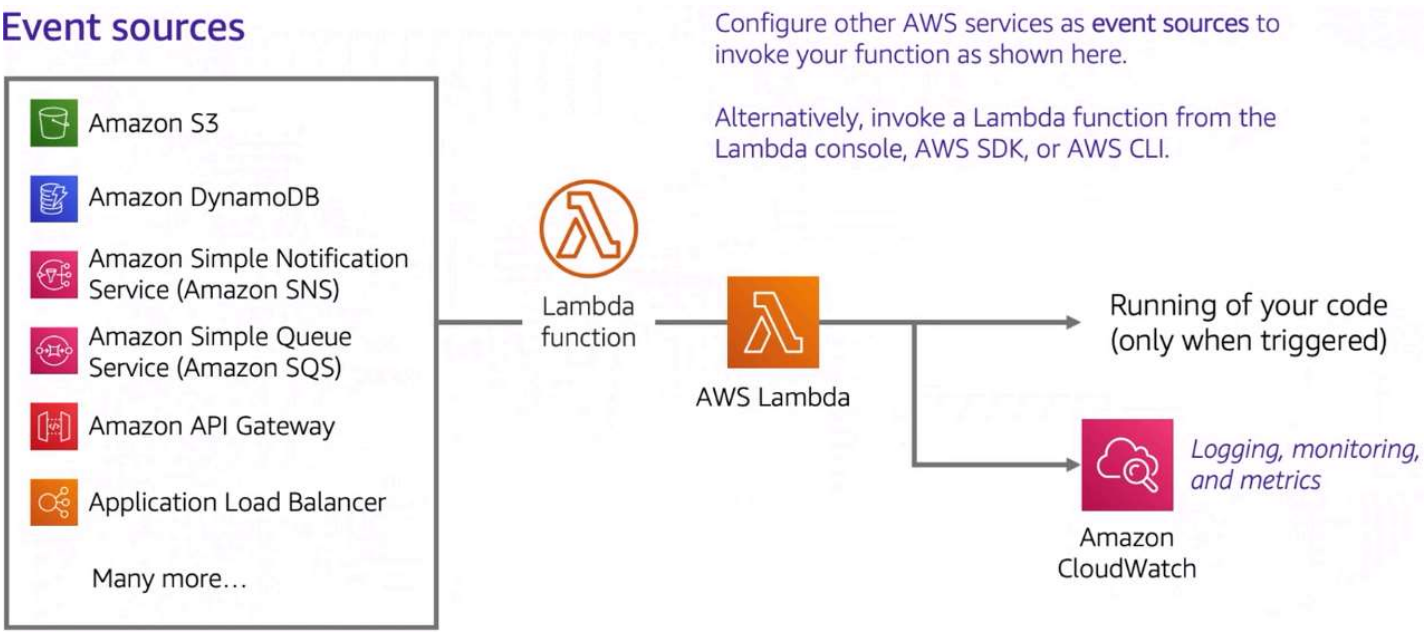
AWS Lambda is a **serverless** compute service.



Benefits of Lambda

- Supports multiple programming languages
- Completely automated administration
- Built-in fault tolerance
- Supports orchestration of multiple functions
- Pay-per-use pricing

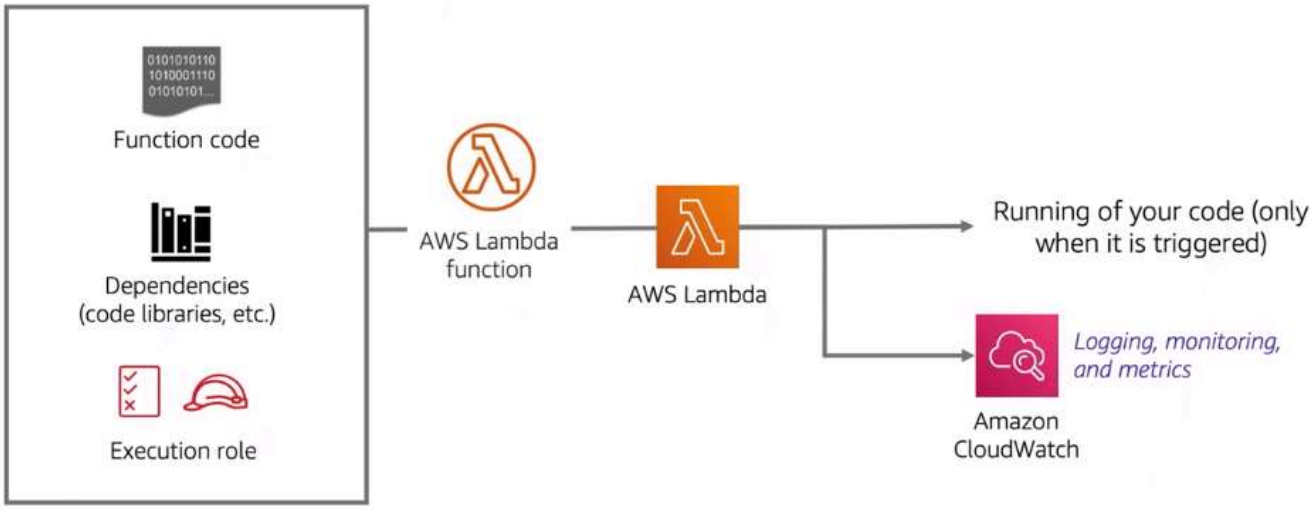
AWS Lambda event sources



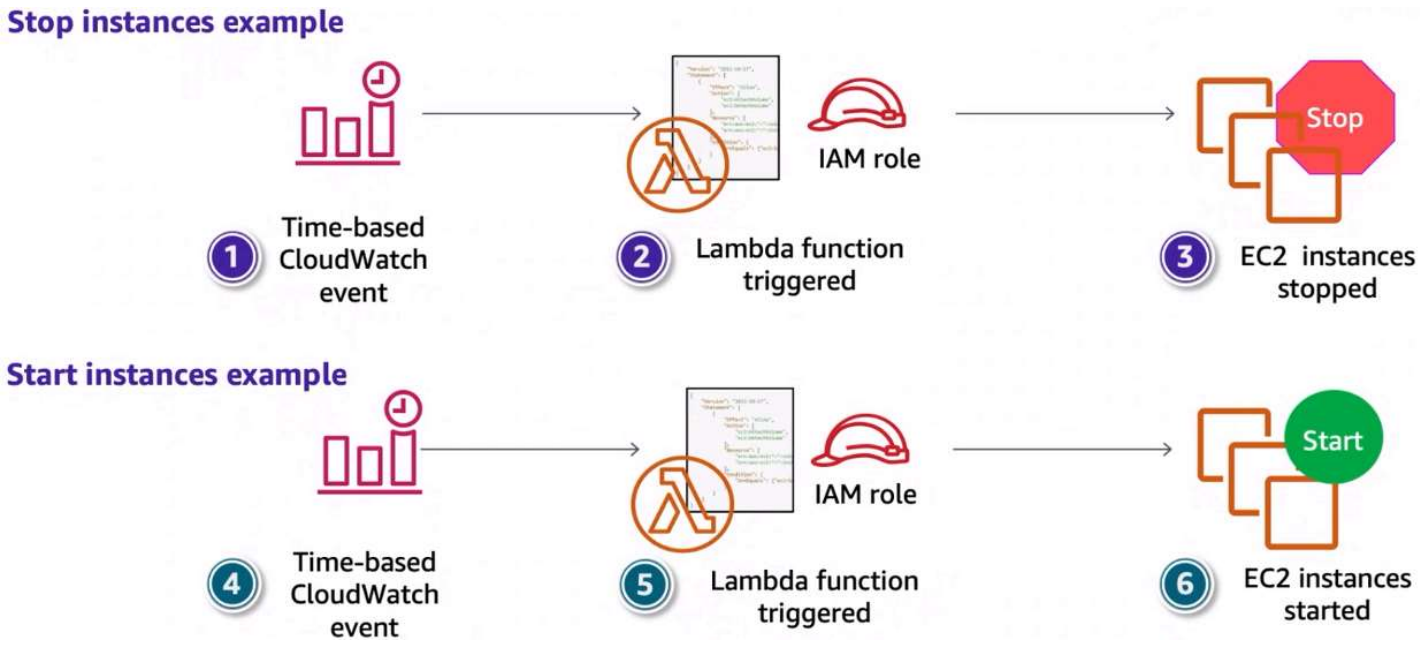
AWS Lambda function configuration

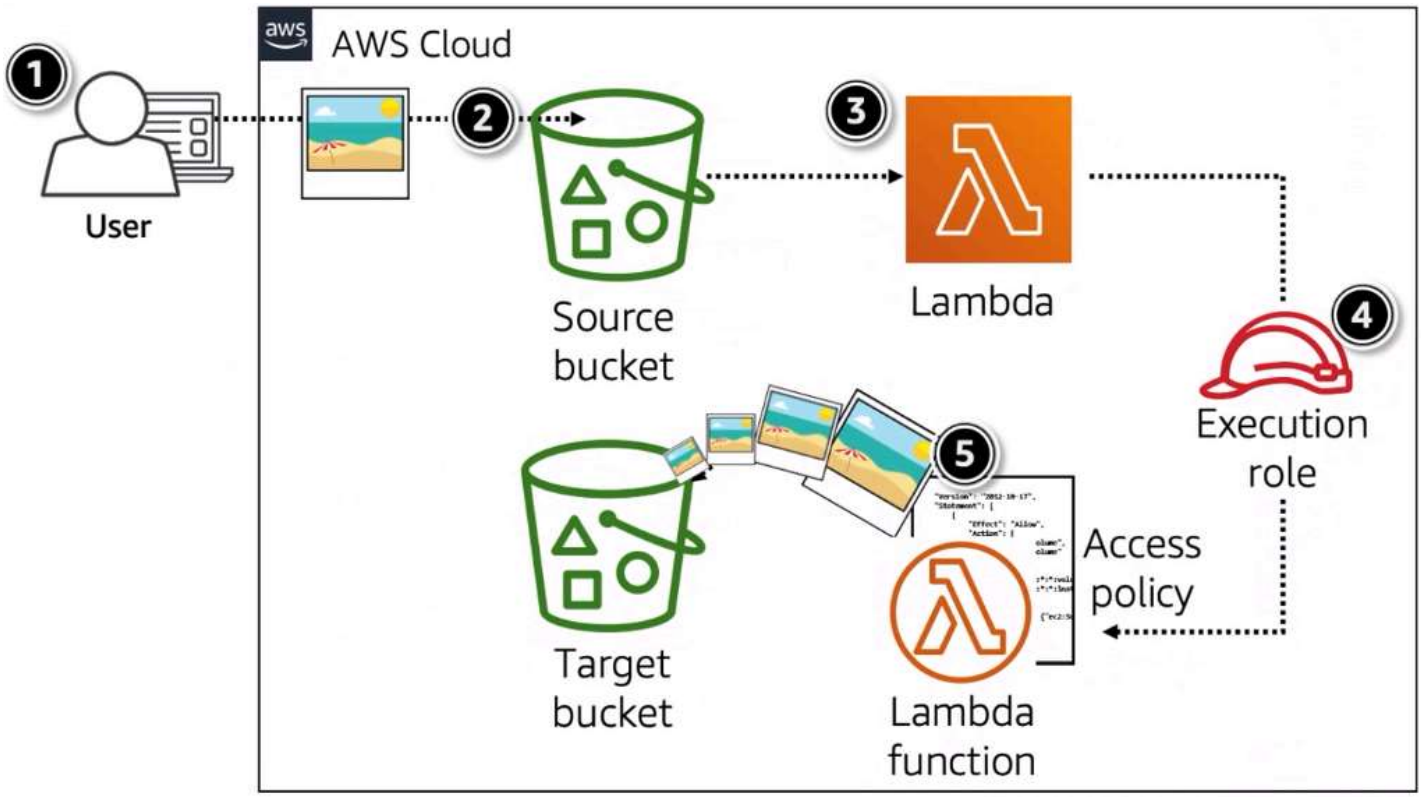
- Create lambda function: give a name
- Runtime environment

- Node.js
- Execution role to grant IAM permission to the function to interact with other services
- Configure the function
  - adding a trigger
- Add function code
- Specify the memory in megabytes (up to 3008MGB)
- Specify env variable



Schedule-based Lambda function example: start and stop EC2 instances





AWS Lambda limits

Soft limits per Region

- Concurrent executions = 1,000
- Function and layer storage = 75GB

Hard limits for individual function:

- Max function memory alloc = 3,008 MB
- Function tiemout = 15 min
- Deployement package size = 250 MB unzipped, including layers

Section 8: Introduction to AWS Elastic Beanstalk

AWS Elastic Beanstalk

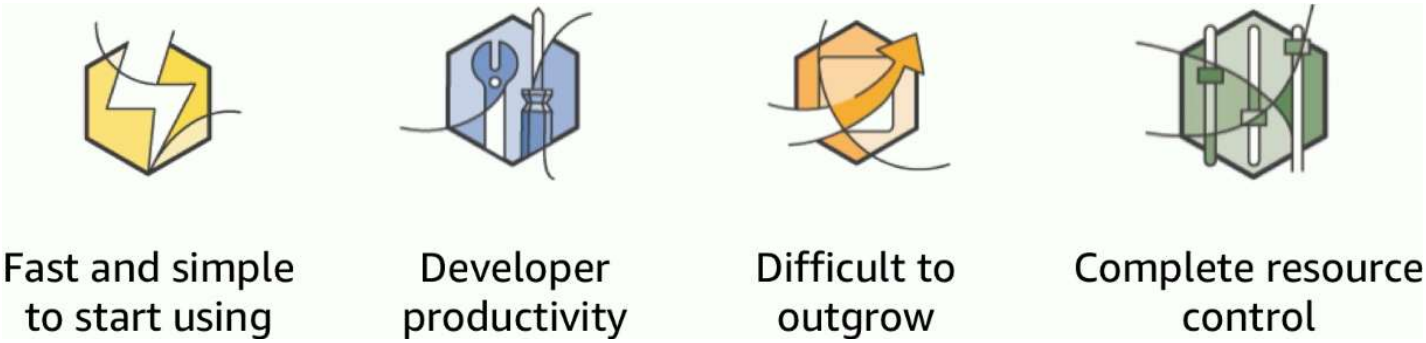
- An easy way to get *web app* up and running
- A *managed service* that automatically handles
  - Infra provisionning and config
  - Deployement
  - Load balancing
  - Automatic scaling
  - Health monitoring
  - Analysis and debugging
  - Logging

- Pay only for the underlying ressources that are used

AWS Elastic Beanstalk deployements

- Supports web app written for common platforms
  - Java, .NET, PHP, Node.js, Python, Ruby, Go and Docker
- You upload your code
  - Elastic Beanstalk automatically handles the deployement
  - Deploys on servers such as Apache, NGINX, Passenger, Puma, and Microsoft Internet Information Services (IIS)

Benefits of Elastic Beanstalk



Wrap-up

Which AWS service helps developers quickly deploy resources which can make use of different programming languages, such as .Net and Java ?

1. AWS CloudFormation
2. AWS SQS
3. AWS Elastic Beanstalk
4. Amazon Elastic Compute Cloud (Amazon EC2)

▶ Answer

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Further Reading

Feb 8, 2021

Feb 8, 2021

Feb 9, 2021

Lien de la note Hackmd Introduction Intro to cloud computing Advantages of cloud…

Lien de la note Hackmd Section 1: Fundamentals of pricing AWS pricing mode…

Lien de la note Hackmd Section 1: AWS Global Infrastructure The AWS Global…

OLDER
AWS Module 5 - Networking and Content Delivery

NEWER
AWS TD 2 - Module 5 and 6