

# Cloud Computing Architecture

Week 2 - Introduction

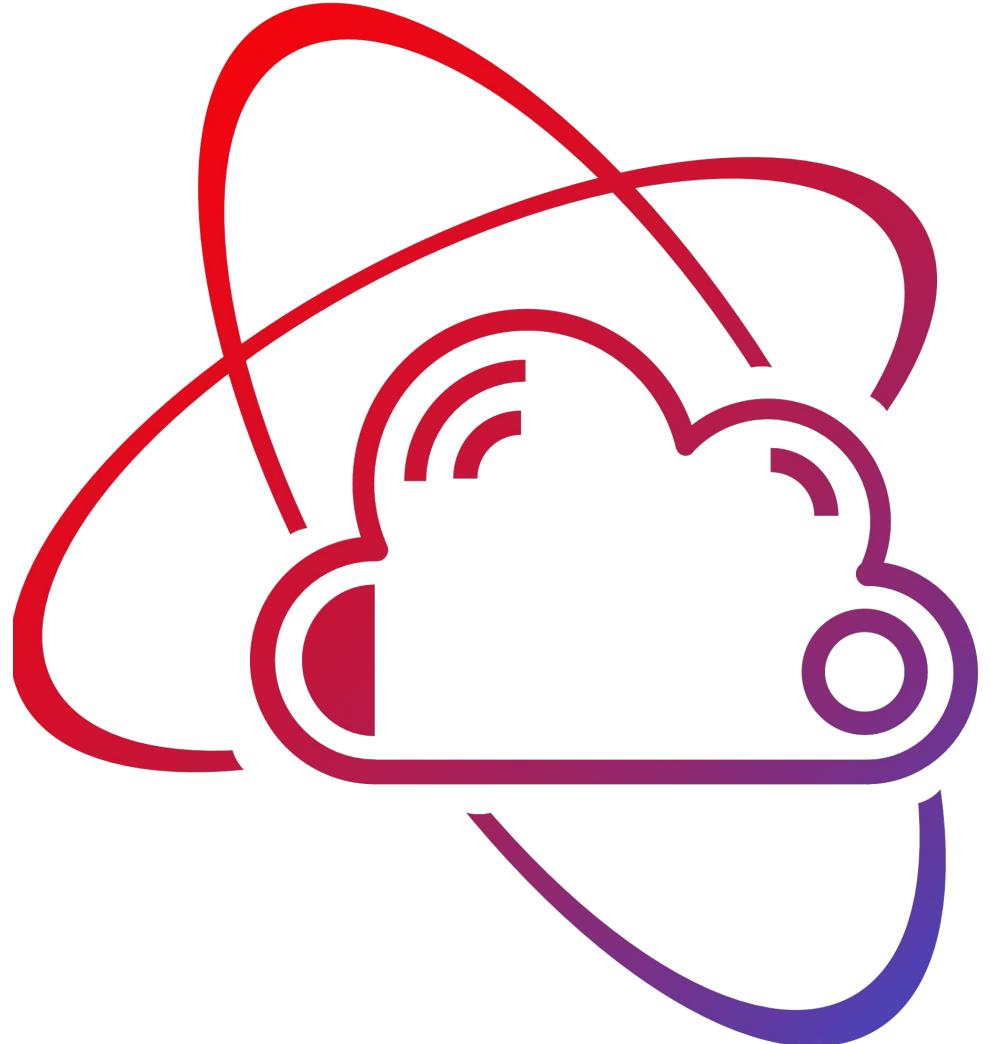


Image licensed under creative commons

# Acknowledgement of Country

We respectfully acknowledge the Wurundjeri People of the Kulin Nation, who are the Traditional Owners of the land on which Swinburne's Australian campuses are located in Melbourne's east and outer-east, and pay our respect to their Elders past, present and emerging.

We are honoured to recognise our connection to Wurundjeri Country, history, culture, and spirituality through these locations, and strive to ensure that we operate in a manner that respects and honours the Elders and Ancestors of these lands.

We also respectfully acknowledge Swinburne's Aboriginal and Torres Strait Islander staff, students, alumni, partners and visitors.

We also acknowledge and respect the Traditional Owners of lands across Australia, their Elders, Ancestors, cultures, and heritage, and recognise the continuing sovereignties of all Aboriginal and Torres Strait Islander Nations.



## Week 2 - Introduction

# In this Presentation:

- AWS Compute Services Overview
- Introduction to AWS Canvas Labs
- Introduction to Assignment 1a

# AWS Compute Services Overview

# AWS Compute Services Overview

## AWS compute services

Amazon Web Services (AWS) offers many compute services. This module will discuss the highlighted services.

Amazon EC2	Amazon EC2 Auto Scaling	Amazon Elastic Container Registry (Amazon ECR)	Amazon Elastic Container Service (Amazon ECS)	VMware Cloud on AWS
AWS Elastic Beanstalk	AWS Lambda	Amazon Elastic Kubernetes Service (Amazon EKS)	Amazon Lightsail	AWS Batch
AWS Fargate	AWS Outposts	AWS Serverless Application Repository		

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Introduction to AWS Canvas Labs

# Week 2 – Introduction: Introduction to AWS Canvas Labs

## Accessing Labs

Week 2 - AVVS - Compute Services

2023 Semester 1

**Lecture**

- Overview
  - Compute services
    - Virtual machines – EC2
    - Serverless computing - Lambda
    - Other compute services
  - Container-based/Serverless services
- Lecture recordings
  - [Week 2 introduction](#)
  - [Virtualization, Compute services, EC2, Cost optimization](#)
  - [Container-based and serverless services](#)
- Demonstration
  - [Setting up an EC2 instance](#)
- Lecture slides
  - [Lecture 02 Computational Services.pdf](#)
- Practice Quiz
  - [Compute Quiz - ACF Mod 6](#)
- Lab**
  - [ACF Lab 3: Introduction to EC2](#)

[◀ Previous](#) [Next ▶](#)

ACFv2EN... > Modules > Module 6 ... > Lab 3 - Introduction to Amazon EC2

Home Announcements Modules Discussions Grades Calendar Inbox History Help

EN\_US

## Lab 3: Introduction to Amazon EC2

### Lab overview and objectives

Availability Zone

IIS Web Server  
Amazon EC2

Details AWS Start Lab End Lab Instructions Actions

```
ddd_v1_w_ckq_1928868@runweb71857:~$
```

# Introduction to Assignment 1a

# Assignment 1a Instructions

Assignment 1a

Assignment Specification ↓

No submission required. Assessment by demonstration in your tutorial Week 4.

Contribution to final assessment: 5%, graded as pass/fail.

**Note:** All AWS resources in assignments are to be implemented in a Lab environment accessible through AWS canvas (**AWS Academy Learner Lab**). Please note that this classroom is NOT the same as the sandbox in ACA/ACF courses that you use to do your weekly labs.  
This classroom comes with a \$100 credit, use it carefully (turn off resources when not in use to save costs, etc.)

**Objectives:**

1. Get familiar with the AWS management console.
2. Launch your own EC2 instance.
3. Deploy your first PHP web page (PhotoAlbum) on Apache web server on your EC2 instance.

**Note:** In this introductory assignment you will create an EC2 Web server in the default VPC. In general, the default VPC is suitable only for experimental / toy deployments, and its use is considered bad practice for production resources. In the next assignments, you will create your own secure VPC.

**Supporting materials:**

Auto Setup EC2 with script tutorial: [Auto\\_Setup\\_EC2\\_with\\_script.pdf](#) ↓

EC2 setup bash script: [EC2\\_setup\\_script.txt](#) ↓

Remote access to an EC2 instance tutorial: [Remote\\_Access\\_to\\_an\\_EC2.pdf](#) ↓

## Week 2 – Introduction: Introducing Assignment 1a

# AWS Learner Lab

The screenshot shows the AWS Learner Lab interface. On the left, there is a sidebar with various navigation options: AWS Account, Dashboard, Courses, Calendar, Inbox, History, and Help. The 'Modules' option is selected. Under 'Modules', there is a 'Learner Lab' section with three items: 'Student Guide.pdf', 'Learner Lab', and 'End of Course Feedback Survey'. The 'Learner Lab' item is highlighted with a blue border. An orange arrow points from the 'Learner Lab' item in the sidebar to the 'Learner Lab' section in the main content area.

The screenshot shows the AWS Learner Lab environment. At the top, there is a header with the AWS logo, account information (ALLv1-37505), and navigation links for Home, Modules, and Discussions. Below the header, there is a dashboard with several cards: 'AWS' (with a red dot), 'Used \$1.9 of \$100', '00:00', and buttons for 'Start Lab' and 'End Lab'. To the right of the dashboard, there is a 'Learner Lab' section with a 'Environment Overview' subsection. The 'Environment Overview' subsection contains links to various AWS services and best practices, such as 'Access the AWS Management Console', 'Region restriction', 'Service usage and other restrictions', 'Using the terminal in the browser', 'Running AWS CLI commands', 'Using the AWS SDK for Python', 'Preserving your budget', 'Accessing EC2 Instances', 'SSH Access to EC2 Instances', 'SSH Access from Windows', and 'SSH Access from a Mac'. The 'Environment Overview' subsection also includes a note about the Learner Lab providing a sandbox environment for ad hoc exploration of AWS services.

# Cloud Computing Architecture

AWS Compute Services: EC2

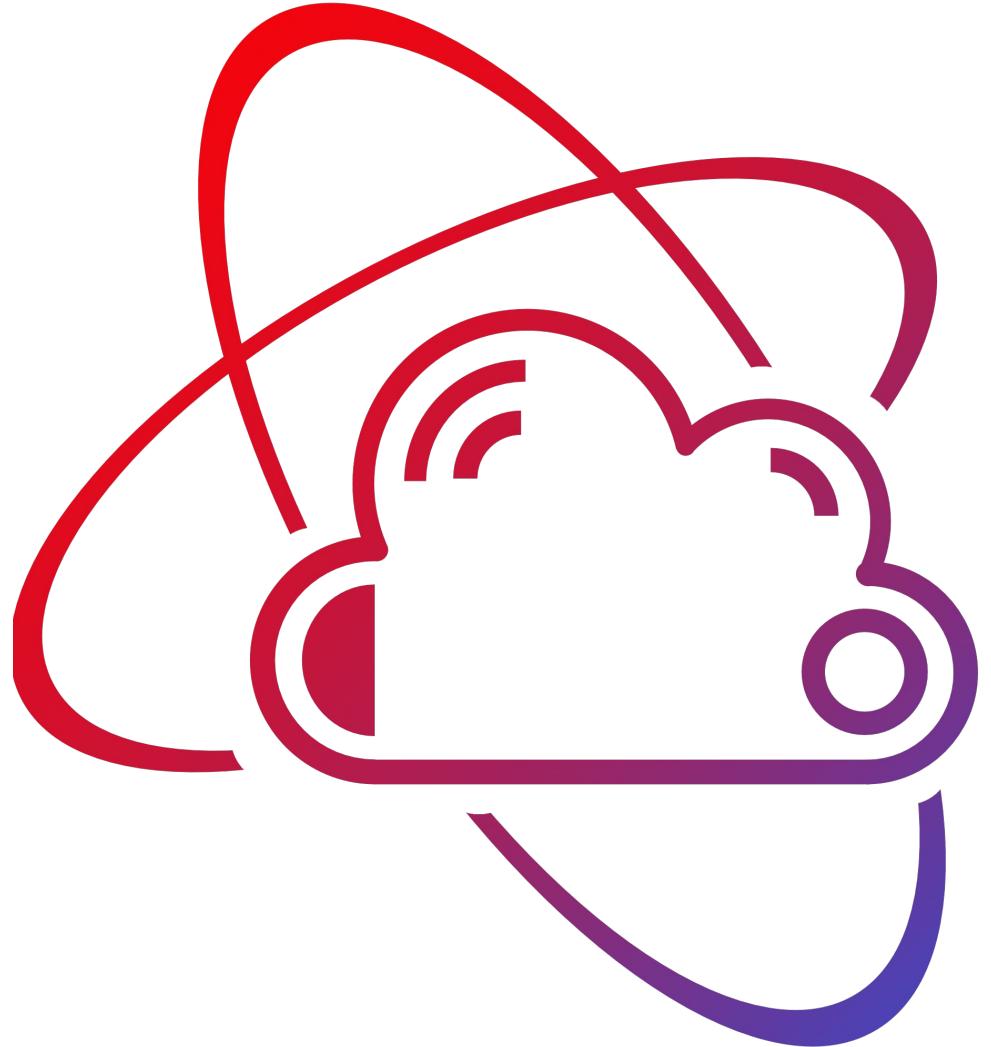


Image licensed under creative commons

- 
- 
- 
- 
- 
- 
- 
- 
- 
- 

## Acknowledgement of Country

We respectfully acknowledge the Wurundjeri People of the Kulin Nation, who are the Traditional Owners of the land on which Swinburne's Australian campuses are located in Melbourne's east and outer-east, and pay our respect to their Elders past, present and emerging.

We are honoured to recognise our connection to Wurundjeri Country, history, culture, and spirituality through these locations, and strive to ensure that we operate in a manner that respects and honours the Elders and Ancestors of these lands.

We also respectfully acknowledge Swinburne's Aboriginal and Torres Strait Islander staff, students, alumni, partners and visitors.

We also acknowledge and respect the Traditional Owners of lands across Australia, their Elders, Ancestors, cultures, and heritage, and recognise the continuing sovereignties of all Aboriginal and Torres Strait Islander Nations.



# AWS Compute Services: EC2

In this Presentation:

- Virtualized Computation
- AWS Compute Services Overview
- Amazon EC2
- EC2 Cost Optimization



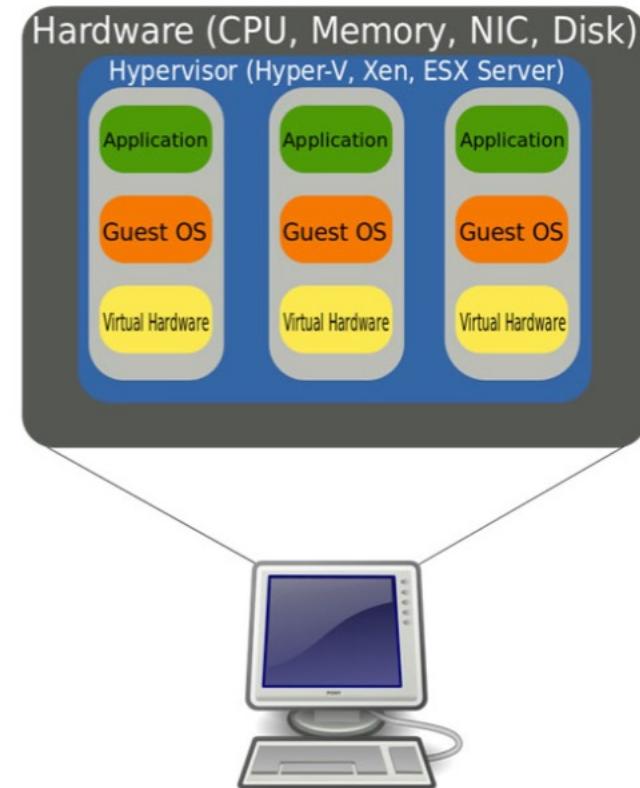
Image from: <https://medium.com/javarevisited/7-best-aws-ec2-amazon-elastic-compute-cloud-online-courses-for-beginners-in-2021-f7a1a55ea719>

# Virtualized Computation

# What do we mean by Virtualized Computation?

### Definitions:

- Virtualization is a technology that allows multiple virtual machines (VMs) to run on a single physical machine.
- Each VM has its own operating system and can run different applications, making virtualization a powerful tool for consolidating hardware and increasing resource utilization.
- Virtualization is widely used in data centres and cloud computing, as well as for remote work, online gaming, and other applications. It allows multiple workloads to share the same physical resources and improves the flexibility, scalability and manageability of IT infrastructures.



# History of Virtualization

- 1960s: IBM develops the concept of virtualization with the IBM System/360 mainframe
- 1970s: IBM releases VM/370, the first commercial implementation of virtualization
- 1980s: VMware is founded and develops a virtualization platform for x86-based computers
- 2000s: Virtualization becomes increasingly popular in data centers and cloud computing
- 2010s: Containers, a more lightweight form of virtualization, gain popularity for application deployment and management
- 2020s: Virtualization continues to be widely used in cloud computing, and is also used for remote work, online gaming, and other applications.

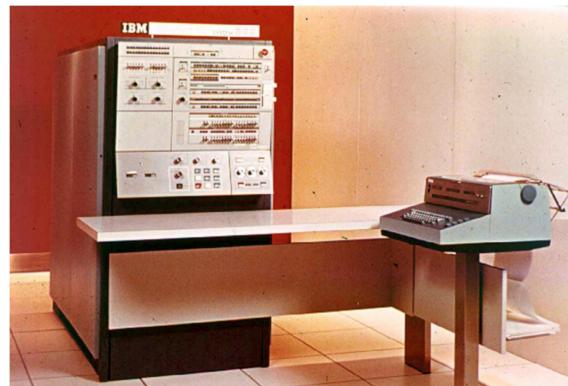


Image from:

<https://about.sourcegraph.com/blog/the-ibm-system-360-the-first-modular-general-purpose-computer>



Image from:

<https://www.ubackup.com/enterprise-backup/vmware-powercli-commands.html>

# What are 'Containers' in Virtualization?

- Containers are a form of operating system virtualization that allows applications to run in isolated environments on a single host.
- Containers use less resources than traditional virtual machines (VMs) and can start and stop faster, making them more efficient for application deployment and scaling.
- Containers rely on the host operating system's kernel, while VMs run on a dedicated hypervisor, which provides a full virtualized hardware environment to each VM. This makes containers more lightweight and portable than VMs.

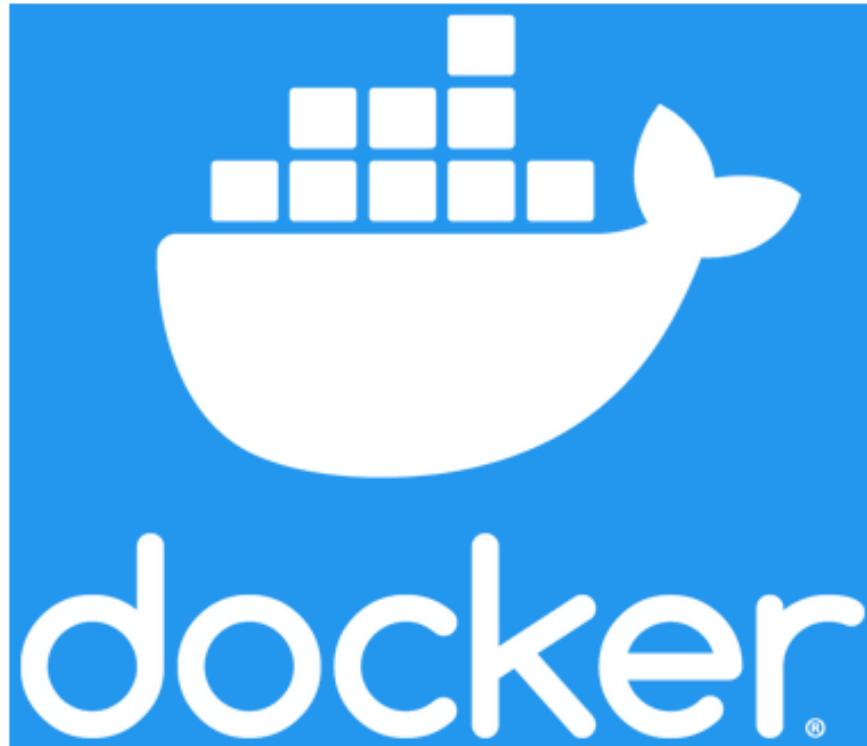


Image from:  
<https://www.docker.com/company/newsroom/media-resources/>

# Serverless Virtual Computation

- Virtualization and serverless computation are complementary technologies that can be used together to optimize resource usage and reduce costs.
- Serverless computing allows developers to run their code without the need to provision or manage servers, which eliminates the need for virtual machines (VMs) for running the code.



Image from: <https://allcode.com/what-is-aws-lambda/>

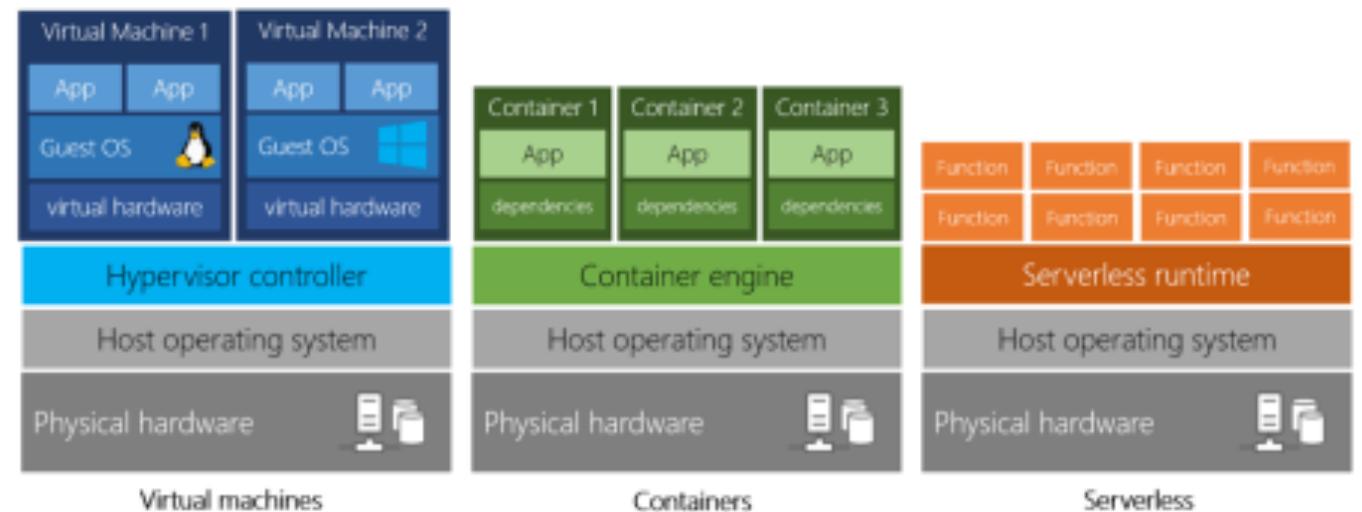


Image from: <https://allaboutdynamic.com/2020/05/30/azure-fundamentals-virtual-machines-vs-containers-vs-serverless-computing/>

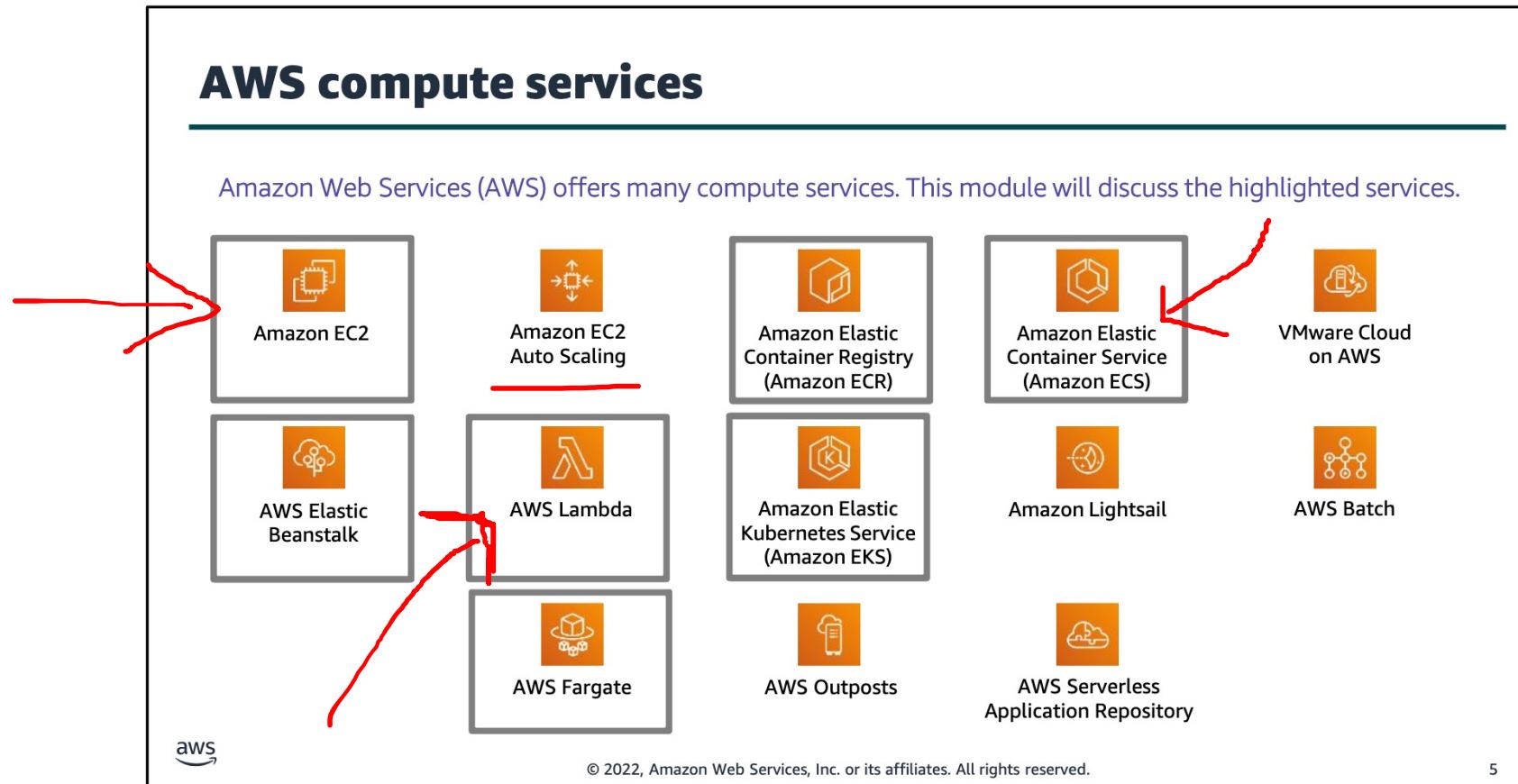
# Serverless Virtual Computation

- Virtualization can be used to run the underlying infrastructure for serverless services, such as containers or functions, thus allowing for more efficient usage of resources.
- Virtualization can also be used to run custom runtime environments, allowing developers to use languages and frameworks that are not natively supported by the serverless provider.
- Serverless providers such as AWS Lambda and Google Cloud Functions use virtualization to provide isolation between different functions and to scale instances as needed.



# AWS Compute Services Overview

# AWS Compute Services Overview



# AWS Compute Services Overview



# AWS Compute Services Overview

## **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 patterns?
  - Which configuration settings will 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



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

7

# AWS Compute Services Overview



Image from: <https://clouductivity.com/amazon-web-services/aws-lambda-vs-ecs/>

# Amazon EC2

# AWS Compute Services Overview

## Amazon EC2 overview

- **Amazon Elastic Compute Cloud (Amazon EC2)**
  - Provides virtual machines—referred to as **EC2 instances**—in the cloud.
  - Gives you *full control* over the guest operating system (Windows or Linux) on each instance.
  - You can launch instances of any size into an Availability Zone anywhere in the world.
    - Launch instances 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.



Amazon  
EC2



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

10

# Amazon EC2

## Amazon EC2 storage options

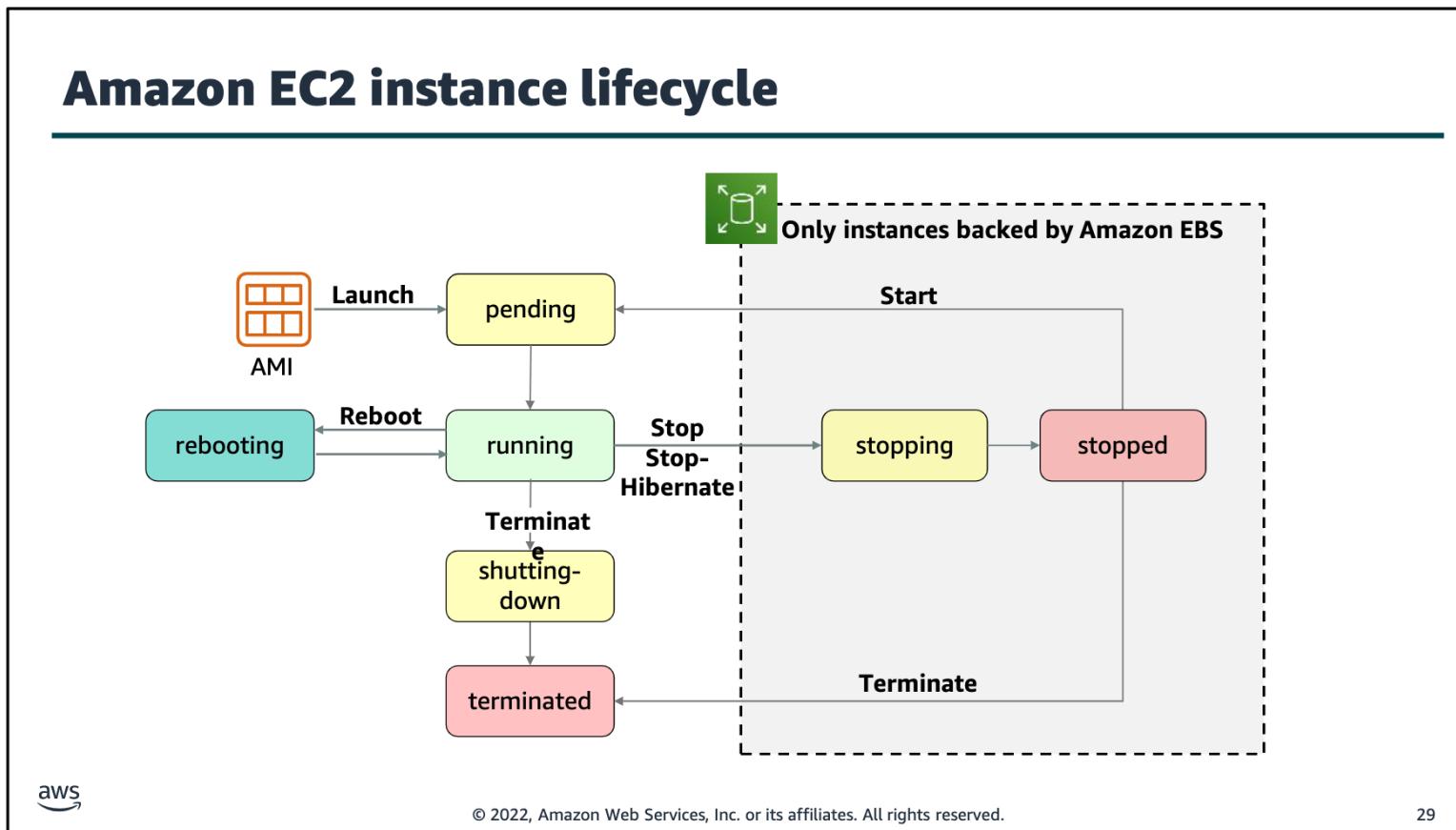
- **Amazon Elastic Block Store (Amazon EBS) –**
  - Durable, block-level storage volumes.
  - You can stop the instance and start it again, and the data will still be there.
- **Amazon EC2 Instance Store –**
  - Ephemeral storage is provided on disks that are attached to the host computer where the EC2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



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

22

# Amazon EC2



# EC2 Cost Optimization

# EC2 Cost Optimization

The screenshot shows the AWS EC2 On-Demand Pricing page. At the top, there's a navigation bar with links for Contact Us, Support, English, My Account, and Sign In to the Console. Below that is a secondary navigation bar for Amazon EC2 with links for Overview, Features, Pricing, Instance Types, FAQs, Getting Started, and Resources. A breadcrumb trail indicates the current location: Products > Compute > Amazon EC2 > Amazon EC2 Pricing.

The main heading is "Amazon EC2 On-Demand Pricing". Below it are two buttons: "Get started for free" (orange) and "Request a pricing quote" (blue). The page title is "On-Demand Plans for Amazon EC2".

On the left, a sidebar lists various AWS services with links: On-Demand Pricing, Data Transfer, Data Transfer within the same AWS Region, EBS-Optimized Instances, Elastic IP Addresses, Carrier IP Addresses, Elastic Load Balancing, On-Demand Capacity Reservations, T2/T3/T4g Unlimited Mode Pricing, Amazon CloudWatch, Amazon Elastic Block Store, Amazon EC2 Auto Scaling, AWS GovCloud Region, and AMD SEV-SNP.

The main content area has sections for "Select a location type and region" (Location Type: AWS Region, Region: Asia Pacific (Sydney)) and "Select an operating system, instance type, and vCPU to view rates" (Operating system: Linux). Below these are dropdown menus for "Instance type" (All) and "vCPU" (All).

A table titled "Viewing 567 of 567 available instances" lists the following data:

Instance name	On-Demand hourly rate	vCPU	Memory	Storage	Network performance
t4g.nano	\$0.0053	2	0.5 GiB	EBS Only	Up to 5 Gigabit
t4g.micro	\$0.0106	2	1 GiB	EBS Only	Up to 5 Gigabit
t4g.small	\$0.0212	2	2 GiB	EBS Only	Up to 5 Gigabit
t4g.medium	\$0.0424	2	4 GiB	EBS Only	Up to 5 Gigabit
t4g.large	\$0.0848	2	8 GiB	EBS Only	Up to 5 Gigabit

At the bottom right, there's a link: "Image from: <https://aws.amazon.com/ec2/pricing/on-demand/>".

# EC2 Cost Optimization

## Amazon EC2 pricing models

### On-Demand Instances

- Pay by the hour
- No long-term commitments.
- Eligible 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 hardware that is dedicated to a single customer.

### Reserved 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 Reserved 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.

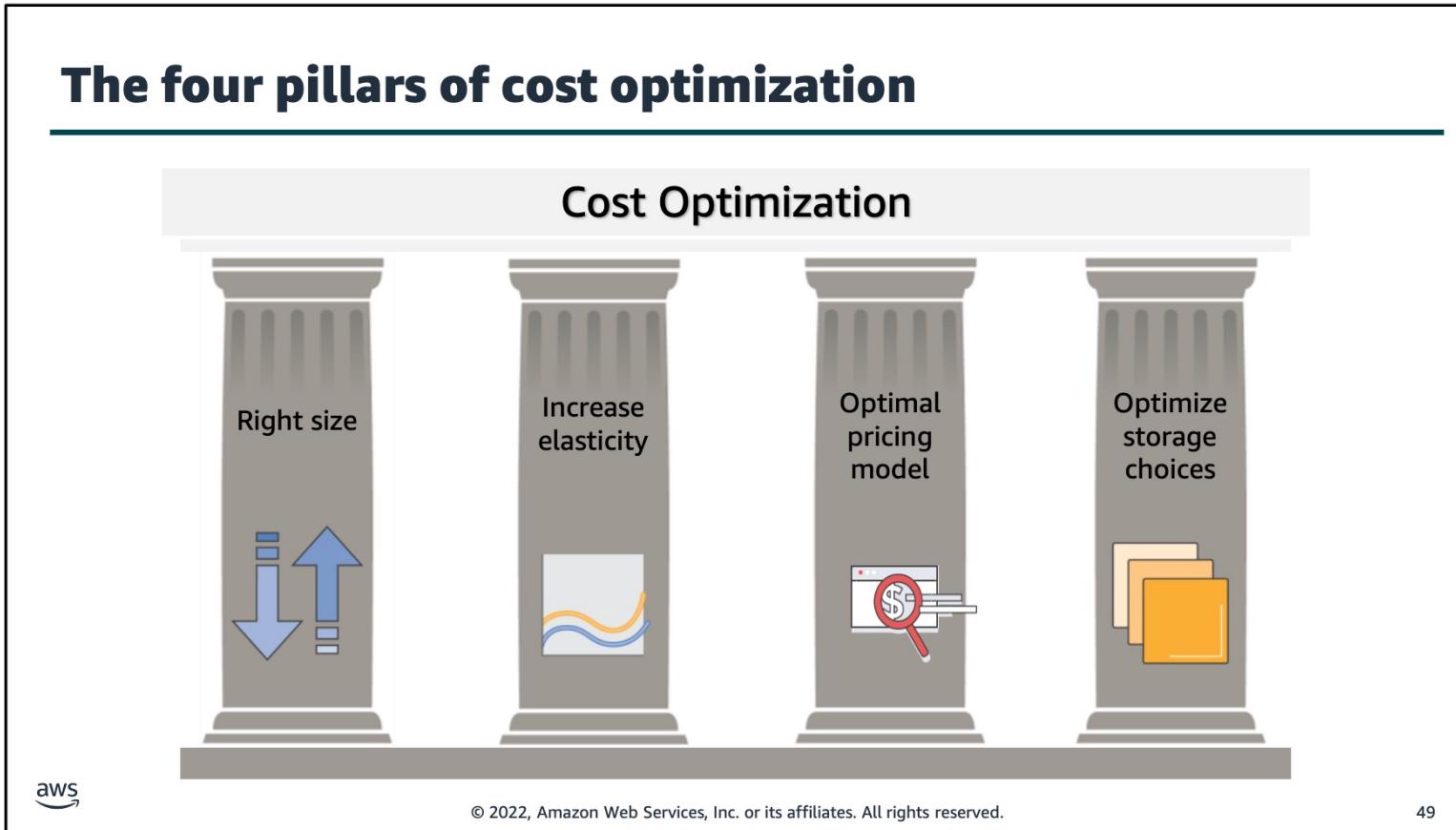


**Per second billing** available for On-Demand Instances, Reserved Instances, and Spot Instances that run Amazon Linux or Ubuntu.

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

46

# EC2 Cost Optimization



Want to learn more?

Check out:

[AWS Academy ACF Module 6 – Compute](#)

[AWS Documentation](#)

# Cloud Computing Architecture

AWS Compute Services: Serverless

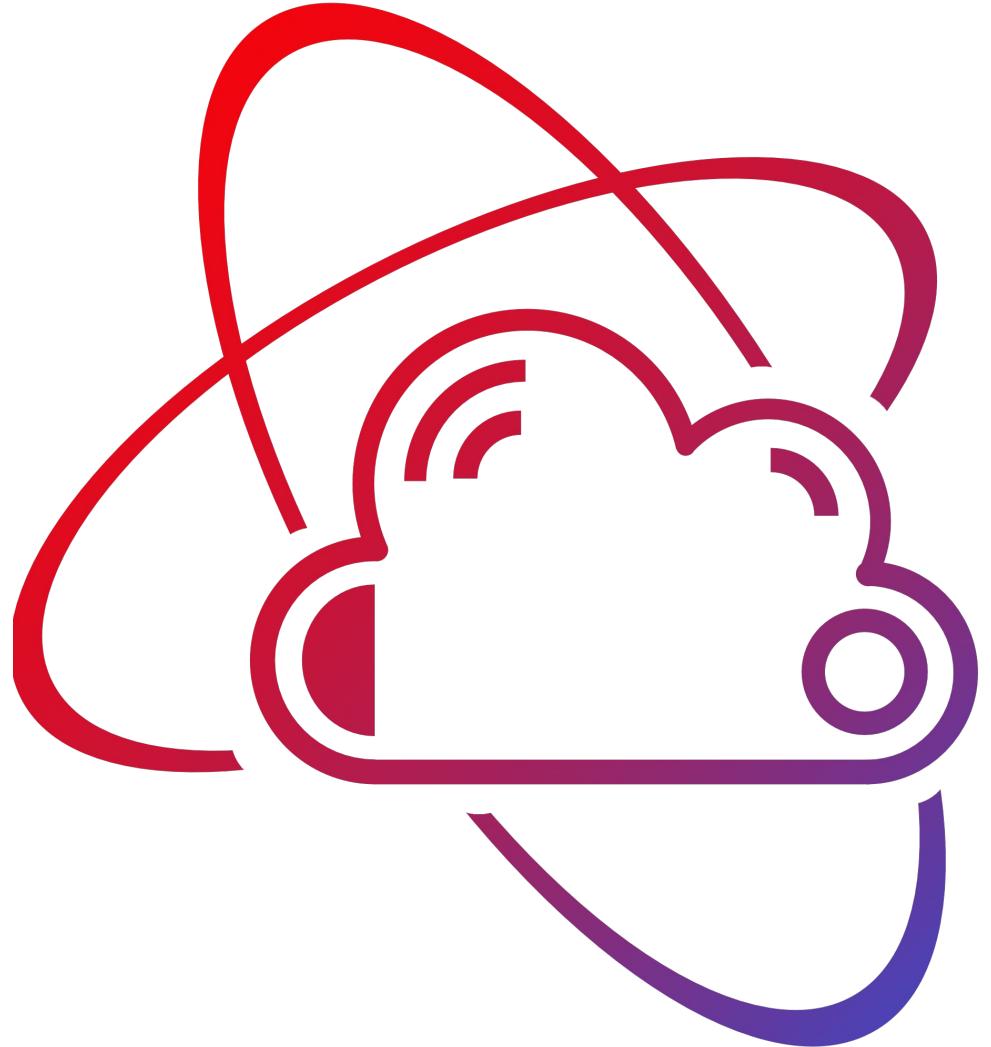


Image licensed under creative commons

# Acknowledgement of Country

We respectfully acknowledge the Wurundjeri People of the Kulin Nation, who are the Traditional Owners of the land on which Swinburne's Australian campuses are located in Melbourne's east and outer-east, and pay our respect to their Elders past, present and emerging.

We are honoured to recognise our connection to Wurundjeri Country, history, culture, and spirituality through these locations, and strive to ensure that we operate in a manner that respects and honours the Elders and Ancestors of these lands.

We also respectfully acknowledge Swinburne's Aboriginal and Torres Strait Islander staff, students, alumni, partners and visitors.

We also acknowledge and respect the Traditional Owners of lands across Australia, their Elders, Ancestors, cultures, and heritage, and recognise the continuing sovereignties of all Aboriginal and Torres Strait Islander Nations.



# AWS Compute Services: Serverless

In this Presentation:

- Container Services
- AWS Lambda



Image from: <https://digitalcloud.training/aws-lambda/>

# Container Services

# Container Services

## Container basics

- **Containers** are a method of operating system virtualization.
- Benefits –
  - Repeatable.
  - Self-contained execution environments.
  - Software runs the same in different environments.
    - Developer's laptop, test, production.
  - Faster to launch and stop or terminate than virtual machines

### Your Container

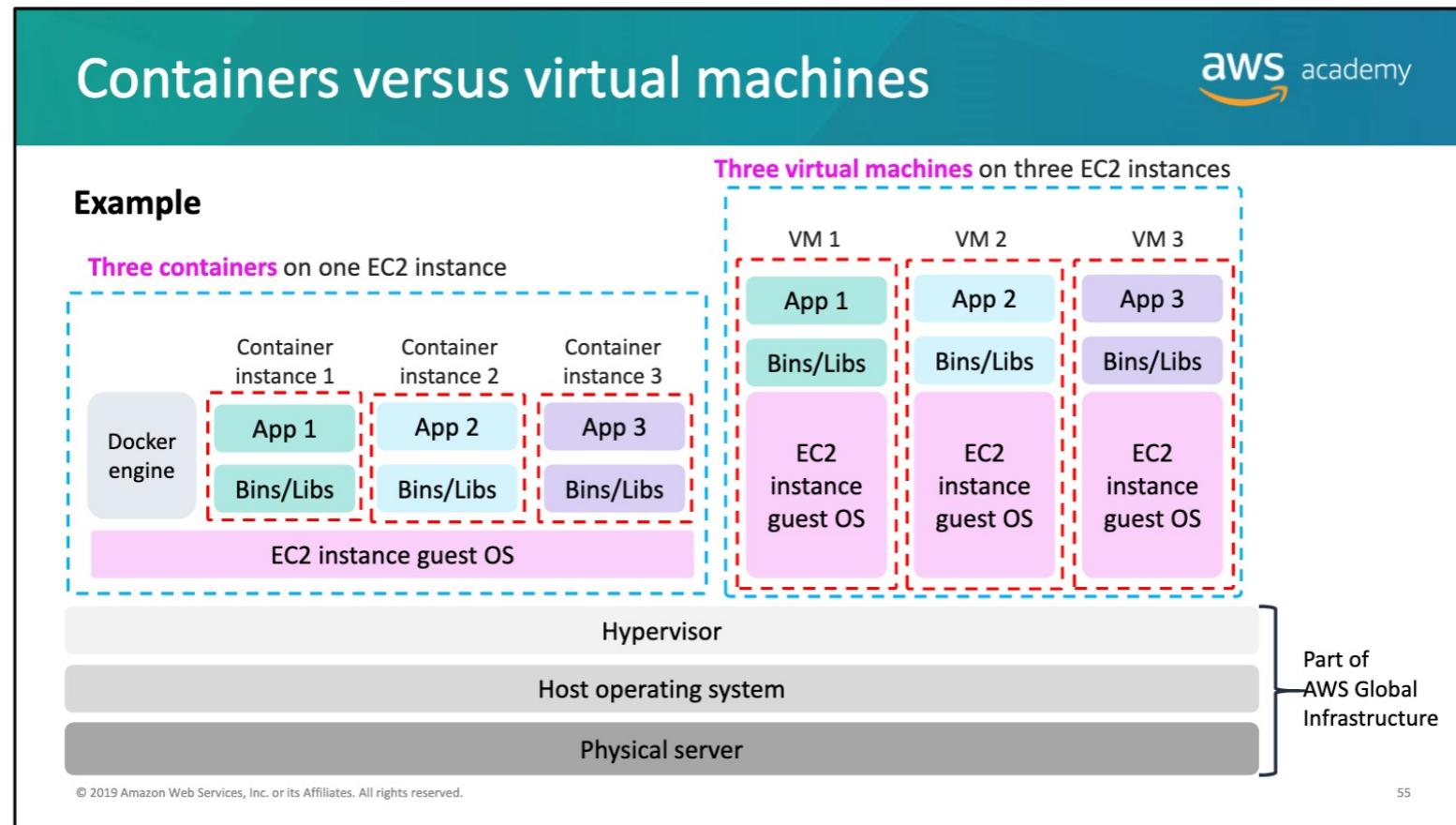
The diagram illustrates the components within a container, enclosed in a dashed-line box:

- Your application (represented by a blue icon)
- Dependencies (represented by a blue icon)
- Configurations (represented by a white icon)
- Hooks into OS (represented by a grey icon)

© 2019 Amazon Web Services, Inc. or its Affiliates. All rights reserved.

53

# Container Services



# Container Services

## AWS compute services

Amazon Web Services (AWS) offers many compute services. This module will discuss the highlighted services.



Amazon EC2



Amazon EC2  
Auto Scaling



Amazon Elastic  
Container Registry  
(Amazon ECR)



Amazon Elastic  
Container Service  
(Amazon ECS)



VMware Cloud  
on AWS



AWS Elastic  
Beanstalk



AWS Lambda



Amazon Elastic  
Kubernetes Service  
(Amazon EKS)



Amazon Lightsail



AWS Batch



AWS Fargate



AWS Outposts



AWS Serverless  
Application Repository



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

5

# AWS Lambda

# AWS Lambda

## AWS Lambda: Run code without servers

**aws academy**

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

The diagram illustrates the AWS Lambda architecture and its benefits:

- Upload your code:** Represented by a laptop icon containing code snippets.
- The code you run is a Lambda function:** Represented by an orange Lambda icon.
- Run your code on a *schedule* or in response to *events*:** Represented by a pink bucket icon (AWS services), a blue mobile phone icon (Mobile apps), and a blue cylinder icon (HTTP endpoints).
- Your code runs only when it is triggered:** Represented by three Lambda icons with binary data (0100100101, 0010010010, 100100100100) being triggered by events.
- Pay only for the compute time that you use:** Represented by a graph showing a green curve over time, with a dollar sign icon indicating cost.

© 2019 Amazon Web Services, Inc. or its Affiliates. All rights reserved.

64

# AWS Lambda

## Benefits of Lambda



**AWS Lambda**

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

© 2019 Amazon Web Services, Inc. or its Affiliates. All rights reserved.

65

# AWS Lambda

## AWS Lambda event sources

aws academy

### Event sources

- Amazon S3
- Amazon DynamoDB
- Amazon Simple Notification Service (Amazon SNS)
- Amazon Simple Queue Service (Amazon SQS)
- Amazon API Gateway
- Application Load Balancer

Many more...

Configure other AWS services as **event sources** to invoke your function as shown here.

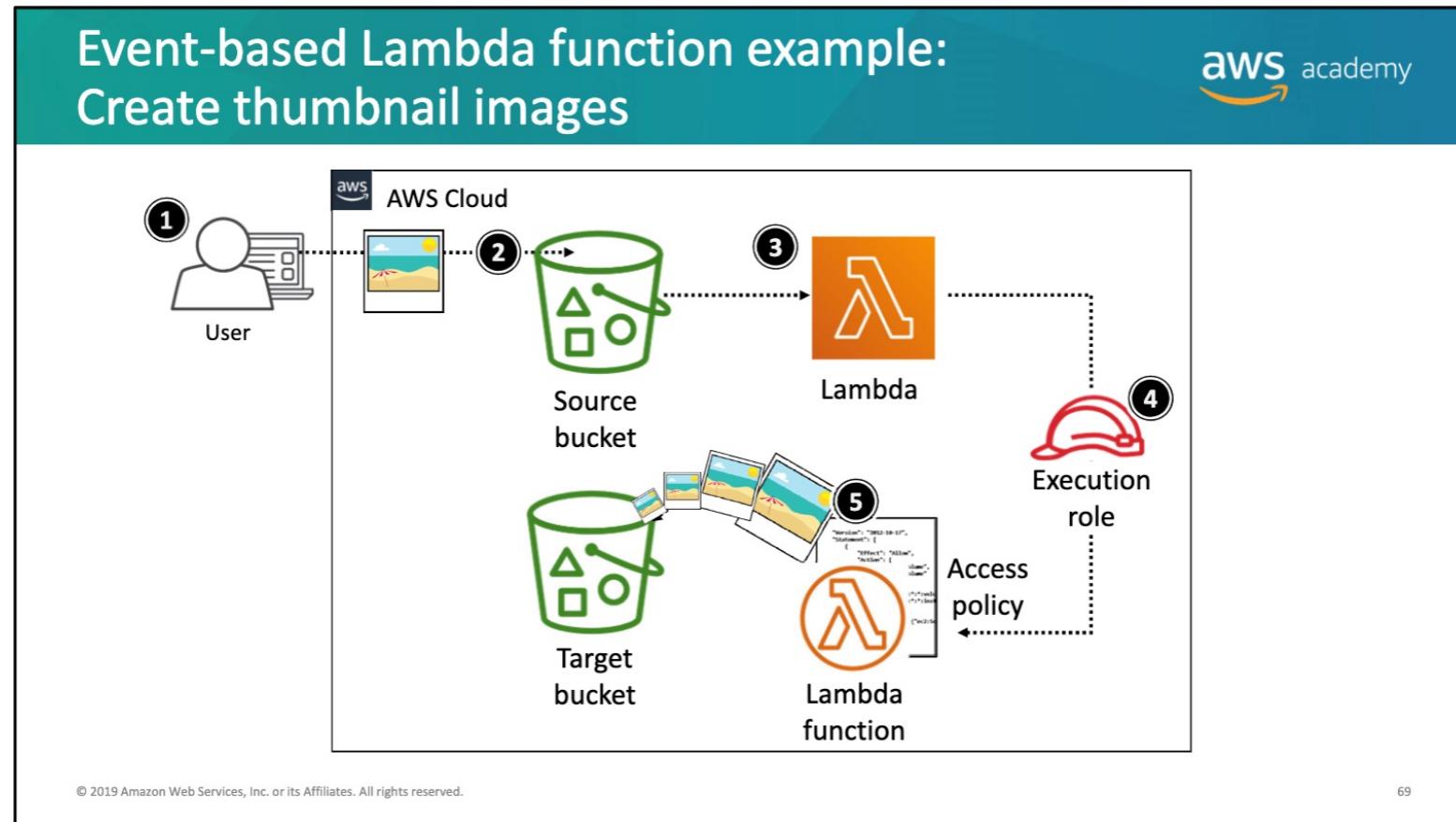
Alternatively, invoke a Lambda function from the Lambda console, AWS SDK, or AWS CLI.

```
graph LR; LS((Lambda)) --> EC[Execution of your code<br>(only when triggered)]; LS --> ACW[Amazon CloudWatch<br>Logging, monitoring,<br>and metrics]; LS --> AL[AWS Lambda]; subgraph ES [Event sources]; direction TB; S3[Amazon S3]; DDB[Amazon DynamoDB]; SNS[Amazon Simple Notification Service<br>(Amazon SNS)]; SQS[Amazon Simple Queue Service<br>(Amazon SQS)]; APIG[Amazon API Gateway]; ALB[Application Load Balancer]; More[Many more...]; end; S3 --- LS; DDB --- LS; SNS --- LS; SQS --- LS; APIG --- LS; ALB --- LS;
```

© 2019 Amazon Web Services, Inc. or its Affiliates. All rights reserved.

66

# AWS Lambda



Want to learn more?

Check out:

[AWS Academy – ACF Module 6: Compute](#)

[AWS Documentation](#)