

Module 1: Global Infrastructure

Module purpose

The purpose of this module is to review the basics of cloud computing. It will cover the benefits of computing in the cloud and the reasons why companies have begun to switch from on-premises computing to cloud computing. It will also touch on the main services offered by cloud computing providers.

Module description

In this module, you will take notes about the benefits of cloud computing and the services offered by cloud providers. We will discuss some of the impacts of cloud computing.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following four categories.

Cloud computing

–

The on-demand delivery of compute power, databases, storage, applications, and other IT resources using the internet with pay-as-you-go pricing.

Amazon Web Services (AWS)

–

A platform that provides a wide range of cloud computing services.

Cloud storage

–

Saving data using a cloud service provider (CSP) instead of a physical machine.

Server

–

A computer designed to process requests and deliver data to another computer over the Internet or a local network. In the cloud, a server is hosted by an outside provider, which is accessed over the internet.

Background and misconceptions

What is cloud computing?

Any time you are working or storing information online (for example, sending an email or watching a streaming video)—as opposed to on your local computer or on a server on your local network—you are using cloud computing.

Why do businesses use cloud computing?

The business benefits of cloud computing include the following:

- Pay less to get your business started. Pay more as your business grows.
- Services are cheaper because costs are spread across many users.
- Your computing power and storage scales to fit what you need, so you only pay for what you use.
- It is faster and easier to add new resources when you need them.
- Cloud providers maintain, secure, and run the computers and facilities for cloud services.

- It is easy to release your application or advertise anywhere in the world because everything is online.

What types of cloud services are there?

Type of Cloud Service	What It Does	Examples
Infrastructure as a service (IaaS)	Compute power, networking, and storage provided over the internet	Amazon Elastic Compute Cloud (Amazon EC2), Rackspace, Google Compute Engine
Platform as a service (PaaS)	Tools provided over the internet for making programs and applications	AWS Elastic Beanstalk, Microsoft Azure, Google App Engine
Software as a service (SaaS)	Applications and programs that are accessed and provided over the internet	Dropbox, Slack, Spotify, YouTube, Microsoft Office 365, Gmail

How did AWS get started?

- Origins began in 2002 when Amazon started the Amazon.com web service.
 - Offered tools for developers to work on the Amazon product catalog
- In 2003, Amazon realized that its infrastructure services could give them an advantage over the competition.
 - Provided hardware power, storage, and databases along with the software tools to control them
- In 2004, Amazon publicly announced that it was working on a cloud service.
- In 2006, Amazon launched AWS with just a few of the services that are still around today.
 - Amazon Simple Storage Service (Amazon S3)
 - Amazon EC2
 - Amazon Simple Queue Service (Amazon SQS)
- By 2009, AWS added more services
 - Amazon Elastic Block Store (Amazon EBS)
 - Amazon CloudFront – a content delivery network (CDN)
- AWS has developed partnerships with several large companies. AWS has been growing and adding new services and tools ever since.

Focus questions

Follow your educator's instructions to answer and discuss the focus questions.

Questions

1. Imagine if one of your social media accounts was hacked and all your data was made public or held for ransom. How would this make you feel? Do you think the trade-off is worth the risk to have all the cloud services at your fingertips?

2. What kind of information do you have stored online? What are the risks of that information being compromised or shared without your consent? What kinds of laws or regulations do you think are necessary to keep your information safe?

3. What are some ways that the internet has made your life easier? What are some ways that the internet has made your life more difficult? What is one thing you wish you could do online, but the technology doesn't exist yet?

Activity 1: Introduction to Cloud Computing

Overview

In this activity, you will work in pairs to take notes about the basics of cloud computing. You will come up with sources to find definitions for key terms and list the benefits that cloud computing offers. You will also find the key services offered by cloud computing providers and give examples of how these services are used in industry.

Objectives

- Define cloud computing and its impacts.
- Identify the benefits of cloud computing.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **What is one way that cloud computing has impacted society as a whole?**
- **Was any of the information surprising or unexpected?**
- **What are some of the sources in which you found your information, and what led you to believe these sources are credible and accurate?**

Activity 2: Using Cloud Services

Overview

In this activity, you will generate cloud service usage plans for a number of business case studies. For each business, you will describe how each of the four services you learned about can be used to improve or benefit the business.

Objective

- Compare the major services offered by cloud computing providers.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **What are the main differences in the ways that the businesses are using the services?**
- **Does one of the services stand out to you as being the most important? If so, why?**
- **If a close friend or family member were starting a business and wanted to use cloud services, what advice would you give?**

Optional connection

Follow your educator's instructions for completing this activity.

Real-world business connections

1. You can begin to look at real-world case studies of companies that rely on AWS at the [AWS Customer Success](#)(opens in a new tab) page.

2. Pick a company and write a short summary of how cloud computing permitted the company to do something that would otherwise not have been possible.

Unplugged option

1. Select a company that might benefit from cloud services.
2. Then make suggestions for:
 1. Which CSP the company should use and provide reasoning
 2. Which cloud services the company could use and how the services would benefit them

Additional connections

- [What is Cloud Computing?\(opens in a new tab\)\(opens in a new tab\)\(opens in a new tab\)\(opens in a new tab\)](#)
- [AWS Free Tier](#)

Lesson 2 of 3

Module 2: Structures of the Cloud

Module purpose

The purpose of this module is to learn about the three different types of cloud services: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). You will also learn about the geographical layout of the Amazon Web Services (AWS) Cloud infrastructure, which includes Regions, Availability Zones, and edge locations.

Module description

This module will consist of note-taking and research. You will also be drawing diagrams of the AWS Global Infrastructure. You will find real-world examples of each type of cloud computing service.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following seven categories.

Availability Zone

–

One or more data centers that house many servers. Each Region has multiple, isolated locations known as Availability Zones. Each Availability Zone is isolated, but the Availability Zones in a Region are connected through low-latency links. An Availability Zone is represented by a region code followed by a letter identifier, for example, us-east-1a.

Edge location

–

A site where data can be stored for lower latency. Often, edge locations will be close to high-population areas that will generate high traffic volumes.

Infrastructure as a service (IaaS)

–

A model in which virtual machines and servers are used for customers to host a wide range of applications and IT services are provided.

Latency

–

The delay before a transfer of data begins after the data has been requested.

Platform as a service (PaaS)

–

A model that provides a virtual platform for customers to create custom software.

Region

–

An area where data is stored. Data storage in a Region closest to you is one of the reasons it can be accessed at lightning speed.

Software as a service (SaaS)

–

A model that provides applications using the internet that are managed by a third party.

Background and misconceptions

The AWS Global Cloud Infrastructure is the most secure, extensive, and reliable cloud platform, offering over 200 fully featured services from data centers globally. That infrastructure is made up of many different components including Regions, Availability Zones, and edge locations. For visual representations of these components, see the [Global Infrastructure\(opens in a new tab\)](#) page.

The differences between the components of the infrastructure can be confusing because they are all interconnected and related to the physical layout of the AWS Cloud. It is good to have a concrete visual example.

Region > Availability Zone > edge location

You can find a resource for the types of cloud services on the AWS [Types of Cloud Computing\(opens in a new tab\)](#) site([opens in a new tab](#)).

- **IaaS:** These services contain the basic building blocks of the cloud. They provide access to computers—physical and virtual—and to network features and storage space. Think of IaaS like renting a kitchen. You can use all the different appliances (mixers, blenders, sinks), and you can rent a kitchen with better appliances if you need them.
 - Examples: Amazon Elastic Compute Cloud (Amazon EC2), Rackspace, Google Compute Engine
- **PaaS:** These services are the tools needed to manage the underlying hardware and launch applications. They include programming environments, application testing platforms, and application launchers. Think of PaaS as going to a restaurant. You are not managing the appliances in the kitchen, but you can ask the waiter or chef to make things however you want.
 - Examples: AWS Elastic Beanstalk, Microsoft Azure, Google App Engine
- **SaaS:** These services are the actual apps and software provided over the internet. You are not responsible for managing or installing the software; you just access and use it. Think of SaaS as eating at an all-you-can-eat buffet. You have access to whatever food is being served. You don't control what is made or how, but you can use as much as you want.
 - Examples: Dropbox, Slack, Spotify, YouTube, Microsoft Office 365, Gmail

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **How does your computer get information from the internet? When you open a website, where does the website come from? Who provides the data? Use what you have learned about computer science and cloud computing in your answer.**
2. **What is a program or an app that you use that runs entirely in the cloud, meaning you don't have to store anything on your computer or device? What do you use the program to do? How do you think the program is provided to you at little or no cost?**
3. **More and more programs and apps are being moved from being stored locally on individual computers to being in the cloud. For example, many people now use internet-based word processing instead of software such as Microsoft Word, and Spotify instead of CDs and MP3 players. What is another program or service that you think will move into the cloud? Why do you think technology is moving in the direction of cloud computing? Give reasoning for your ideas based on what you have learned previously about cloud computing.**

Activity 1: Visualizing the AWS Global Infrastructure

Objectives

- Explain the purpose of a Region, Availability Zone, and edge location.
- Identify connections among Regions, Availability Zones, and edge locations.

Overview

In this activity, you will learn about the AWS infrastructure and its purpose. You will take notes on what Regions, Availability Zones, and edge locations are and what they are used for. You will create your own diagrams of the AWS infrastructure to help make it more concrete in your minds.

- **Region:** Areas where data is stored. Data storage in a Region closest to you is one of the reasons it can be accessed at lightning speed.
- **Availability Zone:** A data center that houses many servers. Each Region has multiple, isolated locations known as Availability Zones. Each Availability Zone is isolated, but the Availability Zones in a Region are connected through low-latency links. An Availability Zone is represented by a Region code followed by a letter identifier, for example, us-east-1a.
- **Edge location:** A site where data can be stored for lower latency. Often, edge locations will be close to high-population areas that will generate high-traffic volumes.

Activity instructions

Follow your educator's instructions to complete the activity.

Here are some sites that might help you with this activity.

- [Regions and Availability Zones\(opens in a new tab\)\(opens in a new tab\)](#)
- [AWS Global Infrastructure\(opens in a new tab\)](#)
- [AWS Global Cloud Infrastructure\(opens in a new tab\)](#)

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **Compare your diagram with that of another student. Are there any differences? What is the same?**
- **How are Regions, Availability Zones, and edge locations connected?**

Activity 2: Types of Cloud Services

Objectives

- Recognize the types of cloud computing.
- Compare types of cloud computing.

Overview

You will learn about the three different types of cloud services. We will discuss the benefits of using these cloud services over traditional models.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss this question.

- **A pediatrician with a private practice has so many patient files, that she is running out of room in her filing cabinets. For this reason, she wants to move her data into the cloud. She wants to be sure the data is secure, but also wants her patients to be able to access their medical records and communicate with her online in a secure way. Describe one way that you can use each type of cloud service and how it would benefit her business.**

Optional connection

Follow your educator's instructions for completing this activity.

Create a rubric where you rank the factors for a business to consider when choosing a Region to locate their cloud services. Then explain why those factors would be most (or least) important when choosing a Region.

Factors to consider:

- AWS cost
- Availability of services

- Speed or latency
- Resiliency of AWS components
- Data rights
- Audience

Additional connections

- [Types of Cloud Computing\(opens in a new tab\)](#): This resource provides descriptions of IaaS, PaaS, and SaaS as they relate to AWS.

Lesson 2 of 3

Module 3: AWS Console

Module purpose

In this module, you will learn how to access and navigate to some of the most common Amazon Web Services (AWS) services in the console. You will also learn about some of the real-world applications of these services.

Module description

This module includes an educator-led activity to introduce you to AWS core services. You will then work in the AWS console to practice navigating to different services. Finally, you will complete a research activity to learn about how these services are used in different industries.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following eleven categories.

Amazon Simple Storage Service (Amazon S3)

–

A service provided by AWS that stores data for users in the cloud.

Amazon Elastic Compute Cloud (Amazon EC2)

–

A web service that provides secure, resizable compute capacity in the cloud. Think of it as renting a computer in the cloud.

Amazon Elastic Block Store (Amazon EBS)

–

Storage for specific EC2 instances. Think of it as the storage drive for your EC2 instance.

Amazon Relational Database Service (Amazon RDS)

–

This lets developers create and manage relational databases in the cloud. Think of a relational database as a set of data with one-to-one relationships. For example, a database of transactions in a department store would match every customer with their purchases. Amazon RDS lets developers track large amounts of this data, and organize and search through it easily. Relational databases are equipped with nonprocedural structured query language (SQL) that simplifies interactions with the database.

Amazon DynamoDB

–

The AWS nonrelational database service. Data is stored in key-value pairs.

AWS Lambda

–

Lambda lets you run code without provisioning or managing servers. You pay only for the compute time you consume—there is no charge when your code is not running. With Lambda, you can run code for virtually any type of application or backend service—all with zero administration. Upload your code, and Lambda takes care of everything required to run and scales your code with high availability. You can set up your code to automatically start from other AWS services or call it directly from any web or mobile app.

Amazon Virtual Private Cloud (Amazon VPC)

–

A service that provides a virtual network that is dedicated to your AWS account. It is logically isolated from other virtual networks in the AWS Cloud. All your AWS services can be launched from a VPC. It is useful for protecting your data and managing who can access your network.

AWS Identity and Access Management (IAM)

–

Involves the application of controls to users who need access to computing resources.

AWS CloudTrail

–

Monitors every action that is performed on your AWS account for security purposes.

Amazon CloudWatch

–

CloudWatch is a monitoring service to monitor your AWS resources and the applications that you run on AWS.

Amazon Redshift

–

The AWS data-warehousing service can store massive amounts of data in a way that makes it fast to query for business intelligence purposes.

Background and misconceptions

This module introduces a lot of new AWS services, features, and resources. The following websites provide good introductory information about these topics:

- [Amazon VPC Overview\(opens in a new tab\)](#)
- [Lambda Overview\(opens in a new tab\)](#)
- [Amazon EC2 Overview\(opens in a new tab\)](#)
- [Amazon S3 Overview\(opens in a new tab\)](#)
- [Amazon EBS Overview\(opens in a new tab\)](#)
- [Amazon RDS Overview\(opens in a new tab\)](#)
- [DynamoDB Overview\(opens in a new tab\)](#)
- [Amazon Redshift Overview\(opens in a new tab\)](#)
- [CloudWatch Overview\(opens in a new tab\)](#)
- [CloudTrail Overview\(opens in a new tab\)](#)

AWS Cloud services include a host of different tools that work together to cover all the computing needs of a user, completely in the cloud.

Amazon VPC is the virtual network you define where you launch AWS resources. This virtual network closely resembles a traditional network that you operate in your own data center, with the benefits of using the scalable infrastructure of AWS.

Here are a few differences between the services:

Amazon S3 and Amazon EBS are both forms of data storage. There are a few key differences:

1. Amazon EBS can only be used when attached to an EC2 instance, and Amazon S3 can be accessed on its own.
2. Amazon EBS cannot hold as much data as Amazon S3.
3. Amazon EBS can only be attached to one EC2 instance, whereas data in an S3 bucket can be accessed by multiple EC2 instances.
4. Amazon S3 experiences more delays than Amazon EBS when writing data.

Amazon RDS, Amazon Redshift, and DynamoDB are all related to databases, but there are differences:

1. Amazon RDS is the classic relational database that uses SQL Server, Oracle Database, Amazon Aurora, or other similar database systems. Think of this as a gradebook where each student is a row, and they all have the same number of assignments (columns) that they are attached to. Businesses can use code to search for specific data based on the information in the rows and columns. Amazon RDS is useful for companies that store a moderate amount of data that is uniform in structure, meaning each unique ID, like student name, is attached to the same number of data points (grades).
2. Amazon Redshift is a relational database like Amazon RDS, but it is specifically made for huge amounts of data. It is a data-warehousing tool that is good for users working with big data.
3. DynamoDB is a nonrelational database, meaning that you can't use traditional systems like SQL Server or Aurora. Each item in the database is stored as a key-value pair or JavaScript Object Notation (JSON). This means that each row could have a different number of columns. The entries do not all have to be matched in the same way. This permits flexibility in processing that works well for blogging, gaming, and advertising.

CloudTrail and CloudWatch are both cloud monitoring services, but they perform different functions:

CloudTrail monitors all the actions that users have taken in a given AWS account. This means that any time someone uploads data, runs code, creates an EC2 instance, changes an S3 drive type, or any other action that can be done on AWS, CloudTrail will keep a log of it. This is very useful for security reasons so that administrators can know who is using their account and what they are doing. If anything goes wrong or if a security issue arises, CloudTrail will be the best evidence to figure out what happened.

CloudWatch monitors what all the different services are doing and what resources they are using. If CloudTrail is the people monitor, CloudWatch is the service monitor. CloudWatch is great for making sure that your cloud services are running smoothly and not using more or

fewer resources than you expect, which is important for budget tracking. CloudWatch is great for making sure all your different resources are running, which can get tricky if a large company is using hundreds of different machines and drives. Monitors and alarms can be set up through CloudWatch to automatically initiate an alert when a metric hits a specific limit.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. What is a cloud service that you use regularly? What benefit does it provide you? Is there any downside to using this cloud service?

Following are brief descriptions of IaaS, PaaS, and SaaS to help you answer the question.

Infrastructure as a Service (IaaS): These services contain the basic building blocks of the cloud. They provide access to computers, both physical and virtual, as well as to network features and storage space. Think of IaaS like renting a kitchen. You can use all the different appliances (mixers, blenders, sinks), and you can rent a kitchen with better appliances if you need them.

- Examples: Amazon EC2, Rackspace, Google Compute Engine

Platform as a Service (PaaS): These services are the tools needed to manage the underlying hardware and launch applications. They include programming environments, application testing platforms, and application launchers. Think of PaaS as going to a restaurant. You are not managing the appliances in the kitchen, but you can ask the waiter or chef to make things however you want.

- Examples: AWS Elastic Beanstalk, Microsoft Azure, Google App Engine

Software as a Service (SaaS): These services are the actual applications and software provided over the internet. You are not responsible for managing or installing the software; you simply access and use it. Think of SaaS as eating at an all-you-can-eat buffet. You have access to whatever food is being served. You don't control what is made or how, but you can use as much as you want.

- Examples: Dropbox, Slack, Spotify, YouTube, Microsoft Office 365, Gmail

2. Most of you have used a SaaS type of cloud service. In the future, how might you use a PaaS or IaaS cloud service? How can the services help you in a career or accomplish a goal that you have?

3. What experience, if any, do you have with the AWS console and services? Which ones have you used, what have you created, are there any that you want to know more about?

Activity 1: Learning the AWS Core Services

Overview

You will take notes on the core services provided by AWS. As you do so, you will navigate the AWS console to find each service.

Objectives

- Identify features and functions of commonly used AWS services.
- Access and navigate to commonly used AWS services.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **Describe one of the real-world uses of an AWS service that you learned about. How does the service help the company or industry that uses it?**
- **Which service do you think is the most important? Which service do you think you will likely use in your planned career area?**

Activity 2: AWS Service Case Studies

Overview

You will be given a real-world industry example in which you will describe the AWS services being used and identify what benefit they are providing.

Objective

- Analyze how AWS services are used in real-world industries.

Activity instructions

1. Your educator will assign you (or your group) a case study.
2. Read the assigned case study and answer the following questions:
 1. What is the company and what does the company create or what service do they provide?
 2. What AWS cloud services does the company use and what do they use the AWS services for?
 3. What benefits are the cloud services providing to the company?
3. You can use your notes and any other resources you are familiar with to complete the task.
4. When you are ready, be prepared to share your findings with the class.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **What surprised you about the case study you read?**
- **Was any part of the cloud service usage confusing?**
- **How do you think the company could have addressed the problem without using cloud services? Is this solution as beneficial to the company? Why or why not?**
- **What, if any, questions do you still have pertaining to the case study you read?**

Optional connection

Follow your educator's instructions for completing this activity

Further case studies

1. Follow this link to the case studies: [Customer Success Stories\(opens in a new tab\)\(opens in a new tab\)](#)
2. Select another business and complete another case study worksheet for that business.

Unplugged option

Do the same activity as previously described with the case studies provided by your educator.

Additional connections

- The [AWS Cloud Practitioner Essentials course\(opens in a new tab\)](#) has videos that cover all the AWS services.

Lesson 2 of 3

Module 4: Virtual Servers

Module purpose

In this module, you will learn how to create an Amazon Elastic Compute Cloud (Amazon EC2) instance and use it to host a website. You will also learn the purpose of access keys, the Domain Name System (DNS), Amazon Route 53, and Virtual Private Clouds.

Module description

The activities in this module include hands-on work creating an EC2 instance, attaching an access key, accessing the instance using the command console, and creating a simple website and hosting it on the EC2 instance using an Amazon Simple Storage Service (Amazon S3) bucket.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following eleven categories.

Amazon Elastic Compute Cloud (Amazon EC2)

–

A web service that provides secure, resizable compute capacity in the cloud. Think of it as renting a computer in the cloud.

Amazon Simple Storage Service (Amazon S3)

–

A service provided by Amazon Web Services (AWS) that stores data for users in the cloud.

Domain Name System (DNS)

–

A naming system for computers, devices, and resources connected to a network.

S3 bucket

–

A container of objects (such as images, audio files, video files, documents, and so on) in Amazon S3.

Policy

–

An object in AWS that, when associated with an identity or a resource, defines its permissions. AWS evaluates these policies when a principal entity (user or role) makes a request.

Domain name

–

A label that identifies a network of computers under centralized control.

Amazon Route 53

–

The AWS DNS web service.

Virtual private cloud (VPC)

–

A virtual network dedicated to your AWS account. It is logically isolated from other virtual networks in the AWS Cloud. All your AWS services can be launched from a VPC. It is useful for protecting your data and managing who can access your network.

JavaScript Object Notation (JSON)

–

A syntax for storing and exchanging data.

Dynamic website

–

A website that changes based on user interactions; often built using Python, JavaScript, PHP, or ASP with Hypertext Markup Language (HTML).

Static website

–

A website that does not change based on user interactions; typically built using HTML and Cascading Style Sheets (CSS).

Background and misconceptions

Amazon EC2 is one of the most basic and commonly used AWS cloud services.

Fundamentally, it provides users with computing power in the cloud that can be used to complete tasks: anything from machine learning, to running applications, querying databases, and streaming video.

There are two types of websites: static and dynamic. Static websites require no actions to take place on the server. Dynamic websites require interactions with the server to respond to requests made on the client machines. In this module, you will need to create an S3 bucket, which is like a folder, to store your static website. You will be making your bucket public so that anyone can view the contents. This makes sense for a public website, but you will want to

consider the privacy controls for different types of data. For instance, if you are storing a private journal in the cloud, you would not want to give the public access.

The object that controls the security and access permissions in AWS is called a policy. Policies are written in a programming language called JSON. You do not have to know how to write JSON for this module; you will be copying and pasting the code directly. You should be aware that JSON is the programming language used for AWS policies and works by allowing or denying actions or permissions.

You will use a text editor such as Notepad to create an index.html file that will serve as the code for your website. Similar to the bucket policy, you do not need to know HTML code because you will be copying and pasting. If you have experience with HTML, you can add code to customize your website.

To register a domain name for your website, you can use Route 53. Registering a domain name will cost money, so this will be optional, but you can still navigate to the service to see how it works.

You will also launch an EC2 instance that you can later use as a server to host your dynamic website.

In general, it is recommended that users create EC2 instances and S3 buckets within a VPC. The VPC is a private network through which the S3 buckets or EC2 instances will be accessed. Using a VPC allows you to strictly control who has access to your resources and from where they can get access. VPCs can be broken down into subnets to give even more granular control over access and security. A VPC is Region based.

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Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **Often, the purpose of a website (or app) is different to a user than to the creator. For example, Google's search engine provides a service to users by bringing them fast and effective search abilities. For Google, however, searches provide data about users that Google can analyze to present users with targeted advertisements. Think about a website (or app) that you use often. What is the purpose of the website (or app) to the user and the creator? Are these purposes similar or different?**
2. **A website's domain name is often our first impression of a website, even before we look at the content. Names like Wikipedia, Twitter, and Facebook evoke ideas for how they will be used. However, names like Google and Amazon don't tell you much about what they are for. What factors do you think are important when**

naming a website and why? How does a website's name impact the user's experience and impressions of the website? When naming your own website, what are at least two factors that will be most important to you?

3. Many websites store data about your usage of the website on your computer (called cookies) or on the website (called session variables). This data allows the website to not only personalize your usage, but also to learn about your patterns and history of usage. This means that websites can give you better recommendations and quickly auto-complete forms. However, it also means they can sell your information to advertisers. This can mean easier and more efficient access at the cost of privacy. When it comes to this type of data gathering, do you think the trade-off is worth it? Why or why not? Should websites have to be more transparent about what types of data they are gathering? Should you be able to opt out?

Activity: All About Amazon EC2, Amazon S3, and DNS

Overview

You will learn about EC2 instances, S3 buckets, and DNS services.

Objectives

- Explain how an S3 bucket and EC2 instance interact to allow for website hosting.
- Explain the functions of the DNS.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- Did anyone have differences in the recommendations for instance type or storage type? If so, why?
- How do an S3 bucket and EC2 instance interact to allow for website hosting?

Lab 1: Launching an EC2 Instance

Overview

The objective of this lab is to use the AWS Management Console to launch an EC2 instance that hosts a simple website.

Objective

- Create an EC2 instance that hosts a simple website.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- **Do any steps for creating an EC2 instance to host a website need further explanation? Where do you think you could look to find out more about that part of the process?**
- **You opened your server to be accessed from any port. How do you think setting up the security group would differ for a large business such as AWS?**
- **Have you any other questions about the process of creating an EC2 instance and running a website?**

Lab 2: Creating an S3 Bucket

Overview

In this lab, you will create an S3 bucket and upload a simple HTML website to the bucket. You will then set the bucket to host a static webpage and access the page.

Objective

- Create an S3 bucket.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- **Do any steps in creating an S3 bucket to host a website need further explanation? Where do you think you could look to find out more about that part of the process?**
- **S3 buckets automatically scale to fit the size of the data stored within. Why do you think this is useful for companies that use the Amazon S3 service?**
- **What types of data do you think can benefit from being stored in the cloud? How does storing the data in the cloud make your data more safe and secure?**
- **How do you think S3 buckets are related to EC2 instances?**

Optional connection

Follow your educator's instructions for completing this activity.

1. Brainstorm ideas for a personal website:
 1. Topic ideas
 2. Issues that interest you
 3. Hobbies

4. Audience
 5. Themes
 6. Styles
2. Create an outline for the content that would be on the website.
 3. Draw a rough draft of the website's layout.

Additional connections

- [Amazon EC2\(opens in a new tab\)](#)
- [Amazon S3\(opens in a new tab\)\(opens in a new tab\)](#)
- [Uploading, Downloading, and Working with Objects in Amazon S3\(opens in a new tab\)\(opens in a new tab\)](#)
- [Tutorial: Configuring a Static Website on Amazon S3\(opens in a new tab\)\(opens in a new tab\)](#)
- [What Is Amazon EC2?\(opens in a new tab\)\(opens in a new tab\)](#)
- [Host a Static Website](#)

Lesson 2 of 3

Module 5: Content Delivery

Module purpose

The purpose of this module is to learn about the Amazon Web Services (AWS) content delivery network (CDN), Amazon CloudFront. You will learn key vocabulary related to content delivery and understand why having a CDN is important.

Module description

In this module, we will discuss the importance of edge locations and caching for a CDN. You will then create a CloudFront distribution and attach it to an Amazon Simple Storage Service (Amazon S3) bucket that contains a Hypertext Markup Language (HTML) website file.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following seven categories.

Amazon CloudFront

—

A fast content delivery network (CDN) service that securely delivers data, videos, applications, and application programming interfaces (APIs) to customers globally with low latency and high transfer speeds, all within a developer-friendly environment.

AWS Direct Connect

—

Direct Connect is a cloud service solution that provides the ability to establish a dedicated network connection from your on-premises environment to AWS. Using Direct Connect, you can establish private connectivity between AWS and your data center, office, or colocation environment, which in many cases can reduce your network costs, increase bandwidth throughput, and provide a more consistent network experience than internet-based connections.

Caching

–
Storing frequently requested data in edge locations so that it can be accessed more quickly.

Content delivery network (CDN)

–
A system of distributed servers (network) that delivers pages and other web content to a user, based on the geographic locations of the user, the origin of the webpage, and the content delivery server.

Distribution

–
Instructs CloudFront where to get the information that it is caching in the edge locations and how to track and manage the content delivery.

Edge location

–
A site where data can be stored for lower latency. Often, edge locations will be close to high-population areas that will generate high traffic volumes.

Origin

–
A complex type that describes the Amazon S3 bucket, Hypertext Transfer Protocol (HTTP) server (for example, a web server), or other server from which CloudFront gets your files.

Background and misconceptions

Due to the nature of the web, certain content is requested more frequently and is expected to be delivered almost instantaneously. A website whose origin is on a server in California might host something that goes viral in Sweden. In this case, there will be a sudden rush of requests for that data, which could lead to increased latency and even crash the website if the server cannot handle the traffic.

CloudFront works with the edge locations that are part of the AWS Global Infrastructure. Together, they facilitate frequently requested data being cached in the edge locations. While the initial request prompts CloudFront to load the file into the cache, subsequent requests can be fulfilled much more quickly, and some of the work can be offloaded from the origin server.

This process can also be seen at a more local level on something like the Amazon.com front page. Products that are being shown on the front page can be cached because every person that visits the Amazon.com site will automatically request those products from the server, which could lead to a slow down. Caching permits these front-page products to be stored in edge locations for faster access. The rest of the products can remain stored on the origin server because they will be requested less often and can tolerate a slightly higher latency.

Caching in edge locations is not permanent, and all cached data has a time to live (TTL), which is the length of time that it is cached for.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **Have you ever tried to access a webpage, stream a video, or download a file, and it didn't work or it worked too slowly? What was it? How did this make you feel? Why do you think this happens?**

2. What does the term *net neutrality* mean? How does this term relate to a CDN and CloudFront?

3. Should internet access be a human right? Why or why not? Should the government be permitted to restrict certain webpages or online content? Why or why not?

[\(opens in a new tab\)](#)

4. What advantages does internet access give a student over a student without internet access? Are there any advantages to not having internet access?

Activity: Content Distribution

Overview

You will research information related to a CDN. Then discuss and/or present what you find.

Objectives

- Recognize benefits of a CDN.
- Explain the uses of a CDN.

Activity instructions

Open the Content Distribution worksheet and follow the instructions to complete the activity.

Reflect

Following your educator's directions, prepare to ask questions about anything you did not find or did not understand in an open forum discussion with your classmates.

Lab: Using CloudFront as a CDN for a Website

Overview

You will use CloudFront to create a content distribution network (CDN) for a website that is stored in Amazon S3.

Objective

- Configure a CloudFront distribution and attach it to a website.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- Were there any steps in creating an S3 bucket or attaching a CloudFront distribution that need further explanation? Where do you think you can look to find out more about that part of the process?
- Why would having a cloud distribution network like CloudFront be important for a video streaming or audio streaming company, such as Hulu or Spotify?

- Based on what you have learned about cloud distribution networks, what will you think or feel when a website is responding slowly or a video is taking a long time to buffer?
- What types of data do you think are most important to have cached for quick distribution?

Optional connection

Follow your educator's instructions for completing this activity.

CloudFront case studies

1. Navigate to the [CloudFront case studies\(opens in a new tab\)](#) webpage.[\(opens in a new tab\)](#)
2. Pick a company and write a short summary of how the company uses CloudFront.

Unplugged option

1. Select a company that can benefit from using CloudFront.
2. Then make suggestions for:
 1. How the company would benefit from using CloudFront
 2. What type of data the company would distribute with CloudFront

Additional connections

- [AWS Direct Connect Overview\(opens in a new tab\)\(opens in a new tab\)](#)
- [Amazon CloudFront Overview](#)

Lesson 2 of 3

Module 6: Virtual Storage

Module purpose

In this module, you will receive an overview of Amazon Elastic Block Store (Amazon EBS). You will compare Amazon EBS and Amazon Simple Storage Service (Amazon S3). Students will learn about different storage tiers and how to choose the best type of storage for a given scenario.

Module description

You will discuss the benefits and features of Amazon EBS. Then you will analyze real-world case studies related to Amazon EBS. Finally, you will create their own EBS volumes and attach them to an Amazon Elastic Compute Cloud (Amazon EC2) instance.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following five categories.

Amazon Elastic Block Store (Amazon EBS)

–

Storage for specific Amazon Elastic Compute Cloud (Amazon EC2) instances. Think of it as the storage drive for your EC2 instance.

Amazon Elastic Compute Cloud (Amazon EC2)

–

A web service that provides secure, resizable compute capacity in the cloud. Think of it as renting a computer in the cloud.

Hard disk drive (HDD)

–

Slower storage that uses a spinning disk to store data.

Input/Output Operations Per Second (IOPS)

–

A common performance measurement used to benchmark computer storage devices like hard disk drives (HDDs) and solid state drives (SSDs).

Solid state drive (SSD)

–

Very fast storage that uses flash memory instead of a spinning disk.

Background and misconceptions

Amazon EBS is storage for EC2 instances with major benefits:

- Data availability
- Data persistence
- Data encryption
- Snapshots

Amazon EBS storage is implemented as a series of fixed-length blocks that can be read and written by the operating system. There is nothing stored about what these blocks represent or their attributes. The blocks are very much like the New Technology File System (NTFS) or File Allocation Table (FAT) file systems that run on your PC or Mac. This means that they can be accessed quickly.

Amazon S3 storage is implemented as an object that has to be read and written by the application that uses the object. Objects contain metadata—data about the object’s attributes that helps the system to catalog and identify the object. Examples of objects are pictures, videos, and music. Objects cannot be processed incrementally. They have to be read and written in their entirety. This can have performance and consistency implications.

There are several other differences between Amazon S3 and Amazon EBS storage, including differences in cost, throughput, and performance. These differences are discussed on the [Cloud Storage on AWS\(opens in a new tab\)](#) webpage. It is up to the user or application designer to decide whether Amazon S3 or Amazon EBS storage is more appropriate for a given application.

There are two major types of EBS volumes, and each major type has two subtypes. Each type has benefits and drawbacks, so it is important to choose the type that fits best with the work you are using it for.

More information about EBS volume types can be found at the AWS webpage, [Amazon EBS volume types\(opens in a new tab\)](#).

Here are several more key differences between Amazon S3 and Amazon EBS data storage:

- Amazon EBS can only be used when attached to an EC2 instance. In contrast, Amazon S3 can be accessed on its own using Hypertext Transfer Protocol (HTTP) protocols.
- Amazon EBS cannot hold as much data as Amazon S3.
- Amazon EBS can only be attached to one EC2 instance, whereas data in an S3 bucket can be accessed by multiple EC2 instances.
- Amazon S3 experiences more delays than Amazon EBS when writing data.
- EBS volumes are encrypted in their entirety, whereas Amazon S3 objects are encrypted individually by server-side encryption (SSE).
- Amazon EBS includes three types of volumes, whereas Amazon S3 includes more types:
 - S3 Standard
 - S3 Standard-Infrequent Access (S3 Standard-IA)
 - S3 One Zone-Infrequent Access (S3 One Zone-IA)
 - S3 Intelligent-Tiering
 - S3 Glacier
 - S3 Glacier Deep Archive

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **In your opinion, how has cloud computing impacted the way that society interacts with technology? Is it a positive or negative impact overall? Why?**
2. **In an election, it is important to make sure that the vote count is accurate. Do you know how votes are actually counted? In some areas, election officials manually read each ballot and add up the number of votes in each race. Other areas have computerized voting systems that transmit vote totals to the central counting facility. Computerized voting is faster than counting ballots by hand, but some people argue that it is risky because it opens elections up to the possibility of hacking. Do you think that it is a good idea to use cloud services to protect and count votes? Why or why not?**
3. **As a student, how do you think cloud computing services could improve your school? Think about the ways that you turn in work, take exams, attend classes and events, or any other factor related to your school.**

Activity 1: All About Amazon EBS

Overview

In this activity, you will learn about Amazon EBS. You will learn about the different volume types and discuss the benefits that Amazon EBS provides.

Objective

- Recognize the benefits, features, and use cases of the four types of EBS volumes.

Activity instructions

Follow your educator's instructions to complete the activity.

The following information about the benefits of Amazon EBS might help you with the activity:

Data availability

- When you create an EBS volume in an Availability Zone, it is automatically replicated within that zone to prevent data loss due to failure of any single hardware component. After you create a volume, you can attach it to any EC2 instance in the same Availability Zone.
- An EBS volume can be attached to only one instance at a time, but multiple volumes can be attached to a single instance.
- An EBS volume and the instance to which it attaches must be in the same Availability Zone.

Data persistence

- An EBS volume is off-instance storage that can persist independently from the life of an instance. You continue to pay for the volume usage as long as the data persists.
- EBS volumes that are attached to a running instance can automatically detach from the instance with their data intact when the instance is terminated. The volume can then be reattached to a new instance, permitting quick recovery.

Data encryption

- For simplified data encryption, you can create encrypted EBS volumes with the Amazon EBS encryption feature. All EBS volume types support encryption. You can use encrypted EBS volumes to meet a wide range of data-at-rest encryption requirements for regulated or audited data and applications.

Snapshots

- Amazon EBS provides the ability to create snapshots (backups) of any EBS volume and write a copy of the data in the volume to Amazon S3, where it is stored redundantly in multiple Availability Zones. Snapshots of encrypted EBS volumes are automatically encrypted.
- When you create a new volume from a snapshot, it's an exact copy of the original volume at the time the snapshot was taken. EBS volumes that are restored from encrypted snapshots are automatically encrypted.

You might also find the [Amazon EBS volume types \(opens in a new tab\)](#) page useful for your research.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **Why do you think AWS provides four different options for EBS volumes?**
- **Describe what makes each of the four benefits of Amazon EBS so important.**

Activity 2: Amazon EBS Use Cases

Overview

In this activity, you will read real-world use cases related to cloud computing and recommend the best type of EBS volume for each use case, citing details about the volume that make it the best option.

Objective

- Analyze a use case and recommend the best type of virtual storage for the particular situation.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss this question.

- **What factor most influenced your recommendation for the type of volume? Why?**

Lab: Attaching an EBS Volume

Overview

In this lab, you will create an EC2 instance if you do not already have one. Students will then attach an EBS volume to their EC2 instance.

Objective

- Create an EBS volume and attach it to an EC2 instance.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- **Was any step in the lab confusing? Where could you look for answers?**
- **How do you think Amazon EBS could help a school run more effectively?**
- **What is an issue that is important to you, and how could you use your knowledge of Amazon EBS and other cloud services to make an impact on that issue?**

Optional connection

Follow your educator's instructions for completing this activity.

Amazon EBS current events

1. Navigate to the [Amazon Elastic Block Store\(opens in a new tab\)](#) page.
2. Scroll down to the **What's new with Amazon EBS** section.
3. Select and read about a recent Amazon EBS update.
 1. Summarize the change or update.
 2. Give an example of how the update would improve EBS.

Unplugged option: Your own Amazon EBS update

1. Brainstorm ideas for what you would add or change about EBS, if you could.
2. Select one or two ideas and explain why the change would be beneficial and how it would be used.

Additional connections

- [Amazon EBS Overview\(opens in a new tab\)\(opens in a new tab\)](#)
- [Attach an Amazon EBS volume to an instance\(opens in a new tab\)\(opens in a new tab\)](#)
- [Amazon EBS volume types](#)

Lesson 2 of 3

Module 6: Virtual Storage

Module purpose

In this module, you will receive an overview of Amazon Elastic Block Store (Amazon EBS). You will compare Amazon EBS and Amazon Simple Storage Service (Amazon S3). Students will learn about different storage tiers and how to choose the best type of storage for a given scenario.

Module description

You will discuss the benefits and features of Amazon EBS. Then you will analyze real-world case studies related to Amazon EBS. Finally, you will create their own EBS volumes and attach them to an Amazon Elastic Compute Cloud (Amazon EC2) instance.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following five categories.

Amazon Elastic Block Store (Amazon EBS)

—

Storage for specific Amazon Elastic Compute Cloud (Amazon EC2) instances. Think of it as the storage drive for your EC2 instance.

Amazon Elastic Compute Cloud (Amazon EC2)

—

A web service that provides secure, resizable compute capacity in the cloud. Think of it as renting a computer in the cloud.

Hard disk drive (HDD)

–

Slower storage that uses a spinning disk to store data.

Input/Output Operations Per Second (IOPS)

–

A common performance measurement used to benchmark computer storage devices like hard disk drives (HDDs) and solid state drives (SSDs).

Solid state drive (SSD)

–

Very fast storage that uses flash memory instead of a spinning disk.

Background and misconceptions

Amazon EBS is storage for EC2 instances with major benefits:

- Data availability
- Data persistence
- Data encryption
- Snapshots

Amazon EBS storage is implemented as a series of fixed-length blocks that can be read and written by the operating system. There is nothing stored about what these blocks represent or their attributes. The blocks are very much like the New Technology File System (NTFS) or File Allocation Table (FAT) file systems that run on your PC or Mac. This means that they can be accessed quickly.

Amazon S3 storage is implemented as an object that has to be read and written by the application that uses the object. Objects contain metadata—data about the object’s attributes that helps the system to catalog and identify the object. Examples of objects are pictures, videos, and music. Objects cannot be processed incrementally. They have to be read and written in their entirety. This can have performance and consistency implications.

There are several other differences between Amazon S3 and Amazon EBS storage, including differences in cost, throughput, and performance. These differences are discussed on the [Cloud Storage on AWS\(opens in a new tab\)](#) webpage. It is up to the user or application designer to decide whether Amazon S3 or Amazon EBS storage is more appropriate for a given application.

There are two major types of EBS volumes, and each major type has two subtypes. Each type has benefits and drawbacks, so it is important to choose the type that fits best with the work you are using it for.

More information about EBS volume types can be found at the AWS webpage, [Amazon EBS volume types\(opens in a new tab\)](#).

Here are several more key differences between Amazon S3 and Amazon EBS data storage:

- Amazon EBS can only be used when attached to an EC2 instance. In contrast, Amazon S3 can be accessed on its own using Hypertext Transfer Protocol (HTTP) protocols.
- Amazon EBS cannot hold as much data as Amazon S3.

- Amazon EBS can only be attached to one EC2 instance, whereas data in an S3 bucket can be accessed by multiple EC2 instances.
- Amazon S3 experiences more delays than Amazon EBS when writing data.
- EBS volumes are encrypted in their entirety, whereas Amazon S3 objects are encrypted individually by server-side encryption (SSE).
- Amazon EBS includes three types of volumes, whereas Amazon S3 includes more types:
 - S3 Standard
 - S3 Standard-Infrequent Access (S3 Standard-IA)
 - S3 One Zone-Infrequent Access (S3 One Zone-IA)
 - S3 Intelligent-Tiering
 - S3 Glacier
 - S3 Glacier Deep Archive

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **In your opinion, how has cloud computing impacted the way that society interacts with technology? Is it a positive or negative impact overall? Why?**
2. **In an election, it is important to make sure that the vote count is accurate. Do you know how votes are actually counted? In some areas, election officials manually read each ballot and add up the number of votes in each race. Other areas have computerized voting systems that transmit vote totals to the central counting facility. Computerized voting is faster than counting ballots by hand, but some people argue that it is risky because it opens elections up to the possibility of hacking. Do you think that it is a good idea to use cloud services to protect and count votes? Why or why not?**
3. **As a student, how do you think cloud computing services could improve your school? Think about the ways that you turn in work, take exams, attend classes and events, or any other factor related to your school.**

Activity 1: All About Amazon EBS

Overview

In this activity, you will learn about Amazon EBS. You will learn about the different volume types and discuss the benefits that Amazon EBS provides.

Objective

- Recognize the benefits, features, and use cases of the four types of EBS volumes.

Activity instructions

Follow your educator's instructions to complete the activity.

The following information about the benefits of Amazon EBS might help you with the activity:

Data availability

- When you create an EBS volume in an Availability Zone, it is automatically replicated within that zone to prevent data loss due to failure of any single hardware component. After you create a volume, you can attach it to any EC2 instance in the same Availability Zone.
- An EBS volume can be attached to only one instance at a time, but multiple volumes can be attached to a single instance.
- An EBS volume and the instance to which it attaches must be in the same Availability Zone.

Data persistence

- An EBS volume is off-instance storage that can persist independently from the life of an instance. You continue to pay for the volume usage as long as the data persists.
- EBS volumes that are attached to a running instance can automatically detach from the instance with their data intact when the instance is terminated. The volume can then be reattached to a new instance, permitting quick recovery.

Data encryption

- For simplified data encryption, you can create encrypted EBS volumes with the Amazon EBS encryption feature. All EBS volume types support encryption. You can use encrypted EBS volumes to meet a wide range of data-at-rest encryption requirements for regulated or audited data and applications.

Snapshots

- Amazon EBS provides the ability to create snapshots (backups) of any EBS volume and write a copy of the data in the volume to Amazon S3, where it is stored redundantly in multiple Availability Zones. Snapshots of encrypted EBS volumes are automatically encrypted.
- When you create a new volume from a snapshot, it's an exact copy of the original volume at the time the snapshot was taken. EBS volumes that are restored from encrypted snapshots are automatically encrypted.

You might also find the [Amazon EBS volume types\(opens in a new tab\)](#) page useful for your research.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **Why do you think AWS provides four different options for EBS volumes?**
- **Describe what makes each of the four benefits of Amazon EBS so important.**

Activity 2: Amazon EBS Use Cases

Overview

In this activity, you will read real-world use cases related to cloud computing and recommend the best type of EBS volume for each use case, citing details about the volume that make it the best option.

Objective

- Analyze a use case and recommend the best type of virtual storage for the particular situation.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss this question.

- **What factor most influenced your recommendation for the type of volume? Why?**

Lab: Attaching an EBS Volume

Overview

In this lab, you will create an EC2 instance if you do not already have one. Students will then attach an EBS volume to their EC2 instance.

Objective

- Create an EBS volume and attach it to an EC2 instance.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- **Was any step in the lab confusing? Where could you look for answers?**
- **How do you think Amazon EBS could help a school run more effectively?**
- **What is an issue that is important to you, and how could you use your knowledge of Amazon EBS and other cloud services to make an impact on that issue?**

Optional connection

Follow your educator's instructions for completing this activity.

Amazon EBS current events

1. Navigate to the [Amazon Elastic Block Store\(opens in a new tab\)](#) page.
2. Scroll down to the **What's new with Amazon EBS** section.
3. Select and read about a recent Amazon EBS update.
 1. Summarize the change or update.
 2. Give an example of how the update would improve EBS.

Unplugged option: Your own Amazon EBS update

1. Brainstorm ideas for what you would add or change about EBS, if you could.
2. Select one or two ideas and explain why the change would be beneficial and how it would be used.

Additional connections

- [Amazon EBS Overview\(opens in a new tab\)\(opens in a new tab\)](#)
- [Attach an Amazon EBS volume to an instance\(opens in a new tab\)\(opens in a new tab\)](#)
- [Amazon EBS volume types](#)

Lesson 2 of 3

Module 8: Security II

Module purpose

The purpose of this module is to continue to develop your understanding of cloud security. The module covers the differences between AWS Shield and AWS WAF. You will learn what a distributed denial of service (DDoS) attack is. You will also learn about Amazon Inspector and AWS Artifact.

Module description

In this module, you will be given scenarios related to the AWS Cloud. You will also determine whether security best practices are being followed and recommend steps to fix any security lapses.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following five categories.

AWS Shield

—

A managed DDoS protection service that safeguards applications running on Amazon Web Services (AWS).

AWS WAF

–

A service that gives you control over which traffic to allow or block to your web applications by defining customizable web security rules.

Distributed denial of service (DDoS)

–

A malicious attempt to make a targeted system, such as a website or application, unavailable to end users. To achieve this, attackers use a variety of techniques that consume network or other resources, interrupting access for legitimate end users.

Amazon Inspector

–

An automated security assessment service. It helps you test the network accessibility of your Amazon Elastic Compute Cloud (Amazon EC2) instances and the security state of your applications running on the instances.

AWS Artifact

–

A central resource for compliance-related information. It provides on-demand access to AWS security and compliance reports and select online agreements.

Background and misconceptions

Four areas of security must be addressed for cloud computing:

- Data: Protecting the information that is stored and processed in the cloud
- Permissions: Regulating who has access to the resources and data in the cloud
- Infrastructure: Protecting the machines and hardware that run, store, and process data in the cloud
- Assessment: Inspecting the infrastructure, permissions, and data to make sure that they are secure

In this module, we will address infrastructure and assessment.

- Shield and AWS WAF are services that address attacks on infrastructure, primarily the network used to access cloud resources.
- Amazon Inspector addresses assessment by investigating how well the cloud resources we use, such as our EC2 instances, are being protected. It also investigates whether these resources are following best practice guidelines.

The nature of the cloud makes it susceptible to cyberattacks that can make websites, applications, and processes stop working. When a billion-dollar company such as Amazon relies on the cloud, the company needs to know that it is protected against attacks.

One major type of cyberattack is called a DDoS. A DDoS occurs when attackers set up programs that send thousands or millions of requests to an app, website, or service at the same time. This spike in traffic can consume resources to the point where the website or app is no longer accessible for legitimate users.

DDoS attacks can be done for many reasons including competition, political motivation, or economic motivation. Whatever the reason, AWS has services that minimize these threats for cloud users.

Shield works in conjunction with Elastic Load Balancing, Amazon CloudFront, and Amazon Route 53 to protect against DDoS attacks. There are two tiers of service:

1. AWS Shield Standard is available to all AWS users at no extra cost. It protects users from the most common DDoS attacks. This protection is applied automatically and transparently to any ELB resources, CloudFront distributions, and Route 53 resources.
2. AWS Shield Advanced provides additional DDoS mitigation capability for volumetric attacks, intelligent attack detection, and mitigation for attacks at the application and network layers. Users get 24/7 access to the DDoS Response Team (DRT) for custom mitigation during attacks. Users also get advanced real-time metrics and reports, and DDoS cost protection to guard against bill spikes in the aftermath of a DDoS attack. Shield Advanced is available at an additional cost.

AWS WAF is another defensive tool provided by AWS. It helps protect web applications from exploits that might affect availability or security or consume resources. AWS WAF can monitor an application's web traffic and decide which traffic to let through based on the specific request being made. AWS users can create their own set of rules to direct what traffic is allowed by AWS WAF down to specific IP addresses.

Amazon Inspector does not actively protect your AWS services. Instead, it monitors the services and gives you updates on any vulnerabilities or any place where you are not following best practices. This can be useful to experts to make sure they are meeting security compliance standards and for new users who can learn about best practices.

Amazon Inspector works by running an assessment on your EC2 instances; the assessment checks for several predetermined best practices. After performing an assessment, Amazon Inspector produces a detailed list of security findings prioritized by level of severity. These findings can be reviewed directly or as part of detailed assessment reports that are available through the Amazon Inspector console or API.

Amazon Inspector security assessments help you check for unintended network accessibility of your EC2 instances and for vulnerabilities on those EC2 instances. Amazon Inspector assessments are offered to you as predefined rules packages mapped to common security best practices and vulnerability definitions. Examples of built-in rules include checking for access to your EC2 instances from the internet, remote root login being activated, or vulnerable software versions installed. AWS security researchers regularly update these rules.

AWS Artifact is a centralized resource for compliance-related information. Different organizations require cloud service providers (CSPs) to meet many different certifications and rules to host their data or process requests. Organizations that handle sensitive data such as bank information, personal information, or medical records must ensure that their cloud service meets certain security standards. AWS Artifact lists and gives details about the different compliance standards they meet.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **What might motivate someone to initiate a cyberattack against a company? What might attackers have to gain? Include an example of a company or a type of business and a kind of cyberattack it might be a victim of.**
2. **Do you think there should be different security standards for the cloud based on the type of data that is being stored or processed? Why do you think that? Give an example. How do you think security differs between data stored in the cloud and data stored on premises?**
3. **What character traits do you think a successful cloud security administrator would need? Why? Would this be a role that you would be interested in?**

Activity 1: AWS Cloud Security Basics

Overview

In this activity, you will take notes on Shield and AWS WAF. You will also learn about DDoS attacks and how a customer can use Amazon Inspector to help secure cloud services. Finally, you will recommend the most useful security tool for a given scenario.

Objectives

- Compare the uses of Shield and AWS WAF.
- Explain functions and features of Amazon Inspector and AWS Artifact.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss this question.

- **Compare and contrast Shield and AWS WAF, giving at least one similarity and one difference.**

Activity 2: AWS Artifact and Compliance Hunt

Overview

In this activity, you will learn about AWS Artifact. You will also choose a compliance program and summarize the details. Finally, you will discuss your findings with the class.

Objective

- Explain functions and features of Amazon Inspector and AWS Artifact.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss this question.

- What industry did you read about? Why does that industry use a compliance program to secure their cloud services?

Optional connection

More compliance programs

1. Navigate to [AWS Compliance Programs\(opens in a new tab\)](#).
2. Select a different program than the one you read about in class.
 1. Read about the compliance program.
 2. Summarize the details.
 3. Explain why the program is important to that industry's cloud security.

Unplugged option

1. Think of an industry that interests you.
2. Write down why it would be important for that industry to secure its cloud services.
3. List three rules that you think would be part of that industry's compliance program.

Additional connections

- [Amazon Inspector\(opens in a new tab\)](#)
- [Amazon Inspector FAQs\(opens in a new tab\)](#)
- [AWS Shield\(opens in a new tab\)](#)
- [AWS Shield FAQs\(opens in a new tab\)](#)
- [AWS Shield - Protect Your Application from DDoS Attacks\(opens in a new tab\)](#)
- [AWS WAF\(opens in a new tab\)](#)
- [AWS WAF FAQs\(opens in a new tab\)](#)
- [AWS Artifact\(opens in a new tab\)](#)
- [AWS Artifact FAQs\(opens in a new tab\)](#)
- [AWS Best Practices for DDoS Resiliency](#)

Lesson 2 of 3

Module 9: Monitoring the Cloud

Module purpose

The purpose of this module is for you to learn about the tools that Amazon Web Services (AWS) provides for monitoring cloud services. These include AWS Config, AWS CloudTrail, and Amazon CloudWatch.

Module description

It is important when operating in the cloud to keep track of activities, because there is probably a cost associated with each one. AWS assists with monitoring, logging, and reporting on the usage of its services by providing tools to do so. You will explore these tools in this module.

In the lab, you will set up an alert using CloudWatch and monitor CloudTrail log files. You will also discuss the different uses of CloudTrail and CloudWatch. Lastly, you will determine which services are best for a given scenario.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following four categories.

Amazon CloudWatch

–

A monitoring service to monitor your AWS resources and the applications that you run on AWS

AWS CloudTrail

–

A service to monitor and log every action that is performed on your AWS account for security purposes

AWS Config

–

A service that lets you assess, audit, and evaluate the configurations of your AWS resources

Amazon Simple Notification Service (Amazon SNS)

–

An AWS tool that lets you send texts, emails, and messages to other cloud services and send notifications in various forms from the cloud to the client

Background and misconceptions

AWS provides many interconnected services that provide a complex basis with which to accomplish tasks in the cloud. As businesses grow, they can be running multiple interconnected AWS accounts. Each account might run dozens of instances that process thousands of gigabytes of data, serving millions of people and representing billions of dollars. No matter a company's size, it is essential to monitor and track your cloud services. This helps you to ensure that all of the cloud assets are running smoothly and to be aware if anything out of the ordinary occurs.

AWS provides powerful tools to monitor all of the cloud services. These tools work together to provide a suite of services that empower cloud users with knowledge.

CloudWatch is a monitoring service to monitor your AWS resources and the applications that you run on AWS.

CloudTrail and **CloudWatch** are both cloud-monitoring services, but they perform different functions:

- **CloudTrail** monitors and logs all the actions that users have taken in a given AWS account. This means that CloudTrail logs each time someone uploads data, runs code, creates an Amazon Elastic Compute Cloud (Amazon EC2) instance, or performs any other action.
- **CloudWatch** monitors what all the different services are doing and which resources they are using. CloudTrail logs activities, whereas CloudWatch monitors activities. CloudWatch helps you make sure that

your cloud services are running smoothly. The services can also help you to not use more or fewer resources than you expect, which is important for budget tracking.

AWS Config is a service that lets you assess, audit, and evaluate the configurations of your AWS resources. AWS Config continuously monitors and records your AWS resource configurations and lets you automate the evaluation of recorded configurations against desired configurations.

Image source: [\(opens in a new tab\)AWS Config\(opens in a new tab\)](#)

For a full description of the image, expand the following block.

For accessibility

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Amazon SNS is how AWS communicates within the cloud and with the outside world. When an event is initiated or a program alerts AWS to send out notifications, Amazon SNS sends the messages to users or other AWS services.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **What tools do you use to stay organized and keep track of your life, work, and schedule? Why are these tools important? What kinds of tools would be helpful to monitor or keep track of your resources in the cloud?**
2. **Have you ever missed or been late to an event you had scheduled, or forgotten an assignment? What happened? How might you have prevented the error? Do you think a similar error might happen when using cloud services with AWS? How might this be prevented?**
3. **A cell phone company uses AWS to let users download mobile apps that let them print remotely from their devices. What data points do you think this company needs to keep track of in their cloud services? Why?**

Activity: CloudTrail, CloudWatch, and AWS Config

Overview

In this activity, you will compare CloudTrail and CloudWatch. You will also learn about AWS Config.

Objective

- Compare CloudTrail and CloudWatch.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **Compare and contrast CloudWatch, CloudTrail, and AWS Config. How are they similar? How are they different? Give an example of when each service would be the most useful.**

Lab: Creating a CloudWatch Alarm That Initiates an Amazon SNS Message

Overview

In this lab, you will create an Amazon CloudWatch alert that sends a message to Amazon SNS to send an email or text when the account has spent over a certain amount of money.

Objective

- Use CloudWatch to set up a text alert event.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- **Why do you think it is best to create a topic and subscribe to it rather than just having the alarm send the message directly to you?**
- **Other than billing metrics, you can also set alarms based on different AWS service metrics. What types of events do you think would initiate an alarm for EC2? How about S3?**
- **What types of alert metrics might you set for your own website? What would you want to be aware of?**
- **How could this process be used to make your AWS account more secure?**

Optional connection

Follow your educator's instructions for completing this activity.

CloudTrail

1. Log in to your AWS account.
 1. Find the CloudTrail service and select it.
2. Follow these steps to create a trail on your Amazon Simple Storage Service (Amazon S3) bucket.
 1. Navigate to the [Creating a trail\(opens in a new tab\)](#) webpage.
 2. This will track all of the actions that are done with that S3 bucket.

Unplugged option

1. Write a personal CloudTrail of your day.
2. Think about what you did, where you went, and when.
 1. Be as specific as possible.

3. Afterward, read through it or share it with a family member or friend.
 1. Did anything surprise you?

Additional connections

- [AWS Config\(opens in a new tab\)](#)
- [AWS CloudTrail\(opens in a new tab\)](#)
- [Amazon CloudWatch\(opens in a new tab\)\(opens in a new tab\)](#)
- [Amazon Simple Notification Service](#)

Lesson 2 of 3

Module 10: Databases

Module purpose

In this module, you will learn about the Amazon Relational Database Service (Amazon RDS), Amazon DynamoDB, and data warehousing with Amazon Redshift. You will also compare relational and nonrelational databases and online transaction processing (OLTP) and online analytic processing (OLAP).

Module description

In this module, you will recommend a relational or nonrelational database depending on a given scenario. You will create an RDS DB instance. You will also learn about and discuss appropriate usage of relational and nonrelational database systems.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following nine categories.

Relational database

–

A collection of datasets organized as records and columns in tables. In a relational database system, relationships are defined between the database tables. Think of a relational database as a set of data with 1-to-1 and 1-to-many relationships. For example, a database of customers would match each customer with an identifier that uniquely identifies the customer. Developers use structured query language (SQL) to interact with the database.

Amazon Relational Database Service (Amazon RDS)

–

Amazon RDS lets developers create and manage relational databases in the cloud. Amazon RDS lets developers track large amounts of data and organize and search through it efficiently.

Amazon DynamoDB

–

The AWS nonrelational database service. Data is stored in key-value pairs.

Nonrelational database

–

Also called a "NoSQL" or "Not only SQL" database. Each entry is stored in a key-value pair in which each key is attached to values. Each entry can have a different number of values attached to a key.

Amazon Redshift

–

The AWS data-warehousing service that can store massive amounts of data in a way that makes it fast to query for business intelligence (BI) purposes.

Online transaction processing (OLTP)

–

A category of data processing that is focused on transaction-oriented tasks. OLTP typically involves inserting, updating, or deleting small amounts of data in a database.

Online analytic processing (OLAP)

–

A computing method that lets users efficiently and selectively extract and query data to analyze it from different points of view.

Amazon Aurora

–

A relational database engine compatible with MySQL and PostgreSQL, built for the cloud, combining the performance and availability of traditional enterprise databases with the simplicity and cost-effectiveness of open-source databases.

MySQL

–

An open-source relational database management system.

Background and misconceptions

OLTP and OLAP

Many different types of databases are available. To decide which type of database you need, it is important to know how the data will be processed. There are two types of data processing: online transaction processing (OLTP) and online analytic processing (OLAP).

OLAP operations are primarily read-only; that is, they read the data and perform various types of aggregation such as sum, group, and sort. Relational database management systems have built-in functions for performing these types of operations. Because they are built in, they are done efficiently. In a nonrelational database, the values must be extracted from the key-values pairs, which can be a time-intensive process.

OLAP systems are often used where the system is required to process a lot of related data, perhaps to generate business reports. Companies often need to analyze a lot of data points that have occurred over a long period of time to determine trends and predict behaviors.

This type of system doesn't necessarily need to be a real-time system—it can run as a background process. For example, in an ecommerce system, an OLAP system could run in the background without impacting the user experience. Today, it's more common to see relational databases (especially large-scale, columnar data stores) rather than nonrelational databases being used for OLAP.

OLTP operations, however, need to update the database in addition to reading it. Updating can involve adding, changing, or deleting values. Updating can become complex because many of the tables in a relational database are virtual. That is, the tables need to be combined in real time from nonvirtual tables. Consider the following example.

A department store database has tables that contain information about customers and products. The customer table has data relating only to customers such as name and address. The product table has data relating only to products such as name and price. To record information about purchases, a purchase table must be created that has a combined primary key that includes both customer-ID and product-ID, showing how much of a certain product a particular customer purchased.

To display a complete readout of the purchase, the customer table and the product table must be combined in real time with the purchase table to show things such as customer name, product name, how much of the product was purchased, and the cost of the sale. The type of operation that combines tables in real time is called a JOIN. The result of a JOIN is a virtual table and, in most cases, it cannot be updated directly.

OLTP systems are often used where the system is required to handle large volumes of transactions at a high rate. Many ecommerce systems, such as shopping carts, sell a large number of items during the checkout process while simultaneously removing the items from the inventory table. When the integrity of the entire transaction is critical, and when processing needs to happen in near-real time, companies should consider OLTP systems.

OLTP systems are not exclusively relational databases, even though there are relationships in the data. It's becoming more common for nonrelational databases to enforce constraints and enable transactions, so that these databases can be used as OLTP systems.

Finally, integrity considerations must be handled in a relational database. In the example, if a product needs to be deleted from the product table, there must be rules to make sure that references to the product are also handled. These types of rules are known as integrity and consistency rules.

Comparison of OLTP and OLAP

OLTP	OLAP
<ul style="list-style-type: none">• Handles recent operational data• Size is smaller, typically ranging from 100 MB to 10 GB• Goal is to perform day-to-day operations• Uses simple queries• Faster processing speeds• Requires read/write operations	<ul style="list-style-type: none">• Handles all historical data• Size is larger, typically ranging from 1 TB to 100 PB• Goal is to make decisions from large data sources• Uses complex queries• Slower processing speeds• Requires only read operations

Applications of OLTP

- Entering orders online
- Processing purchases
- Storing customer details

Applications of OLAP

- Analyzing shopping patterns to make recommendations
- Tracking purchasing trends for targeted advertisement
- Analyzing seasonal buying trends to make sure items are in stock

AWS database services

Amazon RDS is the classic relational database that uses SQL, Oracle, Aurora, or other similar database systems. Think of this as a gradebook in which each student is a row and all students are attached to the same number of assignments (columns). Businesses can use code to search for specific data based on the information in the rows and columns. Amazon RDS is useful for

companies that are storing a moderate amount of data that is uniform in structure, meaning each unique ID (such as student name) is attached to the same number of data points (grades).

Amazon RDS is primarily used for OLTP because it has better methods for maintaining the integrity and consistency of the database when processing data.

DynamoDB is a nonrelational database, meaning that you can't use traditional systems such as SQL or Aurora. Each item in the database is stored as a key-value pair or a JavaScript Object Notation (JSON) file. This means that each row can have a different number of columns. The entries do not all have to be matched in the same way. This permits flexibility in processing that works well for blogging, gaming, and advertising.

Aurora is a relational database engine that is specifically made to work with the AWS Cloud. Aurora is up to five times faster than standard MySQL databases and three times faster than standard PostgreSQL databases. It is designed to provide the security, availability, and reliability of commercial databases at one-tenth the cost. Aurora is fully managed by Amazon RDS, which automates time-consuming administrative tasks such as hardware provisioning, database setup, patching, and backups.

Amazon Redshift is a fast, fully managed data warehouse that makes it efficient and cost effective to analyze all your data using standard SQL and your existing BI tools.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **This module covers different types of databases or tables that store data entries. What are some real-world uses of databases? Why are they useful? When have you used or seen a database in your own life?**
2. **NoSQL databases like the ones used in DynamoDB store a set of values with a key in what is called a key-value pair. A key-value pair is a set of two linked data items: a key, which is an identifier for the item of data, and the value, which is the identity or location of the data. Can you think of anything else that is generally found in a key-value pair? Why is the key-value pairing a useful way to organize ideas or data points? If you were creating key-value pairs to sort your music, picture, or video libraries, what would be some of the values you would want to store?**
3. **Amazon Redshift is a data warehousing service. A data warehouse is a central repository of information that can be analyzed to make better-informed decisions. It is a database specially designed for data analytics, which involves reading large amounts of data to understand relationships and trends across the data. A database is used to capture and store data, such as recording details of a transaction. What types of businesses do you think would benefit from a data warehousing service and how would they use data warehousing to improve their business decisions?**

Activity: Database Engineers

Overview

In this activity, you will role-play as the new database engineer for a company and report information about Amazon RDS and DynamoDB.

Objectives

- Compare relational and nonrelational databases.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **Why do you think more companies are migrating to the cloud? What do you think is holding some companies back from migrating more quickly?**

Lab: Creating an Amazon RDS Database Instance

Overview

In this activity, you will create an Amazon RDS database (DB) instance that maintains data used by a web application.

Objective

- Compare relational and nonrelational databases.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- **Why do you think the default security setting for a database does not allow public connections to the instance?**
- **How might the relational database that you created be used by a real-world company?**
- **How might you use the process you learned in this lab in your life outside school?**
- **What challenges, if any, did you run into during this process? What advice would you give to a new Amazon Web Services (AWS) user who wanted to create a relational database?**

Optional connection

Follow your educator's instructions for completing this activity.

Practice with SQL

1. Go to the SQL practice website that your educator provides.[\(opens in a new tab\)](#)
2. Spend 30 minutes learning about how SQL works to query a database.

Unplugged option

1. Think about the types of actions that a customer might perform on the AnyCompany Crafting web application.
 1. List these actions.
2. For each action, think about what type of query would be made to the AnyCompany Crafting database. Write down as many ideas as you can think of.
 1. Example: When a customer adds an item to their cart, the product database might be queried for price or availability.

Additional connections

- [Amazon Relational Database Service\(opens in a new tab\)](#)
- [Amazon Redshift\(opens in a new tab\)](#)
- [Amazon Redshift FAQs\(opens in a new tab\)](#)
- [Amazon Aurora\(opens in a new tab\)](#)
- [Overview of a key-value database\(opens in a new tab\)](#)
- [Overview of Data Warehouse Concepts\(opens in a new tab\)](#)
- [Amazon RDS Instance Types\(opens in a new tab\)](#)
- [Amazon DynamoDB](#)

Lesson 2 of 3

Module 11: Load Balancers and Caching

Module purpose

In this module, you will learn the purpose of Amazon ElastiCache and the benefits of caching data. You will also learn about Elastic Load Balancing.

Module description

You will use your knowledge of ElastiCache and ELB to create an advertisement for the services. You will use the AWS Management Console to create and configure a load balancer for a website.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following five categories.

Amazon ElastiCache

—

A web service that makes it easy to deploy, operate, and scale an in-memory cache in the cloud. The service improves the performance of web applications by letting you retrieve information from fast, managed, in-memory caches, instead of relying on slower disk-based databases.

Cache

—

In computing, a cache is a high-speed data storage layer that stores a subset of data, typically transient in nature, so that future requests for that data are served up faster than is possible by accessing the data's primary storage location.

Data caching

–

Storing data in a cache lets you efficiently reuse previously retrieved or computed data. The data in a cache is generally stored in fast-access hardware such as random access memory (RAM) and can also be used with a software component.

Elastic Load Balancing

–

Elastic Load Balancing automatically distributes incoming application traffic across multiple targets, such as Amazon Elastic Compute Cloud (Amazon EC2) instances, containers, IP addresses, and AWS Lambda functions. If traffic to a website suddenly spikes, that traffic can be routed to other EC2 instances (or other types of instances such as Lambda instances) that have been established in advance for this purpose. This load balancing avoids a single server being overloaded because of increased traffic routed to it.

Random access memory (RAM)

–

Volatile, temporary memory storage. This is the data that is held temporarily while a machine is in use; however, once the machine is powered off or the task is completed, this data goes away. Virtual memory is stored in the read-only memory (ROM) as a supplement to RAM when there is not enough temporary memory available.

Background and misconceptions

Of the many ways to handle data on a computer, one of the most common is read-only data that needs to be presented quickly and to a large number of users, such as music or videos that are streamed to the world. This type of data is rarely updated or deleted, but there is a large volume of it, and the demand for it can fluctuate dramatically (think of a video or song that goes viral). Because the need for this type of access is becoming so popular, Amazon Web Services (AWS) provides tools for handling it. The tools are mainly ones that can retrieve data rapidly and distribute data across multiple servers in response to peaks and valleys of demand—and do it in a cost-effective way that only charges for usage.

Applications and websites often provide a wide range of data and services to users. Within this wide range of data, there is often a smaller subset of data that is requested and accessed more often. This might be the data on the front page that is shown to every visitor (think Amazon's top 10 products of the day) or it might be a recently released piece of media that is having a spike in popularity (a new song released on Spotify).

Other applications run processes that are extremely memory intensive that might suffer from performance problems on a slower storage drive.

For this type of heavily requested or memory-intensive data, a data caching service such as ElastiCache can help to ensure that the data can be accessed and processed extremely quickly. It works by storing the data in extremely fast but temporary memory that is faster than disk-based storage. The trade-off is that the fast memory has less storage space and does not store the data permanently.

Many companies use ElastiCache to build real-time apps, speed up ecommerce, and cache their websites.

Image source: [\(opens in a new tab\)Amazon ElastiCache\(opens in a new tab\)](#)

For a full description of the image, expand the following block.

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Heavy traffic can shut down apps and websites if the server cannot handle the load. This is why AWS has ELB, which can detect when there are too many requests and automatically divert traffic into a new server to maintain speed and stability. There are three types of ELB in AWS.

Application Load Balancer: Application Load Balancer is best suited for load balancing of Hypertext Transfer Protocol (HTTP) and Secure HTTP (HTTPS) traffic and provides advanced request routing targeted at the delivery of modern application architectures, including microservices and containers. Operating at the individual request level (Layer 7), Application Load Balancer routes traffic to targets within Amazon Virtual Private Cloud (Amazon VPC) based on the content of the request.

Application Load Balancer balancing is done based on the content of the uniform resource locator (URL). For example, if the URL ends in */main*, the request will be routed to one instance; if the URL ends in *blog/*, it will be routed to a different instance if the Application Load Balancer definition work has been done in advance to make this happen.

Network Load Balancer: Network Load Balancer is best suited for load balancing of Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Transport Layer Security (TLS) traffic where extreme performance is required. Operating at the connection level (Layer 4), Network Load Balancer routes traffic to targets within Amazon VPC and is capable of handling millions of requests per second while maintaining ultra-low latencies. Network Load Balancer is also optimized to handle sudden and volatile traffic patterns.

Because of the increased speed that can be achieved at the connection layer, the Network Load Balancer type of load balancing is more desirable when trying to avoid higher volumes of network traffic. For example, to avoid delay when interest in a website goes viral, you would choose to use Network Load Balancer balancing.

Classic Load Balancer: Classic Load Balancer provides basic load balancing across multiple EC2 instances and operates at the request and connection levels. Classic Load Balancer is intended for applications that were built within the EC2-Classic network.

Image source: [\(opens in a new tab\)What is a Classic Load Balancer?\(opens in a new tab\)](#)

For a full description of the image, expand the following block.

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Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **Is there anything you have done so often that it has become automatic for you or you can do it without thinking? What actions fit this category? How do you think this relates to data caching?**
2. **This module is about load balancing. What strategies or tools do you use to balance your responsibilities and life? Why is it important to have a way to maintain balance?**

3. **Data caching is crucial for parts of websites and apps that need to be processed or retrieved very quickly. Remember that because the cache is a snapshot of the data on a server, it is not updated immediately when the data changes. What are some examples of data in websites or apps that you think should be cached? Why?**

Activity: ElastiCache and ELB Advertisement

Overview

In this activity, you will create a poster, slide deck, or script that advertises the benefits of ElastiCache and ELB.

Objectives

- Describe features and benefits of load balancing.
- Describe the benefits of caching data.
- Explain the purpose of ElastiCache.

Activity instructions

1. Your advertisement must include explanations of what ElastiCache and ELB are and how they work. It should also describe the benefits of the services and how they would benefit a business. They should, of course, be persuasive as well.
2. Your educator will give you time to research the two services. There will be an opportunity to discuss and ask questions following.
3. Talk with your group and decide what type of advertisement you want to create. Choose from the following:
 - Slide deck
 - Poster
 - A script for a commercial
 - Perhaps another option, if approved by your educator
4. Share your advertisement with the class.

Lab: Using Load Balancers

Overview

In this activity, you will create and configure a load balancer, register a webpage as a target for the load balancer, and test the load balancer.

Objectives

- Attach a load balancer to a webpage.
- Evaluate the performance of a load balancer.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- When creating a load balancer, why is it important to select multiple Availability Zones?
- Why do you think an Application Load Balancer is important for highly trafficked web applications?
- If you created a website, would you use an Application Load Balancer? Why or why not?
- What services would let you monitor the effectiveness of your load balancer?
- What is the difference between load balancing and automatic scaling?

Optional connection

Follow your educator's instructions for completing this activity.

ElastiCache case studies

1. Navigate to the [Amazon ElastiCache Customers\(opens in a new tab\)](#) website.
2. Choose **Amazon ElastiCache for Redis Customers** or **Amazon ElastiCache for Memcached Customers**.
3. Select a business that interests you, and learn about how that business uses Amazon ElastiCache.
4. Summarize how that business uses ElastiCache.
 1. Try to simplify the language so that someone new to AWS would understand.

Unplugged option

1. Select a business that you know of or think of one that you would like to start.
2. Write about how ElastiCache and ELB would benefit that business.

Additional connections

- [Elastic Load Balancing\(opens in a new tab\)](#)
- [Caching Overview\(opens in a new tab\)](#)
- [Amazon ElastiCache](#)

Lesson 2 of 3

Module 12: Elastic Beanstalk and CloudFormation

Module purpose

The purpose of this module is for you to understand the purpose of and be able to use AWS Elastic Beanstalk and AWS CloudFormation.

Module description

In this module, you will create an application using Elastic Beanstalk and build a CloudFormation template.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following three categories.

AWS Elastic Beanstalk

–

Elastic Beanstalk automatically handles the deployment details of capacity provisioning, load balancing, automatic scaling, and application health monitoring of an application. In many ways, using Elastic Beanstalk is like running a macro or a batch file that places a wrapper around an existing application so that it runs smoothly in the Amazon Web Services (AWS) Cloud.

AWS CloudFormation

–

This service gives developers and businesses an easy way to create a collection of related AWS resources and provision them in an orderly and predictable fashion. CloudFormation provides a means for combining a stack of AWS services, similar to writing macros or batch files in Linux or Microsoft Windows.

Stack

–

A collection of AWS resources that you can manage as a single unit. You can create, update, or delete a collection of resources by creating, updating, or deleting stacks.

Background and misconceptions

Elastic Beanstalk

Elastic Beanstalk is an easy-to-use service for deploying and scaling web applications and services developed with Java, .NET, PHP, Node.js, Python, Ruby, Go, and Docker on familiar servers such as Apache, Nginx, Passenger, and IIS.

You upload your code and Elastic Beanstalk automatically handles the deployment, from capacity provisioning, load balancing, and automatic scaling to application health monitoring. At the same time, you retain full control over the AWS resources powering your application and can access the underlying resources at any time.

Benefits of Elastic Beanstalk:

1. Fast and simple to begin
 1. Elastic Beanstalk is the fastest and simplest way to deploy your application on AWS.
2. Developer productivity
 1. Elastic Beanstalk provisions and operates the infrastructure and manages the application stack (platform) for you, so you don't have to spend the time or develop the expertise.
3. Impossible to outgrow
 1. Elastic Beanstalk automatically scales your application up and down based on your application's specific need using easily adjustable automatic scaling settings.
4. Complete resource control

1. You have the freedom to select the AWS resources, such as Amazon Elastic Compute Cloud (Amazon EC2) instance type, that are optimal for your application.

CloudFormation

CloudFormation provides a common language for you to describe and provision all the infrastructure resources in your cloud environment. CloudFormation lets you use programming languages or a simple text file to model and provision, in an automated and secure manner, all the resources needed for your applications across all AWS Regions and accounts.

Benefits of CloudFormation

1. Model it all.
 1. CloudFormation lets you model your entire infrastructure with a text file or programming languages.
2. Automate and deploy.
 1. CloudFormation provisions your resources in a safe, repeatable manner, letting you build and rebuild your infrastructure and applications, without having to perform manual actions or write custom scripts.
3. It's code.
 1. Codifying your infrastructure lets you treat your infrastructure as code.

Image source: [AWS CloudFormation\(opens in a new tab\)\(opens in a new tab\)](#)

For a full description of the image, expand the following block.

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CloudFormation works as follows. The first step is to code your infrastructure from scratch with the CloudFormation template language, in either YAML or JSON format, or start from many available sample templates.

The next step is to check out your template code locally, or upload it into an S3 bucket.

The next step is to use AWS CloudFormation via the browser console, command line tools, or APIs to create a stack based on your template code.

Finally, AWS CloudFormation provisions and configures the stacks and resources you specified on your template.

How Elastic Beanstalk differs from CloudFormation

These services are designed to complement each other. Elastic Beanstalk provides an environment to easily deploy and run applications in the cloud. It is integrated with developer tools and provides a one-stop experience for you to manage the life cycle of your applications.

CloudFormation is a convenient provisioning mechanism for a broad range of AWS resources. It supports the infrastructure needs of many different types of applications such as existing enterprise applications, legacy applications, and applications built using a variety of AWS resources and container-based solutions (including those built using Elastic Beanstalk).

To be clear, Elastic Beanstalk is like running a .bat file and CloudFormation is like writing a .bat file. Elastic Beanstalk lets developers upload and run their code; it then does all the behind-the-scenes cloud setup such as launching EC2 instances and attaching elastic block storage. With CloudFormation, you are basically setting up a template for all of the cloud resources you want to run so that it can all be done at once and in a repeatable way.

CloudFormation supports Elastic Beanstalk application environments as one of the AWS resource types. This lets you, for example, create and manage an application hosted by Elastic Beanstalk, along with an Amazon Relational Database Service (Amazon RDS) database to store the application data. In addition to RDS DB instances, any other supported AWS resources can be added to the group as well.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **Elastic Beanstalk is a service that lets developers upload their applications and automatically provision all of the needed resources for the application to run smoothly and efficiently. How do you think this process differs from traditional application deployment (without the cloud)? Why is this style of deployment beneficial?**
2. **What things do you picture or think of when you hear the name *Elastic Beanstalk*? Why do you think the AWS Cloud service that provides the necessary resources for an uploaded application is called *Elastic Beanstalk*?**
3. **CloudFormation is a service that lets you create a template to deploy any number of cloud resources at any time. What are some other industries or processes that use a template to build or create something quickly? Why is this process beneficial?**

Activity: What Are Elastic Beanstalk and CloudFormation?

Overview

In this activity, you will take notes on Elastic Beanstalk and CloudFormation and use case studies to apply your learning.

Objective

- Describe features and uses of Elastic Beanstalk and CloudFormation.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss this question.

- **How would a new company benefit from CloudFormation and Elastic Beanstalk?**

Lab: Using Elastic Beanstalk and CloudFormation

Overview

In this lab, you will create a simple application and upload it to run with Elastic Beanstalk. You will then use a template to set up a virtual private cloud (VPC) with CloudFormation.

Objectives

- Create an application using Elastic Beanstalk.
- Use a template and CloudFormation to build a VPC.

Lab instructions

Follow your educator's instructions to complete the lab.

Reflect

After completing the lab, be prepared to answer and discuss these questions.

- **When you created the environment using Elastic Beanstalk, it also created a stack in CloudFormation. How do you think these two services work together?**
- **Provide an example of how this process of using Elastic Beanstalk or CloudFormation would be used in a real-world setting.**
- **How might Elastic Beanstalk or CloudFormation be useful to you when you are using AWS Cloud services?**

Optional connection

Follow your educator's instructions for completing this activity.

Build your own CloudFormation template using Designer

1. Go to the AWS Academy Learner Labs environment.
 1. Go to the CloudFormation console.
 2. Select **Create stack** and select **With new resources (standard)**.
 3. Select **Create template in Designer**.
2. In a new tab, navigate to this [AWS Walkthrough\(opens in a new tab\)](#).
3. Complete the steps within **Step 1: Add and connect resources** to design a stack that will create a basic web server.
 1. If you want a challenge, continue past **Step 1**.

Unplugged option

1. Think of an application or a website that you use often.
2. Make a list of the AWS services that you think would be required to run that application or website.
3. Draw a visualization of how the services that you listed would interact in the cloud.

Additional connections

- [AWS CloudFormation\(opens in a new tab\)](#)
- [AWS Elastic Beanstalk\(opens in a new tab\)](#)
- [AWS Elastic Beanstalk FAQs\(opens in a new tab\)](#)
- [AWS CloudFormation FAQs\(opens in a new tab\)](#)
- [AWS CloudFormation User Guide\(opens in a new tab\)](#)
- [Coinbase Case Study](#)

Lesson 2 of 3

Module 13: Emerging Technologies in the Cloud

Module purpose

In this module, you will research emerging technologies in the cloud with a focus on machine learning (ML) and its impacts on society, business, and technology.

Module description

In this module, you will discuss the societal impacts of machine learning, read case studies about how machine learning is being used, and explore your own emerging technology and provide a use case for it.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following seven categories.

Machine learning (ML)

–

A subset of artificial intelligence (AI) in which a computer algorithm can modify its own behavior

Artificial intelligence (AI)

–

A computer system able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages

Amazon SageMaker

–

Provides every developer and data scientist with the ability to build, train, and deploy ML models quickly

Deep learning

–

An AI learning process; the process of the AI scanning the artificial neural network

AWS DeepRacer

–

A fully autonomous, 1/18th-scale race car driven by reinforcement learning, a 3D racing simulator, and a global racing league

AWS DeepLens

–

A fully programmable video camera, with tutorials, code, and pretrained models designed to expand ML skills

Neural network

–

A model or algorithm that is designed to make decisions in a way similar to a human brain

Background and misconceptions

As the programs that we create become more and more complex, they begin to resemble the inner workings of our own brains. With ML and deep learning, we can begin to develop software that learns, reasons, shows creativity, and even creates novel solutions to problems. These solutions can range from self-driving cars to making novel economic models.

For businesses, ML and AI can mean getting a head start on business intelligence and future-proofing a company. It can also be used to improve security, data analytics, and income projections.

There are multiple methods to approaching ML.

- **Supervised ML:** Supervised ML starts with training data that includes the required output to adjust the ML algorithm. Supervised ML algorithms are divided into two categories, **classification** and **regression**:
 - **Classification:** Classification algorithms examine an input and choose a response from specific preset choices. For example, an algorithm might be trained to classify emails as spam or not spam.
 - **Regression:** Regression algorithms are trained to assign a value, or a number, to an input. For example, a weather prediction regression might be trained to give a predicted temperature for a given date in the future.
- **Unsupervised ML:** Unsupervised machine learning starts with training data that does not include the desired output. Unsupervised machine learning algorithms can examine input and group related items together into groups called clusters. The clusters are not predefined or labeled, but are inferred by the algorithm during the training process.
- **Semisupervised ML:** Semisupervised ML algorithms combine some features of supervised ML with some features of unsupervised ML. Usually semisupervised ML algorithms start training with a relatively small amount of labeled data and then analyze large amounts of unlabeled data to improve accuracy.
- **Reinforcement ML:** With reinforcement learning, the algorithm receives feedback to guide it to the best outcome. Reinforcement learning allows the algorithm to develop complex behaviors by refining the output through trial and error. An example of reinforcement machine learning in action is an autonomous robot that learns to stay within a driving lane by receiving a reward for proceeding in the right direction or staying inside lane markers.

In its simplest form, machine learning is finding patterns in data and making predictions on future data based on those patterns. Then, it measures the accuracy of those predictions and repeats this thousands or millions of times to more accurately predict things like weather, media recommendations, and sports outcomes.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **This module is about ML. What do you think of when you hear the words machine learning? What images does the name bring to mind? What do you predict ML is used for?**
2. **ML is a subset of AI. Where have you heard references to AI being used in media? What are some real-world uses for AI?**
3. **ML is a subset of AI in which a computer algorithm can modify its own behavior. AWS provides access to a service named SageMaker that supports ML. Why do you think the cloud is beneficial for ML and AI? What cloud services that you learned about previously do you think will be beneficial for ML and why?**

Activity 1: AI, Cloud Computing, and Society

Overview

In this activity, you will review resources, such as an article, about how AI currently or potentially could affect society.

Objectives

- Define machine learning.
- Discuss the impact of machine learning on cloud computing.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **What was the main idea or purpose of the article or resource that you read?**
- **What is one example that your article or resource gave for how AI can be used?**
- **What was one positive impact and one negative impact that you read about AI?**
- **What is a rule or regulation that you would recommend that could help counter a negative impact?**
- **How do you think AI will impact or be impacted by cloud computing?**

Activity 2: Emerging Technologies and the Cloud

Overview

In this activity, you will choose an emerging technology and research it with the goal of writing a movie pitch related to that technology. You will then write a short outline of the technology, including a use case and how it relates to or could be connected with cloud computing.

Objective

- Identify potential use cases for emerging technology in the cloud.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **What emerging technology do you think will have the greatest impact? Why?**
- **What are some other future uses for the technologies you learned about?**
- **Do any of the emerging technologies create problems or conflicts? For example, what if medical advances or lab-grown organs can save lives, but most people can't afford them? Or what if people lose jobs because now robots are able to do them?**

Optional connection

Follow your educator's instructions for completing this activity.

AWS SageMaker deep dive

1. Go to the AWS Academy Learner Labs environment.
2. Navigate to the SageMaker service on the services menu.
3. Follow the steps in [Build, Train, and Deploy a Machine Learning Model with Amazon SageMaker](#)[\(opens in a new tab\)](#) to deploy your first ML model.[\(opens in a new tab\)](#)

Unplugged option

1. Write a prediction for what emerging technologies are possible in cloud computing.
 1. Choose a name for an Amazon Web Services (AWS) service that could come out in 20 years.
2. Write a description of the new AWS service.
 1. What does it do?
 2. How does it work?
 3. What problem does it solve?

Additional connections

- [AWS DeepRacer](#)[\(opens in a new tab\)](#)
- [SageMaker](#)[\(opens in a new tab\)](#)
- [AWS DeepLens](#)[\(opens in a new tab\)](#)
- [AWS DeepRacer FAQs](#)

Module 14: Billing and Support

Module purpose

In this module, you will learn about the AWS Support plans. You will also learn about the Amazon Web Services (AWS) Simple Monthly Calculator. Lastly, you will understand why AWS Organizations and consolidated billing are beneficial to businesses using cloud computing.

Module description

In this module, you will use the Simple Monthly Calculator to analyze value propositions. You will look at real-world case studies to make recommendations for an AWS Support plan. Lastly, you will determine the benefits of using Organizations and consolidated billing.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following five categories.

AWS Simple Monthly Calculator

–

Provides an estimated monthly bill based on the storage and compute requirements of the user.

AWS Support plan

–

Support plans are designed to give you the right mix of tools and access to expertise so that you can be successful with AWS while optimizing performance, managing risk, and keeping costs under control.

AWS Organizations

–

Helps you centrally manage billing; control access, compliance, and security; and share resources across your AWS accounts.

Consolidated billing

–

With the consolidated billing feature in Organizations, you can consolidate billing and payment for multiple AWS accounts. Every organization in Organizations has a management (payer) account that pays the charges of all the member (linked) accounts.

Technical Account Manager (TAM)

–

This dedicated support person and cloud advisor for enterprise-level AWS accounts answers support questions, monitors your cloud account, and gives recommendations for optimization.

Background and misconceptions

AWS provides a number of useful billing and support services that help cloud users to make the most efficient use of their resources. These services include a calculator that will estimate monthly costs, billing dashboards to visualize expenditures, and a range of support plans with differing prices and services. To make it easier for large businesses with many accounts to pay for services, Organizations permits consolidated billing, which lets one account pay for all other accounts in an organization.

This table shows the most important similarities and differences between AWS Support plans.

Criteria	Basic	Developer	Business	Enterprise
Cost	Free		Greater of \$100 per month	Greater of \$15,000 per month
			or	or
		Greater of \$29 per month	10% of monthly AWS usage for the first \$0–\$10K	10% of monthly AWS usage for the first \$0–\$150K
		or	7% of monthly AWS usage from \$10K–\$80K	7% of monthly AWS usage from \$150K–\$500K
		3% of monthly AWS usage	5% of monthly AWS usage from \$80K–\$250K	5% of monthly AWS usage from \$500K–\$1M
			3% of monthly AWS usage over \$250K	3% of monthly AWS usage over \$1M
Use case	Learning	Experimenting	Production use	Mission-critical use
Tech support	No	Business hours email	24/7 email, chat, and phone	24/7 email, chat, and phone
Support response time	N/A	12–24 hours during business hours	1-hour response to urgent cases	15-minute response to critical support cases
TAM	No	No	No	Yes
Support cases	None	One person, unlimited cases	Unlimited contacts/cases	Unlimited contacts/cases

All AWS customers receive the basic level of support for at no additional cost. Notice that only Enterprise-level accounts receive the benefit of a TAM. For Enterprise-level customers, a TAM provides technical expertise for the full range of AWS services and obtains a detailed understanding of your use case and technology architecture. TAMs work with AWS Solution Architects to help you launch new projects and recommend best practices throughout the implementation lifecycle. You have a direct telephone line to your TAM, who serves as your primary point of contact for ongoing support needs.

As you can see, the price for the different support plans ranges greatly from free to \$15,000 a month, so selecting the right plan for your business is important.

Organizations is a great resource with many benefits. By permitting an organization to link multiple AWS accounts under a central account, one person can:

- Centrally manage policies across multiple AWS accounts
- Govern access to AWS services, resources, and Regions
- Automate AWS account creation and management
- Configure AWS services across multiple accounts
- Consolidate billing across multiple AWS accounts

For a full description of the image, expand the following block.

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An organizational unit (OU) is a container for multiple accounts. By attaching a policy to an OU, that policy applies to all accounts in that OU.

You will learn about the AWS Simple Monthly Calculator. With the Simple Monthly Calculator, you enter your needs in relation to Amazon Elastic Compute Cloud (Amazon EC2) instances, Amazon EC2 Dedicated Hosts, Amazon Elastic Block Store (Amazon EBS) volumes, and other cloud services. The calculator then estimates the cost of running these services each month. It is a great way for businesses to get an idea of their cloud budget as they plan how they want to structure their cloud usage.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **AWS has four different levels of support, ranging in price from free to greater than \$15,000 a month. Why do you think AWS offers four levels of support? What do you think the key differences are between the four support plans?**
2. **Organizations allows one account to control users, security settings, account access, and billing for any other linked accounts. Why do you think AWS provides this feature? What types of businesses do you think could best take advantage of this feature? Why?**

Activity: AWS Support Plans and AWS Organizations

Overview

In this activity, you will review the AWS Support plans to recommend the best plan for a given scenario. You will then review and take notes about the benefits of AWS Organizations.

Objectives

- Recommend the best AWS Support plan for a given situation.
- Identify the benefits of using Organizations and consolidated billing for cost savings and easier AWS Identity and Access Management (IAM) permissions management.

Activity instructions

Follow your educator's instructions to complete the activity.

Reflect

After completing the activity, be prepared to answer and discuss these questions.

- **Why do you think AWS offers different support plans?**
- **Do you think that the different levels of support AWS offers are adequate? Are there other things that customers might look for?**
- **Do you think that using Organizations and consolidated billing is the best solution for all customers? For whom does it work best?**

Lab: AWS Simple Monthly Calculator

Overview

In this lab, you will use the Simple Monthly Calculator to estimate the cost of different cloud architectures.

Objectives

- Use the Simple Monthly Calculator to estimate the cost of a cloud architecture.

Lab instructions

Follow your educator's instructions to complete the lab.

Additional connections

- [AWS Organizations terminology and concepts](#)

Lesson 2 of 3

Module 15: Other Cloud Features

Module purpose

This module explores Amazon Web Services (AWS) services related to protecting data and managing networks. It also explores the integration of blockchain technologies within AWS services.

Module description

You will use whitepapers to research and become a specialist in a service, later reporting back to your class. Next, an educator-led discussion about blockchain technologies will prepare you to debate blockchain benefits and scenarios.

Technology terminology

To learn more about the technology terminology used in this module, expand each of the following seven categories.

Blockchain

–

A decentralized database technology that maintains a continually growing set of transactions and smart contracts hardened against tampering and revision using cryptography

Block

–

A growing list of records in a blockchain

Transaction

–

An exchange, usually of currency, in a blockchain

Ledger

–

A digital record of transactions

Immutable

–
The ability of a blockchain to remain unchanged

Trust

–
The dispersed confidence in accuracy among blockchain users

Transparency

–
Clear and open accounting of transactions

Background and misconceptions

Amazon Athena

Athena is an interactive query service that makes it easy to analyze data in Amazon Simple Storage Service (Amazon S3) using standard structured query language (SQL).

Athena is serverless, so there is no infrastructure to manage, and users pay only for the queries that they run. Users can quickly query your data without having to set up and manage any servers or data warehouses. Point to the data in Amazon S3, define the schema, and start querying using the built-in query editor. Athena lets users tap into all of their data in S3 without the need to set up complex processes to extract, transform, and load (ETL) the data.

Athena is easy to use; there's no need for complex ETL jobs to prepare data for analysis. This makes it easy for anyone with SQL skills to quickly analyze large-scale datasets.

Athena is out-of-the-box integrated with AWS Glue Data Catalog, letting users create a unified metadata repository across various services, crawl data sources to discover schemas, populate the Data Catalog with new and modified table and partition definitions, and maintain schema versioning. Users can also use AWS Glue fully managed ETL capabilities to transform data or convert it into columnar formats to optimize cost and improve performance.

With Athena, users pay only for the queries that they run. Users can save from 30 percent to 90 percent on per-query costs and get better performance by compressing, partitioning, and converting data into columnar formats. Athena queries data directly in Amazon S3. There are no additional storage charges beyond S3.

Athena uses Presto with ANSI SQL support and works with a variety of standard data formats, including CSV, JavaScript Object Notation (JSON), Apache ORC, Apache Avro, and Apache Parquet. Athena is ideal for quick, one-time querying, but it can also handle complex analysis, including large joins, window functions, and arrays. Athena is highly available and runs queries using compute resources across multiple facilities and multiple devices in each facility. Athena uses Amazon S3 as its underlying data store, making data highly available and durable.

With Athena, users don't have to worry about having enough compute resources to get fast, interactive query performance. Athena automatically runs queries in parallel, so most results come back within seconds.

Amazon Macie

Macie is a security service that uses machine learning to automatically discover, classify, and protect sensitive data in AWS. Macie recognizes sensitive data such as personally identifiable information (PII) or intellectual property and provides dashboards and alerts that give visibility into how this data is being accessed or moved. The fully managed service continuously monitors data access activity for anomalies and generates detailed alerts when it detects risk of

unauthorized access or inadvertent data leaks. Macie is available to protect data stored in Amazon S3, with support for additional AWS data stores coming soon.

Macie makes it easy for security administrators to have management visibility into data storage environments, beginning with S3, with additional AWS data stores coming soon.

Macie uses machine learning to automate the process of discovering, classifying, and protecting data stored in AWS. This helps you better understand where sensitive information is stored and how it's being accessed, including user authentication and access patterns.

Macie can send all findings to Amazon CloudWatch Events. This lets users build custom remediation and alert management for existing security ticketing systems.

Blockchain and Amazon Managed Blockchain

Blockchain is a way to manage an open distributed ledger of transactions. A ledger is a type of database in which transactions are only appended, never changed, making it immutable and trusted because there is no way to alter entries. A transaction is the record of some event taking place where ownership or possession is being transferred. An example of a transaction is the transfer of money from one account to another. The primary objective of a blockchain is to eliminate a central authority or middleman in order to speed things up.

Blockchain is a growing list of records, like a database—called *blocks*—that are linked using cryptography. Each block contains information about the block before it, a timestamp, and transaction data. Blockchain began with the development of cryptocurrency and has now branched out into new products and services.

Blockchain makes it possible to build applications where multiple parties can run transactions without the need for a trusted central authority. Today, building a scalable blockchain network with existing technologies is complex to set up and hard to manage. To create a blockchain network, each network member needs to manually provision hardware, install software, create and manage certificates for access control, and configure networking components. After the blockchain network is running, you need to continuously monitor the infrastructure and adapt to changes, such as an increase in transaction requests or new members joining or leaving the network.

Managed Blockchain is a fully managed service that lets users set up and manage a scalable blockchain network with a few clicks. Managed Blockchain eliminates the overhead required to create the network and automatically scales to meet the demands of thousands of applications running millions of transactions. After the network is up and running, Managed Blockchain makes it easy to manage and maintain your blockchain network. It manages certificates and lets users easily invite new members to join the network.

Managed Blockchain is a service that assists in choosing and provisioning other AWS services together with non-AWS services such as Ethereum in order to implement a blockchain. By asking a series of structured questions, Managed Blockchain guides the process of choosing the services needed to implement one of several types of blockchain.

With Managed Blockchain, users can quickly create blockchain networks that span multiple AWS accounts, letting a group of members run transactions and share data without a central authority. Unlike self-hosting a blockchain infrastructure, Managed Blockchain eliminates the need for manually provisioning hardware, configuring software, and setting up networking and security components. With the Managed Blockchain voting application programming interface (API), network participants can vote to add or remove members. After a new member is added,

Managed Blockchain lets that member launch and configure multiple blockchain peer nodes to process transaction requests and store a copy of the ledger. Managed Blockchain also monitors the network and automatically replaces poorly performing nodes.

Managed Blockchain supports two popular blockchain frameworks: Hyperledger Fabric and Ethereum. Hyperledger Fabric is well suited for applications that require stringent privacy and permission controls with a known set of members; for example, a financial application where certain trade-related data is only shared with select banks. Ethereum is well suited for highly distributed blockchain networks where transparency of data for all members is important; for example, a customer loyalty blockchain network that lets any retailer in the network independently verify a user's activity across all members to redeem benefits. Alternatively, Ethereum can be used for joining a public Ethereum blockchain network. Ethereum and Hyperledger Fabric are products that are produced by companies outside AWS.

Managed Blockchain can easily scale your blockchain network as the usage of applications on the network grows over time. When a network member requires additional capacity for creating and validating transactions, the member can quickly add a new peer node using Managed Blockchain APIs. Managed Blockchain provides a selection of instance types that comprise varying combinations of central processing unit (CPU) and memory to give the flexibility to choose the appropriate mix of resources for the workload. Additionally, Managed Blockchain secures the network's certificates with AWS Key Management Service (AWS KMS) technology, eliminating the need for users to set up their own secure key storage.

Image source: [Amazon Managed Blockchain\(opens in a new tab\)\(opens in a new tab\)](#)

For a full description of the image, expand the following block.

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Blockchain technologies are often used to solve two types of customer needs. In the first case, multiple parties work with a centralized, trusted authority to maintain a complete and verifiable record of transactions. An example is a retail customer looking to connect their suppliers with a centralized ledger that maintains a transparent and verifiable history of information related to the movement of a product through its supply chain.

In the other case, multiple parties transact in a decentralized manner without the need for a centralized, trusted authority. An example is a consortium of banks and export houses looking to perform cross-boundary transfer of assets (for example, letters of credit) among each other, without a centralized authority acting as a liaison.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **A grocery store chain is attempting to set up a nationwide network for hosting their customer discount card. What types of hardware and software hurdles might they encounter?**
2. **If an international banking conglomerate wanted to host transaction data, such as transferring money from one person to another, on a virtual computing environment, would it want a central person managing the network and data or for all users to have equally transparent access to data?**

3. **Blockchain is a digital ledger of transactions in a virtual environment, where transactions are encrypted and secure, but also transparent and accessible by all. Digital currency relies on blockchain. Can you describe a time when you heard of blockchain being used by another company?**

Activity 1: AWS Services Experts

Overview

You will use whitepapers to research and answer questions related to AWS services.

Objective

- Identify cloud services that can analyze and protect data, and manage networks.

Activity instructions

You have learned about many AWS services that help individuals and businesses to effectively meet their technological needs. Today, you will look at several that protect data and help people manage networks.

1. Your educator will divide the class into three equal groups.
2. Each group will be assigned one of the following articles:
 - [What Is Amazon Macie?\(opens in a new tab\)\(opens in a new tab\)](#)
 - [What is Amazon Athena?\(opens in a new tab\)](#)
 - [Blockchain on AWS\(opens in a new tab\)](#)
3. Each group will gather the following information for their assigned AWS service:
 1. Features
 2. Function or purpose
 3. Case study of use by a company
 4. Pricing
 5. Any other important information found
4. Your groups will then present their findings to the remainder of the class.

Reflect

Follow your educator's instructions to answer and discuss the following questions.

- **How do AWS services protect confidential data from security breaches?**

Activity 2: Blockchain Discussion

Overview

In this activity, the educator will lead a discussion about blockchain technologies. This discussion prepares you to summarize the benefits of using blockchain.

Objective

- Explain benefits of blockchain technologies.

Activity instructions

1. View the [Blockchain on AWS\(opens in a new tab\)](#) link. Consider the following:
 1. What is an important benefit of blockchain?
 2. How does using blockchain help address security issues?
2. Review the [blockchain partner stories\(opens in a new tab\)](#) (search for "blockchain").
 1. Your educator might divide the class into groups for this task.
 2. Either individually or as a group, you will be assigned one of the partner stories to focus on.
3. Read the assigned partner story and explain how the business uses blockchain.
 1. Summarize the benefits of using blockchain.
 2. Be prepared to share findings with the class.
4. A volunteer from each group will share their group's findings.

Reflect

Follow your educator's instructions to answer and discuss the following question.

- **When is it beneficial to use blockchain?**

Optional connection

Follow your educator's instructions for completing this activity.

Convincing the bank

Using what you have learned in this module, write a letter to a fictional nationwide bank chain, explaining the benefits of using Athena and Macie in protecting customer data and analyzing company-wide data trends. Research and list specific benefits that the bank might expect from these two services.

Additional connections

- [What is Amazon Athena?\(opens in a new tab\)](#)
- [What is Amazon Macie?\(opens in a new tab\)](#)
[\(opens in a new tab\)](#)
- [Blockchain on AWS\(opens in a new tab\)](#)
- [Amazon Managed Blockchain\(opens in a new tab\)](#)
- [Amazon Managed Blockchain Resources\(opens in a new tab\)](#)
- [Amazon Managed Blockchain FAQs\(opens in a new tab\)](#)
- [AWS Blockchain Templates](#)

Module 16: Optimizing the Cloud with the AWS CDK

Module purpose

In this module, you will explore the AWS Cloud Development Kit (AWS CDK) and how it integrates with services within the AWS Management Console. You will develop a computational artifact that demonstrates your understanding.

Module description

In this module, you will follow an educator-led discussion of the AWS CDK and complete a hands-on task to apply the learning. You will then install and configure the AWS CDK and create your first AWS CDK application.

Technology terminology

To learn more about the technology terminology used in this module, expand the following category.

AWS Cloud Development Kit (AWS CDK)

–

An open-source software development framework that models and provisions cloud application resources

Background and misconceptions

AWS CDK

The AWS CDK is an open-source software development framework that models and provisions cloud application resources using familiar programming languages.

Provisioning cloud applications can be a challenging process that requires users to perform manual actions, write custom scripts, maintain templates, or learn domain-specific languages. The AWS CDK uses the familiarity and expressive power of programming languages for modeling applications. It provides users with high-level components that preconfigure cloud resources with proven defaults, so they can build cloud applications without needing to be an expert. The AWS CDK provisions resources in a safe, repeatable manner through AWS CloudFormation. It also lets users compose and share their own custom components that incorporate their organization's requirements, helping them start new projects faster. The AWS CDK reduces the work of defining and configuring network resources compared to using Amazon CloudFront alone.

Benefits

The AWS CDK accelerates onboarding to Amazon Web Services (AWS) because there are very few new things to learn. With the AWS CDK, you can use existing skills and tools, and apply those to the task of building cloud infrastructure. It also provides high-level components that preconfigure cloud resources with proven defaults, helping users build on AWS without needing to be an expert.

The AWS CDK gives users the expressive power of programming languages for defining infrastructure. Familiar features such as objects, loops, and conditions accelerate the development process. Users can also use the AWS CDK with their integrated development environment (IDE) to take advantage of existing productivity tools and testing frameworks.

With the AWS CDK, users can design their own reusable components that meet their organization's security, compliance, and governance requirements. As with any other software library, users can share components around their organization, letting them rapidly start up new projects with best practices by default.

The AWS CDK lets users build a cloud application without leaving their IDE. Users can write their runtime code and define their AWS resources with the same programming language. Managing infrastructure as code provides great benefits and is often a stepping-stone for a successful application of DevOps practices. In this way, instead of relying on manually performed steps, both administrators and developers can automate provisioning of compute, storage, network, and application services required by their applications using configuration files.

For example, defining your infrastructure as code makes it possible to:

- Keep infrastructure and application code in the same repository.
- Make infrastructure changes repeatable and predictable across different environments, AWS accounts, and AWS Regions.
- Replicate production in a staging environment to permit continuous testing.
- Replicate production in a performance test environment used only for the time required to run a stress test.
- Release infrastructure changes using the same tools as code changes so that deployments include infrastructure updates.
- Apply software development best practices to infrastructure management such as code reviews or deploying small changes frequently.

Image source: [\(opens in a new tab\)](#)[\(opens in a new tab\)](#)[AWS CDK](#)[\(opens in a new tab\)](#)

For a full description of the image, expand the following block.

For accessibility

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Use preconfigured application components: Download preconfigured components from a package manager or artifact repository.

Model your application: Model your application logic and infrastructure in a programming language.

Provision your application with AWS CloudFormation: Provision your application code and supporting infrastructure with AWS CloudFormation.

Constructs

Constructs are cloud components that encode configuration detail, boilerplate, and glue logic for using one or multiple AWS services. The AWS CDK provides a library of constructs that cover many AWS services and features, letting users define their applications' infrastructure at a high level. Additionally, constructs are adjustable and composable. Users can quickly change any of the parameters or encode their own custom construct.

The AWS CDK also provides low-level constructs called *CFN Resources*, which directly represent base-level CloudFormation resources and provide a way to define CloudFormation

with a programming language. CFN Resources provide complete coverage of CloudFormation resources and are available shortly after a CloudFormation resource is updated or newly available.

With the AWS CDK, anyone can customize, share, and reuse constructs within their organization or community, as with any other software library. This lets users build constructs that help them get started faster and incorporate best practices by default.

The AWS CDK lets users define their infrastructure with code and provision it through CloudFormation. They get all the benefits of CloudFormation, including repeatable deployment, rapid rollback, and drift detection.

The AWS CDK lets users model application infrastructure using TypeScript, Python, Java (developer preview), and .NET (developer preview). With the AWS CDK, developers can use existing IDE, testing tools, and workflow patterns. By using tools such as autocomplete and in-line documentation, the AWS CDK lets users spend less time switching between service documentation and their code.

The AWS CDK lets users reference their runtime code assets in the same project with the same programming language. For example, they can include their AWS Lambda runtime code or Docker container image in an AWS CDK project and, when they deploy their application, the AWS CDK framework automatically uploads and configures the AWS service with their runtime assets. When the AWS CDK deployment is complete, they will have a fully functional application.

The AWS CDK command line interface (CLI) lets users interact with their AWS CDK applications and facilitates functionality such as synthesizing a CloudFormation template, showing the differences between the running stack and proposed changes, confirming security-related changes before deployment, and deploying multiple stacks across multiple environments.

Image source: [\(opens in a new tab\)AWS Cloud Development Kit \(CDK\) – TypeScript and Python and Now Generally Available\(opens in a new tab\)](#)

For a full description of the image, expand the following block.

For accessibility

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In an AWS CDK application, one construct consists of Amazon SQS and AWS Lambda and another construct consists of Amazon S3 and Amazon DynamoDB. An arrow points from this stack to a box labeled CloudFormation Template, which contains code. Another arrow points from this box to a box labeled AWS CloudFormation. Three arrows point from the AWS CloudFormation box to Resources.

Focus questions

Follow your educator's instructions to answer and discuss the following questions.

Questions

1. **When have you used a template to create a document or a presentation? Why did you use a template instead of creating a new document from scratch?**
2. **Companies often have a basic product that they customize for different needs. For example, all baseball gloves are similar, but they can be customized for different needs such as to wear on the left or right hand. The AWS CDK empowers developers to rapidly**

- customize existing infrastructure. What is an example of an application that might need to be customized for different users?
3. The AWS CDK lets you implement code using the programming language of your choice. Why might this be valuable to both novice developers and more advanced users?
 4. How is using the AWS CDK different than using CloudFormation to create a stack? How does this compare to building a house using raw materials compared to using prefabricated components?

Activity: AWS CDK Infomercial

Overview

In this activity, you will interact with media and print to explore the infrastructure of the AWS CDK.

Objective

- Explain the infrastructure of the AWS CDK.

Activity instructions

1. Your educator will break the class up into small groups and explain the activity.
2. View [AWS CDK Overview\(opens in a new tab\)](#).
 1. Write down notes of important features you want to highlight.
3. Read the technical literature your educator hands out or read it online at [AWS Cloud Development Kit FAQs\(opens in a new tab\)](#).
 1. Underline or highlight important information you want to use in your infomercial.
4. Develop your infomercial advertising the AWS CDK and present it to the class. Your group should consider:
 - **The audience:** A group of developers interested in the AWS CDK
 - **Purpose:** To inform the developers of the benefits of using the AWS CDK
 - **Presentation style:** You can act out your infomercial in front of the class.
 - **Information required:** Benefits of using AWS CDK, features, potential uses of the AWS CDK

Reflect

After completing the activity, be prepared to answer and discuss this question.

- **What would you identify as the most important feature of the AWS CDK?**

Optional connection

Follow your educator's instructions for completing this activity.

AWS CDK constructs

Consider the following idea: *Constructs are the basic building blocks of AWS CDK applications. A construct represents a cloud component and encapsulates everything that CloudFormation needs to create the component.*

A construct can represent a single resource, such as an Amazon Simple Storage Service (Amazon S3) bucket, or it can represent a higher-level component consisting of multiple AWS CDK resources. Examples of such components include a worker queue with its associated compute capacity, a scheduled job with monitoring resources and a dashboard, or even an entire application spanning multiple AWS accounts and Regions.

Use this information to write a scenario in which a developer would use constructs to build a schoolwide cloud service. What steps would the developer take within the AWS CDK? What would the cloud service accomplish for the school?

Additional connections

- [Constructs\(opens in a new tab\)](#)
- [AWS Cloud Development Kit\(opens in a new tab\)](#)
- [Getting Started with the AWS CDK](#)