AWS Cloud Computing Services Introduction

Cloud computing is the on-demand delivery of compute power, database storage, applications, and other IT resources through a cloud services platform via the internet with pay-as-you-go pricing.

Welcome to **AWS Cloud Computing Services.** This module will introduce you to many of the AWS Cloud Computing services. The pace at which AWS is releasing features and services can be overwhelming. We will be introducing many of the core AWS services.

At the end of this lesson, you will be able to:

- Define cloud computing
- Identify core services provided by AWS

AWS Overview

Cloud computing is the on-demand delivery of compute power, database storage, applications, and other IT resources through a cloud services platform via the internet with pay-as-you-go pricing.

Cloud Computing Basics

Whether you are running applications that share photos to millions of mobile users or you're supporting the critical operations of your business, a cloud services platform provides rapid access to flexible and low cost IT resources. With cloud computing, you don't need to make large upfront investments in hardware and spend a lot of time on the heavy lifting of managing that hardware. Instead, you can provision exactly the right type and size of computing resources you need to power your newest bright idea or operate your IT department. You can access as many resources as you need, almost instantly, and only pay for what you use.

How Does Cloud Computing Work?

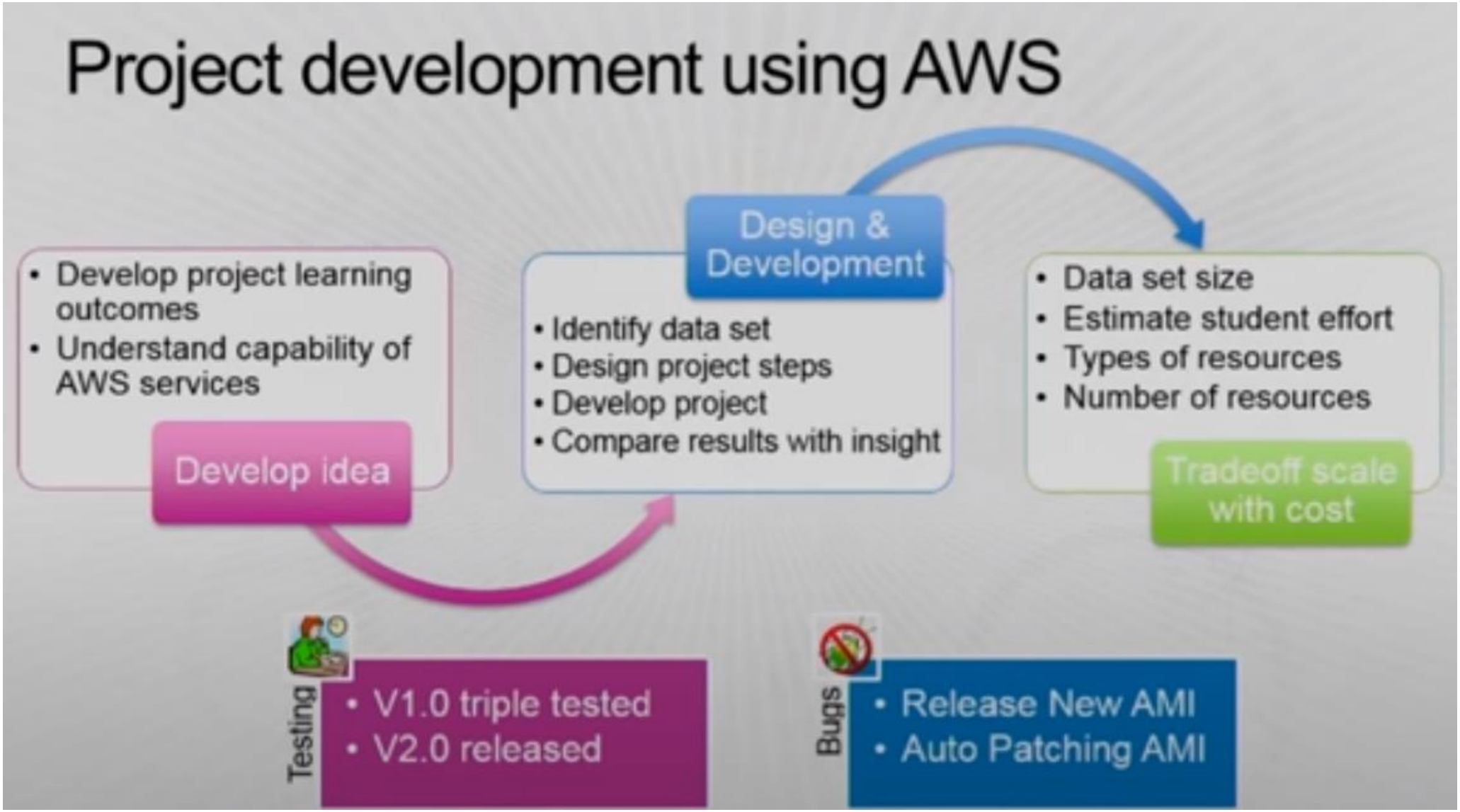
Cloud computing provides a simple way to access servers, storage, databases and a broad set of application services over the Internet. A Cloud services platform such as Amazon Web Services owns and maintains the network-connected hardware required for these application services, while you provision and use what you need via a web application.

Course content

Overview of Cloud Computing	Enabling technologies
	Service and deployment models
	Economic models
Data Centers	Technologies,
	Design considerations,
	Power, Cooling, PUE
Cloud Resource Sharing	CPU
	Memory
	I/O Virtualization
Cloud Storage	Distributed File Systems
	NoSQL Databases
Analytics Engines for the Cloud	Hadoop MapReduce
	Pregel
	GraphLab

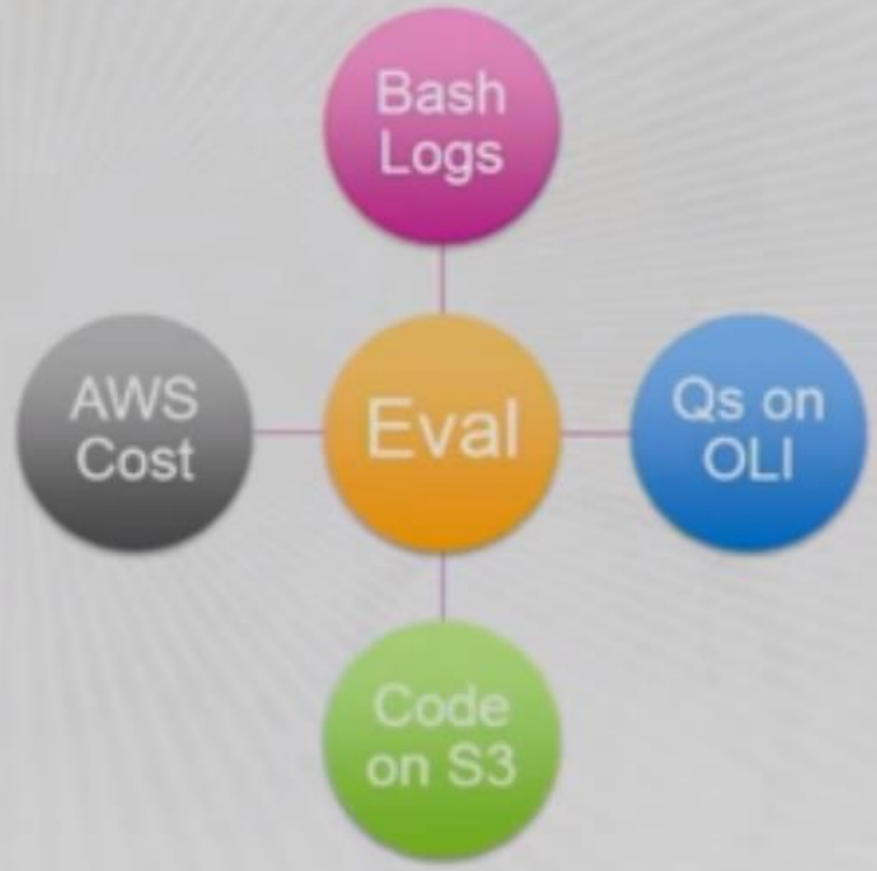
Projects on AWS (public cloud)

0. AWS Account Setup & Tool Primer	• Amazon EC2, Amazon S3, SSH, Authentication, Billing, Security Groups…
1. Big Data Analytics	• Amazon EC2, Amazon EMR
2. Scaling and Elasticity	• Amazon EC2, Amazon ELB, Amazon CloudWatch, Amazon SNS
3. Cloud Storage	• Amazon EBS, MySQL, HBase, Amazon RDS, Amazon DynamoDB
4. Analytics Engines for the Cloud	• Amazon EMR, HBase
5. A Complete Web Service (Team project)	• No restrictions on tools or AWS services • Evaluated based on cost and performance


Project development using AWS
Develop project learning outcomes
Understand capability of AWS services
Develop idea
Design & Development
Identify data set
Design project steps
Develop project
Compare results with insight
Data set size
Estimate student effort
Types of resources
Number of resources
Tradeoff scale with cost
Testing
V1.0 triple tested
V2.0 released
Bugs
Release New AMI
Auto Patching AMI

Evaluation of projects and monitoring

- Evaluation
  - Unique questions
  - Bash logs
  - AWS expenditure
  - Code submission
- Cheat Checking
  - Code similarity check using MOSS
  - Log Correlation
- Monitor Expenditure
  - Daily
  - Per project module (tagging)



Cheat checking

Cheating should be more work than learning

- Code similarity check with Stanford's MOSS
- Answers on OLI project quizzes
- Expenditure report
  - Resources provisioned
  - Time on task
- Log analysis

Managing budgets

Full Score = Correctness + Performance + Budget

- Release a per project module budget
- Release a penalty chart
  - If AWS expenditure > budget → 10% penalty
  - If AWS expenditure > 2 * budget → 100% penalty
- Analyze expenditures daily & weekly
  - Issue automatic penalties & notify students by email
- Results
  - 10% penalties: 43 in Week 1 → 0 in Week 8
  - 100% penalties: 6 in Week 1 → 0 in Week 8
  - A 10% penalty for double the number of attempts is acceptable

AWS cost

Amazon's Educational Grants + Out of Pocket

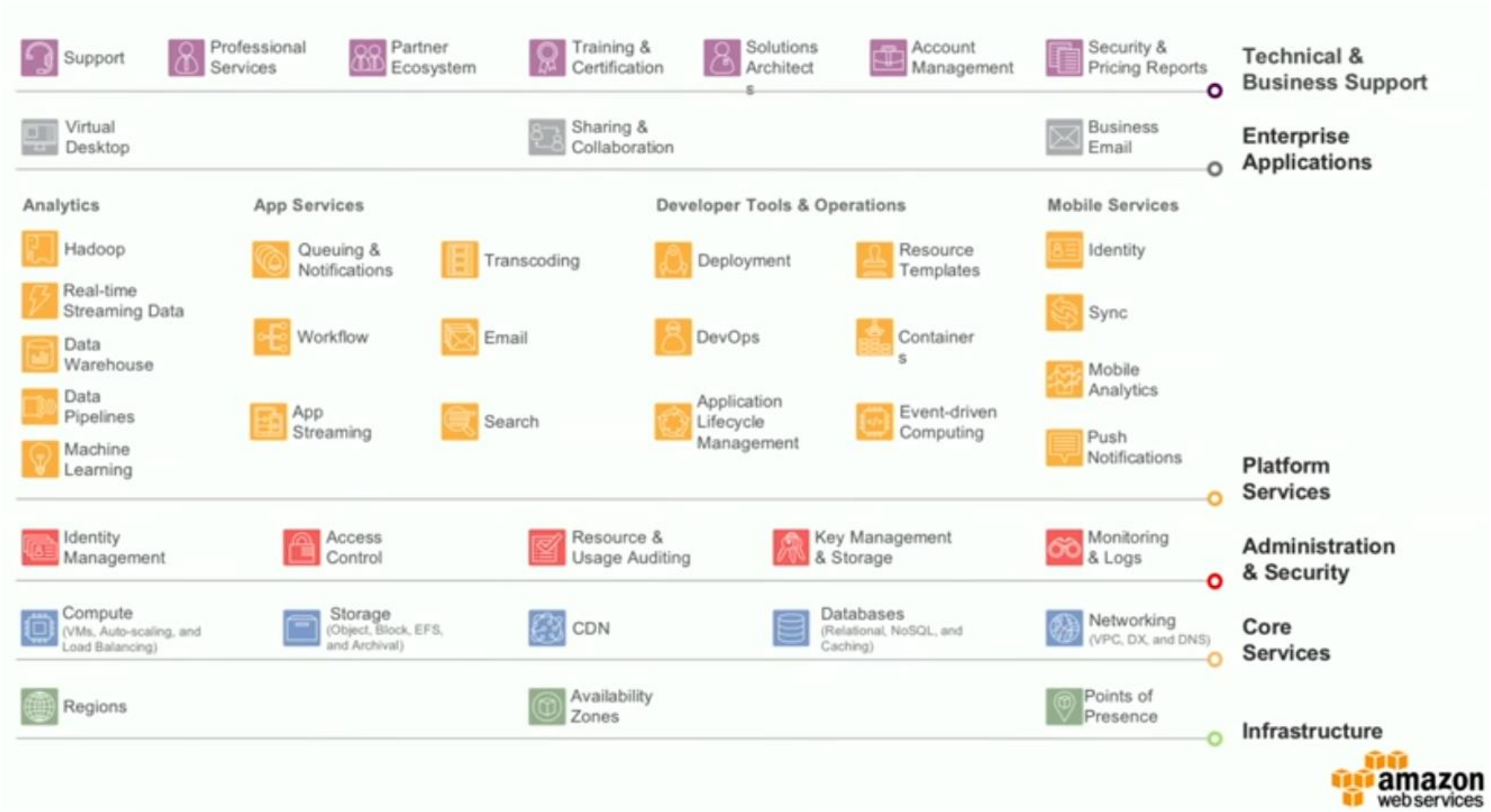
- Actual cost
  - S13: Average $300/student
  - F13: Average $317/student
  - S14: Average $300/student
  - F14: Estimated $150-$200/student
- Control over student spending
  - Budgets for projects
  - Penalties for over spending
  - Need for caps

Lessons

- Always a work in progress
  - Data collection & analysis, surveys, bugs, content, …
- Carefully designed activities
  - Provide useful wrong answers
- Timely and quality feedback
  - Activities, Quizzes, Projects
- Well-trained TAs are critical to success
  - Global course, global TAs
- Videotape recitations and demos
- Auto grading is necessary to scale
- Systems will break; need contingencies

Future plans

- Continue to offer course to CMU global campuses
  - Consider professional development access
- Increase scale for projects
  - TBs of data &100s of VMs
- Develop new projects
  - Mitigating dependence on spot instances
  - Tolerating transient faults
  - Cloud-enabled mobility
  - Streaming data
- IAM roles for students
- AMI authentication
- Grade analytics


Support
Professional Services
Partner Ecosystem
Training & Certification
Solutions Architects
Account Management
Security & Pricing Reports
Technical & Business Support
Virtual Desktop
Sharing & Collaboration
Business Email
Enterprise Applications
Analytics
Hadoop
Real-time Streaming Data
Data Warehouse
Data Pipelines
Machine Learning
App Services
Queuing & Notifications
Transcoding
Workflow
Email
App Streaming
Search
Developer Tools & Operations
Deployment
Resource Templates
DevOps
Containers
Application Lifecycle Management
Event-driven Computing
Mobile Services
Identity
Sync
Mobile Analytics
Push Notifications
Platform Services
Identity Management
Access Control
Resource & Usage Auditing
Key Management & Storage
Monitoring & Logs
Administration & Security
Compute (VMs, Auto-scaling, and Load Balancing)
Storage (Object, Block, EFS, and Archival)
CDN
Databases (Relational, NoSQL, and Caching)
Networking (VPC, DX, and DNS)
Core Services
Regions
Availability Zones
Points of Presence
Infrastructure
amazon web services

Every type of web application runs on AWS

Static website

Static content

Blogs

Basic product page

Website hosting

DNN TYPO3

WordPress Drupal Joomla!

Medium-sized website

CMS systems

Dynamic web application

PBS

Unilever vodafone

Highly interactive websites

Web applications

Online services

Social & sharing sites

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Deployment and management

Focus on writing code, not managing servers

Model, customize, & automate applications

Provision and version collections of resources

Elastic Beanstalk

OpsWorks

CloudFormation

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Security – Secured premises

AWS's world-class, highly secured data centers utilize state-of-the-art electronic surveillance and multi-factor access control systems.

Data centers are staffed 24x7 by trained security guards, and access is authorized strictly on a least privileged basis.

Security - Secured access

AWS provides fully configurable access restrictions by group, user, IP address, and CIDR block to ensure that access to administrative ports is only available from expected addresses. These same controls also can be applied to internal network segmentation via VPC.

Security - Secured users

AWS allows you to permissions at the user and group-level.

You can control what resources each user has access to so you can avoid overly permissive user accounts.

Security - Secured login

AWS allows you to require multi-factor authentication for your users through physical or software-based single use login tokens to thwart stolen passwords and key loggers as an attack vector.

Security – Secured storage

AWS supports protecting your data at rest. Amazon S3 provides AES-265 encryption for your stored data to protect against physical and software-based attacks on your stored data.

Security – Secured communications

AWS requires connections over encrypted connections for administrative functions using RDP & SSH. User-based connections support SSL.

Security - Complete control of software

AWS provides you complete control on every aspect of your software so you can choose the OS, encryption tools, security applications, and users/access management solutions that are right for your needs.

Security - Certifications

Simple Architecture Drawbacks

- Single Point of Failure
  - Can't tolerate instance or AZ failure
- Not scalable (without downtime)
- All components on same instance
  - Leads to resource contention
- No separation of app from data

How to scale?

- Let's break out the WordPress installation into tiers
- Load Balancer tier
  - Elastic Load Balancing
- Web/App Tier
  - EC2 AutoScaling Group
- Caching Tier
  - Elasticache for Memcached
- Database Tier
  - Multi-AZ RDS

How to scale?

- Static Content
  - Amazon S3
- Content Delivery
  - Amazon CloudFront

Benefits

- Elastic Load Balancing
  - Works Across Availability Zones
  - Scales Automatically
  - Integrated with AutoScaling
- EC2 AutoScaling
  - Automatically grow or shrink number of web/app instances based on actual traffic
  - Auto healing in cases of instance or AZ failure

Benefits

- Amazon ElastiCache
  - Cluster of memcached instances
  - Caches most commonly used SQL queries, reducing load on DB
  - Can be used for session store, helping make the app/web tier state-less
- Amazon RDS
  - Managed patching, backups
  - Multi-AZ enables redundancy, automatic failover across AZs

Benefits

- Amazon S3
  - Offloads static content (js/css/images)
  - Reduces load on web servers
  - Scalable by nature
- Amazon CloudFront
  - Reduces latency for users
  - Reduces load on web servers
  - DDoS Protection

AWS Educate Value Proposition

Grants for free usage of AWS services

Labs and training on cloud topics and AWS products

Open course content by leading professors and AWS

Communities that share best practices virtually and in person

- ✓ Positively impact students around the world
- ✓ Curriculum change
- ✓ Student app development and entrepreneurship
- ✓ Accelerate career opportunities and corporate hiring pipeline

+JOBS

amazon web services

What is AWS?

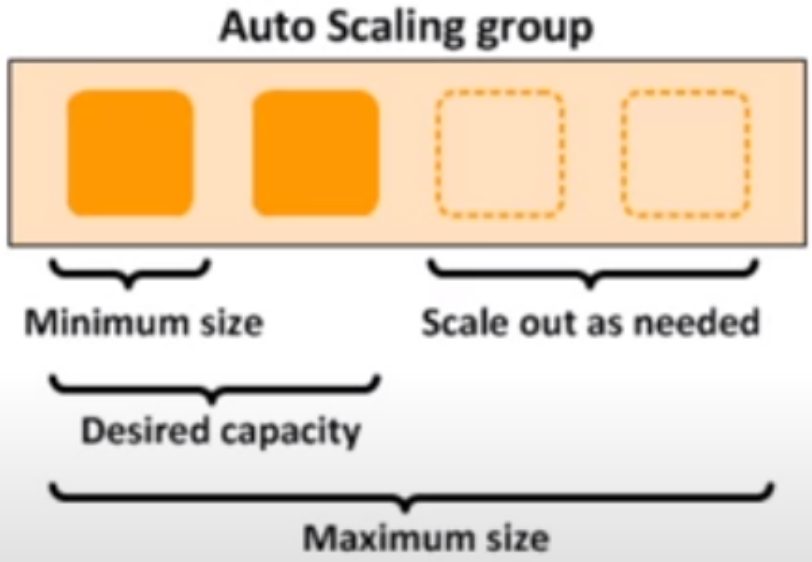
- Global cloud platform
- Used by around 80% of Fortune 500 Companies
- Infrastructure as a service
- Platform as a service
- Software as a service
- Cloud storage platform

Why it is Such a Hit?

- Per hour billing
- Easy sign up process
- Simple billing
- Stability
- Trusted vendor

Service Overview

- EC2 (Elastic Compute Cloud)
- VPC (Virtual Private Cloud)
- S3 (Simple Storage Service)
- Relational Database Service
- Route 53
- ELB (Elastic Load Balancing)
- Autoscaling



How Much it Costs?

- Per hour billing for almost everything
- Region specific pricing
- Term specific pricing
- Spot resources

How Big is it?

- 15 Regions
- Global foorprint
- Multiple availability zones per region
- Massive data centers

Future

- 64 Services currently
- Launching new services in all domains
- Focus on machine learning
- Focus on SAAS products
- Reduction in costs

AWS Analytics Services

Powerful services to process, analyze, visualize data easily and cost-effectively.

Extracting insights and actionable information from data requires a broad array of technology that can work with data efficiently, scalably, and cost-effectively. AWS offers a comprehensive set of services to handle every step of the analytics process chain including data warehousing, business intelligence, batch processing, stream processing, machine learning, and data workflow orchestration. These services are powerful, flexible, and yet simple to use, enabling organizations to put their raw data to work quickly and easily.

Explore the videos and resources below to learn more about AWS Analytics services.

Amazon ElasticSearch

Amazon Elastic MapReduce

Amazon Redshift
Fast, simple, cost-effective data warehousing.

Amazon Kinesis
Easily collect, process, and analyze video and data streams in real time.

Amazon Athena
Start querying data instantly. Get results in seconds. Pay only for the queries you run.

AWS Compute Services

Virtual Server Hosting, Container Management, and Serverless Computing.

Building and running your business starts with compute, whether you are building mobile apps, or running massive clusters to sequence the human genome. AWS has over 70 infrastructure services and plans to deliver thousands of new features in the coming years. With more than twice as many compute instance families, twice the compliance certifications, and the largest global footprint of any other cloud vendor, AWS provides a robust and scalable platform to help organizations of all types and sizes innovate quickly.

AWS offers multiple compute products allowing you to deploy, run, and scale your applications as virtual servers, containers, or code.

Explore the videos and resources below to learn more about AWS Compute services.

Amazon EC2 Amazon Lambda Amazon Lightsail Amazon Elastic Container Service (ECS)

AWS Database Services

Purpose-built databases for all your application needs

Managed Relational, Non-Relational, Data Warehouse, In-Memory Data Store, and Graph Databases.

AWS offers a broad range of databases purpose-built for your specific application use cases. Our fully managed database services include relational databases for transactional applications, non-relational databases for internet-scale applications, a data warehouse for analytics, an in-memory data store for caching and real-time workloads, and a graph database for building applications with highly connected data. If you are looking to migrate your existing databases to AWS, the AWS Database Migration Service makes it easy and cost effective to do so.

Explore the videos and resources below to learn more about AWS Database services.

Amazon DynamoDB
Fast and flexible NoSQL database service for any scale. Pay only for the throughput and storage you need.

Amazon Redshift
Fast, simple, cost-effective data warehousing.

Amazon Relational Database Service (RDS)
Managed relational database service with a choice of six popular database engines. Set up, operate, and scale a relational database in the cloud with just a few clicks.

Amazon Aurora
MySQL and PostgreSQL compatible relational database built for the cloud. Performance and availability of commercial-grade databases at 1/10th the cost, and it is available through RDS.

AWS Developer Tools

Host code and automatically build, test, and deploy your applications to AWS

The AWS Developer Tools is a set of services designed to enable developers and IT operations professionals practicing DevOps to rapidly and safely deliver software. Together, these services help you securely store and version control your application's source code and automatically build, test, and deploy your application to AWS or your on-premises environment. You can use AWS CodePipeline to orchestrate an end-to-end software release workflow using these services and third-party tools or integrate each service independently with your existing tools.

Explore the videos and resources below to learn more about AWS Developer Tools services.

Amazon CodeCommit

AWS CodeCommit is a fully-managed source control (Enlaces a un sitio externo.) service that makes it easy for companies to host secure and highly scalable private Git repositories. CodeCommit eliminates the need to operate your own source control system or worry about scaling its infrastructure. You can use CodeCommit to securely store anything from source code to binaries, and it works seamlessly with your existing Git tools.

Amazon CodeDeploy

AWS CodeDeploy is a service that automates software deployments to a variety of compute services including Amazon EC2, AWS Lambda, and instances running on-premises. AWS CodeDeploy makes it easier for you to rapidly release new features, helps you avoid downtime during application deployment, and handles the complexity of updating your applications.

Amazon CodePipeline

AWS CodePipeline is a continuous integration (Enlaces a un sitio externo.) and continuous delivery (Enlaces a un sitio externo.) service for fast and reliable application and infrastructure updates. CodePipeline builds, tests, and deploys your code every time there is a code change, based on the release process models you define. This enables you to rapidly and reliably deliver features and updates. You can easily build out an end-to-end solution by using our pre-built plugins for popular third-party services like GitHub or integrating your own custom plugins into any stage of your release process. With AWS CodePipeline, you only pay for what you use. There are no upfront fees or long-term commitments.

Amazon CodeBuild

Build and test code with continuous scaling. Only pay for the build time you use.

AWS Management Tools

Complete Control for Your Cloud Environment

AWS provides a set of management tools that allows you to programmatically provision, monitor, and automate all the components of your cloud environment. Using these tools, you can maintain consistent controls without restricting development velocity. AWS provides four kinds of management tools that all work together and are integrated with every part of the AWS platform, from Amazon EC2 to Amazon DynamoDB, in order for you to easily control all parts of your cloud infrastructure.

Explore the videos and resources below to learn more about AWS Management Tools.

Amazon CloudFormation
Model and provision all of your cloud infrastructure resources.

Amazon CloudWatch
Monitor resources and applications.

Amazon Systems Manager
Gain operational insights and take action on AWS resources.

Amazon CloudTrail
Track user activity and API usage.

AWS Networking and Content Delivery Services

Virtual private cloud, direct connections, load balancing, and DNS

AWS networking products enable you to isolate your cloud infrastructure, scale your request handling capacity, and connect your physical network to your private virtual network.

AWS networking products work together to meet the needs of your application. For example, Elastic Load Balancing works with Amazon Virtual Private Cloud (VPC) to provide robust networking and security features.

Explore the videos and resources below to learn more about AWS Networking and Content Delivery services.

Amazon Virtual Private Cloud (VPC)
Isolate cloud resources with your own private virtual network

Amazon Elastic Load Balancing
Automatically distribute application traffic across multiple Amazon EC2 instances in the cloud

Amazon CloudFront
Highly secure global content delivery network (CDN)

Amazon Direct Connect
Dedicated network connection between your network and your Amazon VPC

Amazon Route 53
Highly available and scalable cloud DNS to connect user requests to your AWS resources

AWS Storage Services

A reliable, scalable, and secure place for your data

Cloud storage is a critical component of cloud computing, holding the information used by applications. Big data analytics, data warehouses, Internet of Things, databases, and backup and archive applications all rely on some form of data storage architecture. Cloud storage is typically more reliable, scalable, and secure than traditional on-premises storage systems.

AWS offers a complete range of cloud storage services to support both application and archival compliance requirements. Select from object, file, and block storage services as well as cloud data migration options to start designing the foundation of your cloud IT environment.

Explore the videos and resources below to learn more about AWS Storage services.

Amazon Elastic Block Storage (EBS)
Store and Process Block Data on Persistent Volumes for Amazon EC2 instances

Amazon Elastic File System (EFS)
Store and Share Data in Simple, Scalable File Systems

Amazon Glacier
Archive Data in Low-Cost Storage

Amazon S3
Object Store