Tamkang University

淡江大學

TKU AII Club
淡江AI創智社

NTPU
國立臺北大學
National Taipei University

Cloud Computing Architecture for Artificial Intelligence
(人工智慧雲端運算架構)

Host: 閆立中, TKU AI創智社社長
Time: 18:00-20:00, May 24, 2022 (Tuesday)
Place: TKU AII Club, MS Teams

戴敏育 副教授
Min-Yuh Day, Ph.D, Associate Professor
國立臺北大學 資訊管理研究所
Institute of Information Management, National Taipei University

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2022-05-24

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國立臺北大學 資訊管理研究所 副教授

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國立臺灣大學 資訊管理 博士

Publications Co-Chairs, IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2013-)

Program Co-Chair, IEEE International Workshop on Empirical Methods for Recognizing Inference in TExt (IEEE EM-RITE 2012-)

Publications Chair, The IEEE International Conference on Information Reuse and Integration for Data Science (IEEE IRI)

NTPU
國立臺北大學
National Taipei University

aws academy
Accredited Educator

aws certified
Solutions Architect
Associate

aws certified
Cloud Practitioner

aws educate | Cloud Ambassador
2020 Cohort

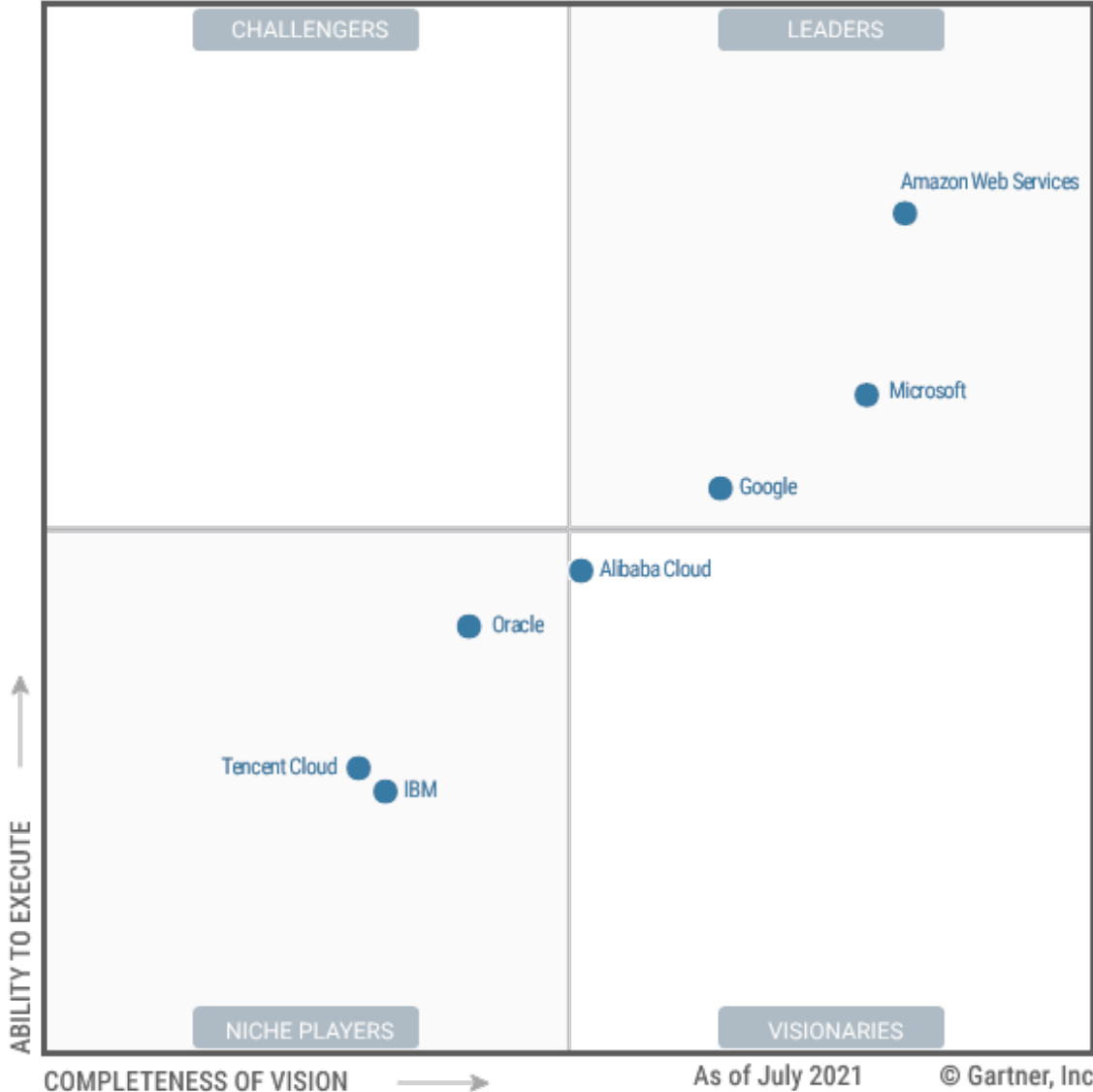國立臺北大學
National Taipei University

ACADEMIA SINICA
1928

Outline

- **Cloud Computing Architecture for AI**
- **AWS Certifications Roadmap for Machine Learning**
- **AWS Serverless Architecture**

Cloud Computing Architecture

Gartner Magic Quadrant for
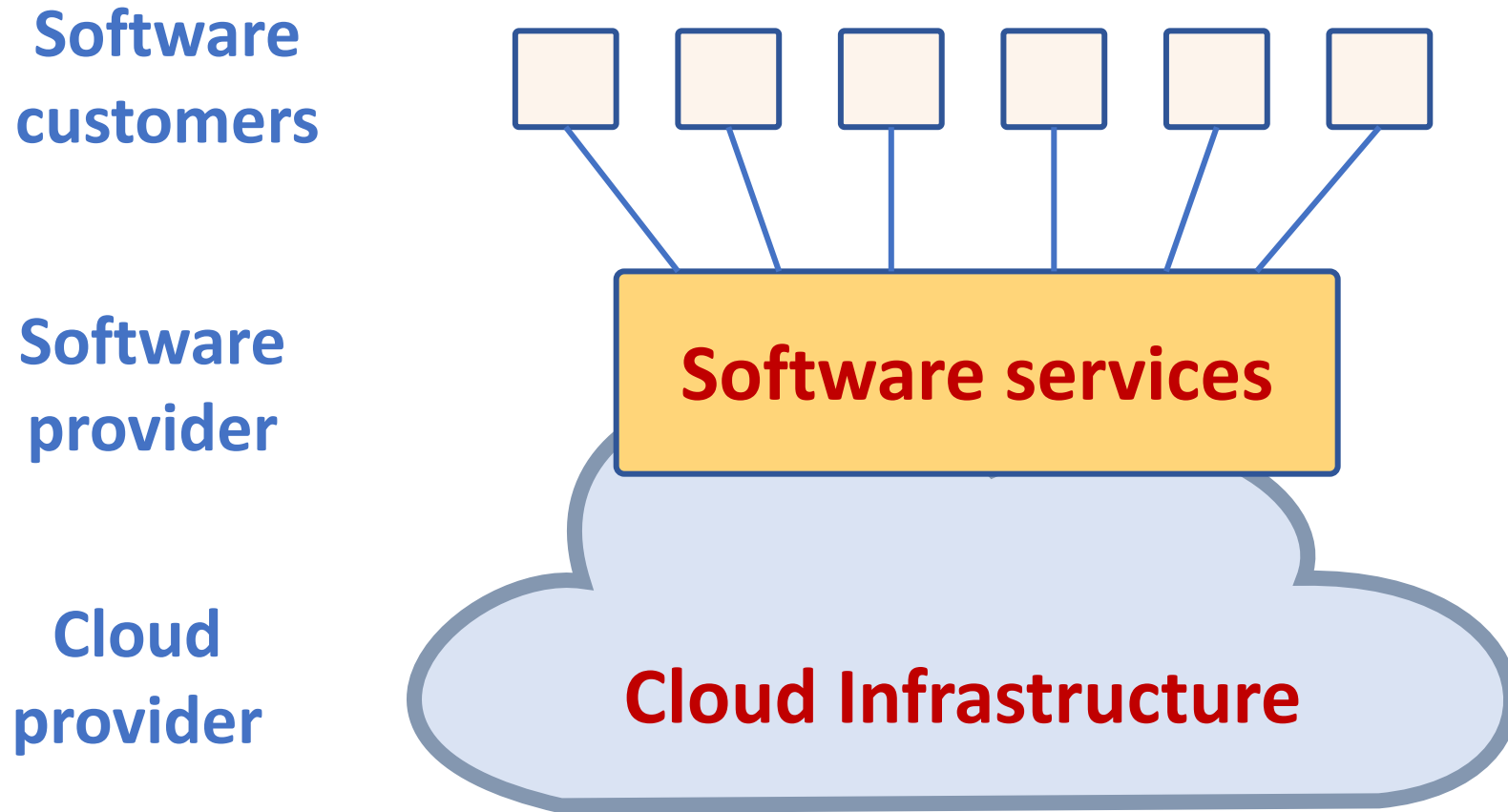# Cloud Infrastructure and Platform Services
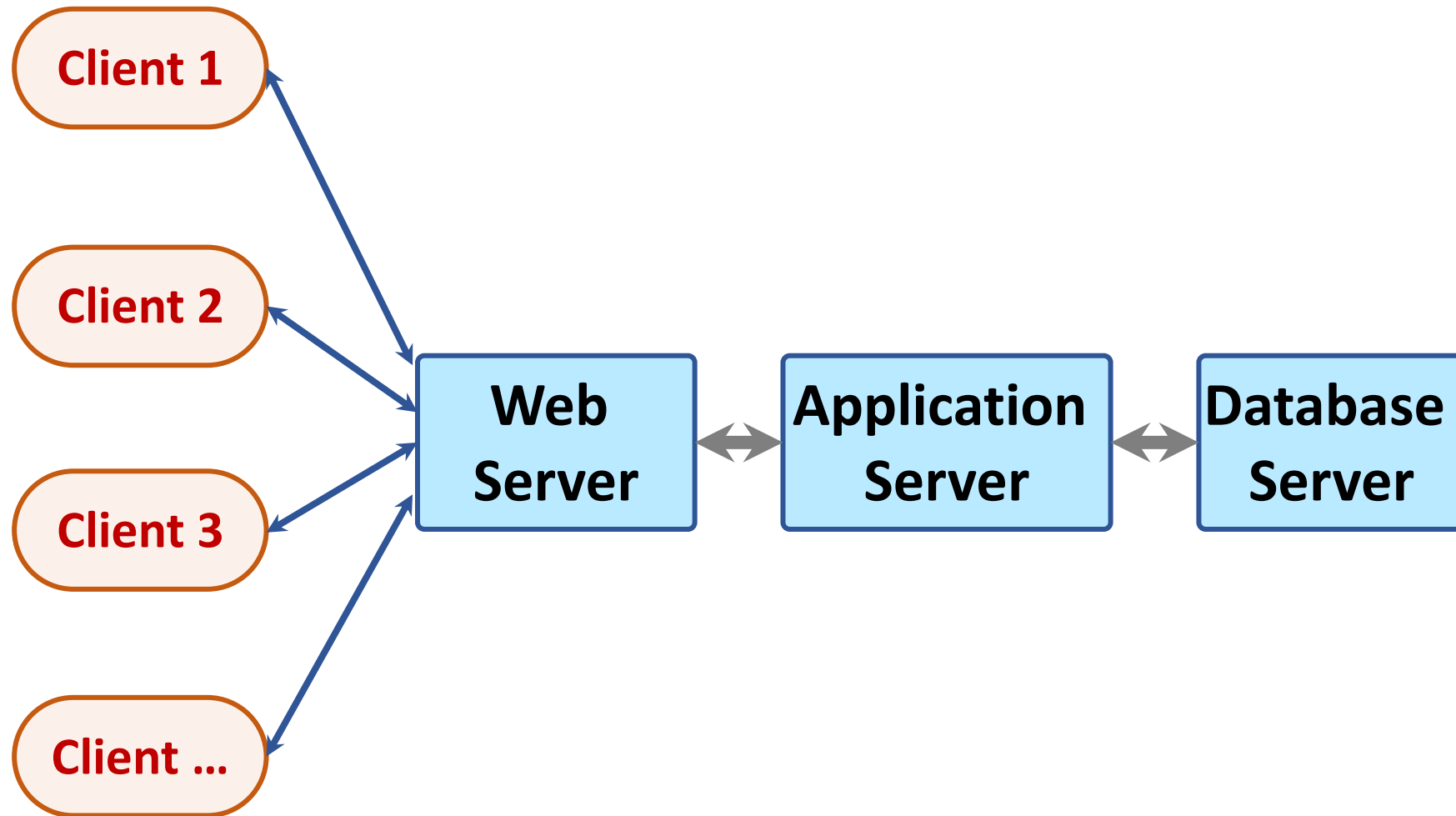

Amazon Web Services

Microsoft

Google

Software as a service

Software customers

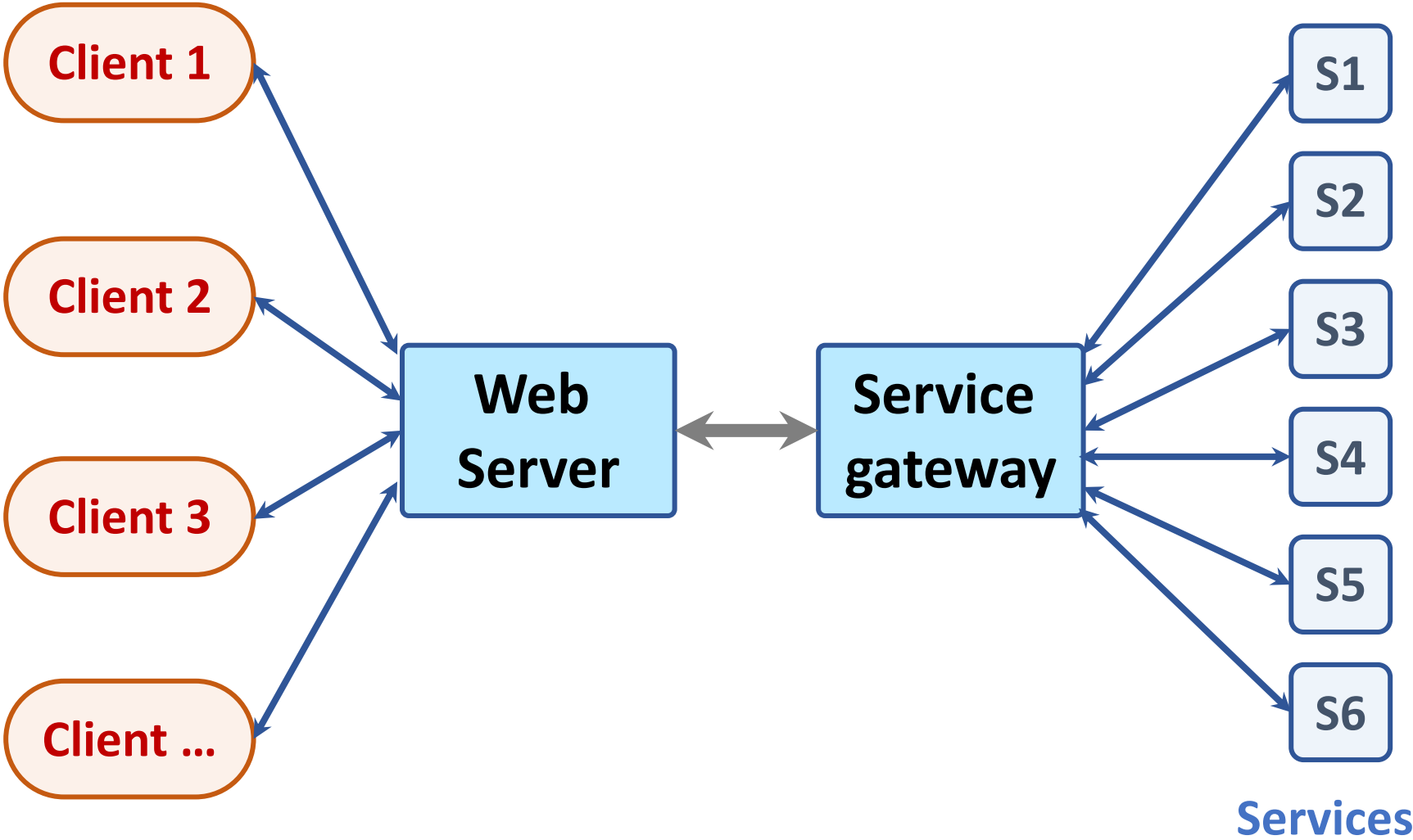**Software provider**

Cloud provider

Software services
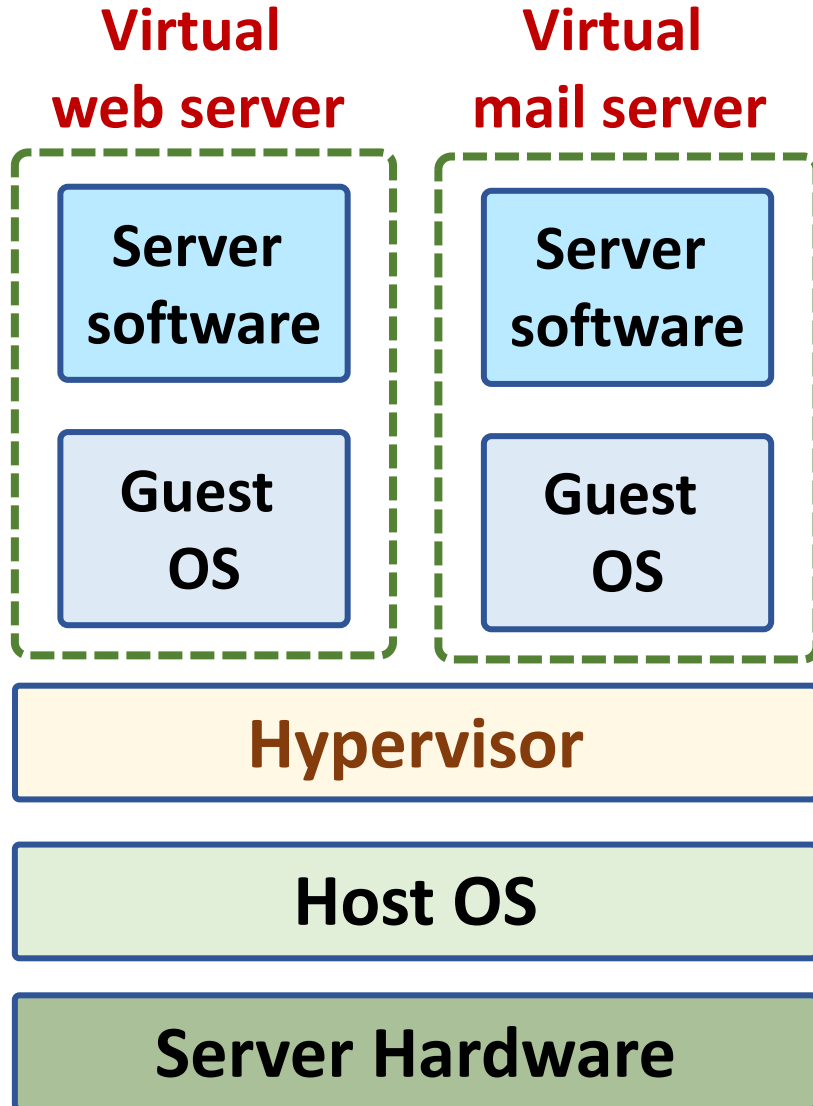
Cloud Infrastructure

Multi-tier client-server architecture

Service-oriented Architecture

VM   # Container

Virtual web server   **Virtual mail server**   **User 1 Container 1**   **User 2 Container 2**

Server software	Server software	Application software	Application software
Guest OS	Guest OS	Server software	Server software

Hypervisor	Container manager
Host OS	Host OS
Server Hardware	Server Hardware

Everything as a service

Photo editing

Cloud management Monitoring

Storage Network

Software as a service (SaaS)

Platform as a service (PaaS)

Infrastructure as a service (IaaS)

Cloud data center

Logistics management

Database Software development

Computing Virtualization
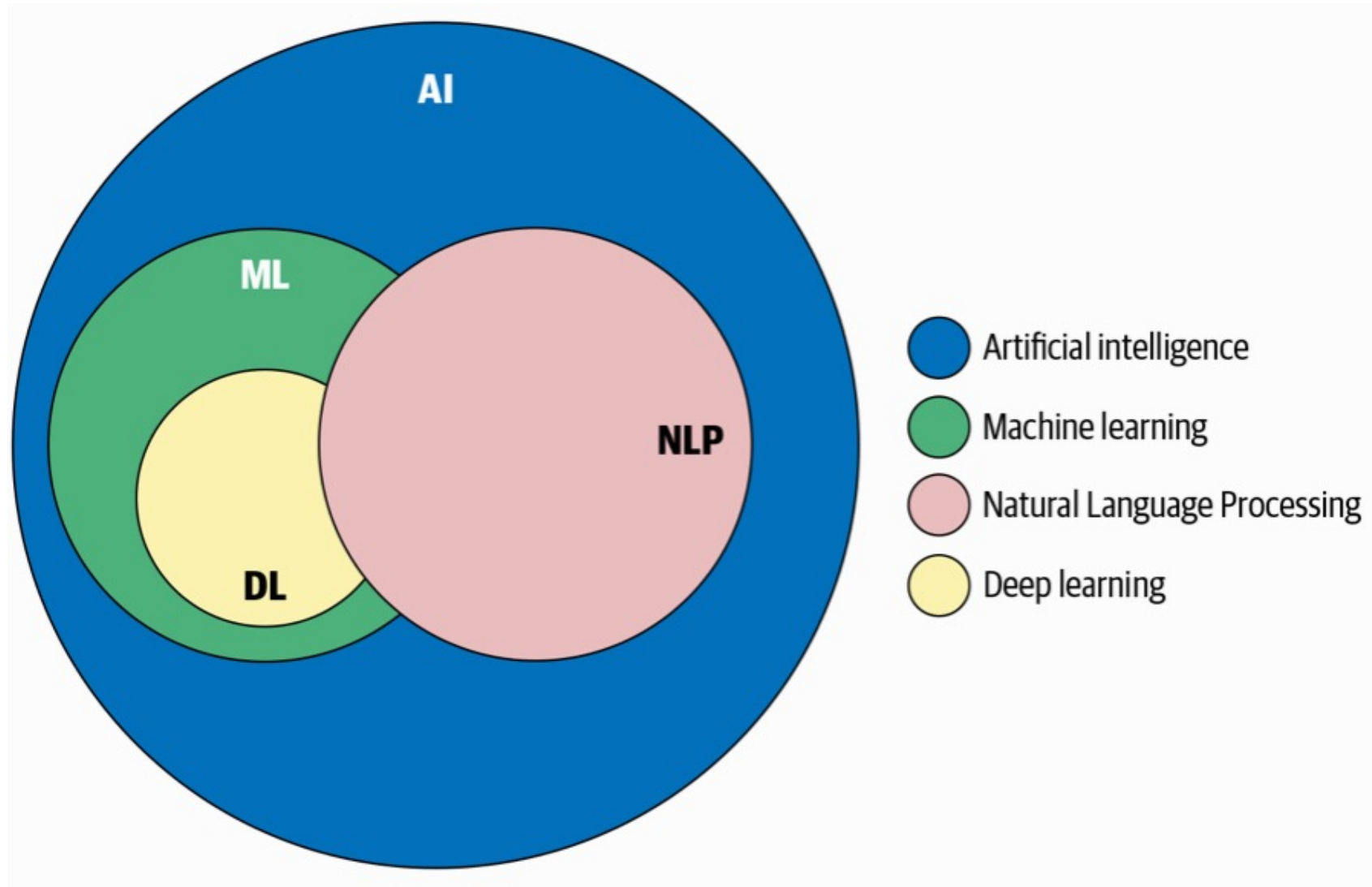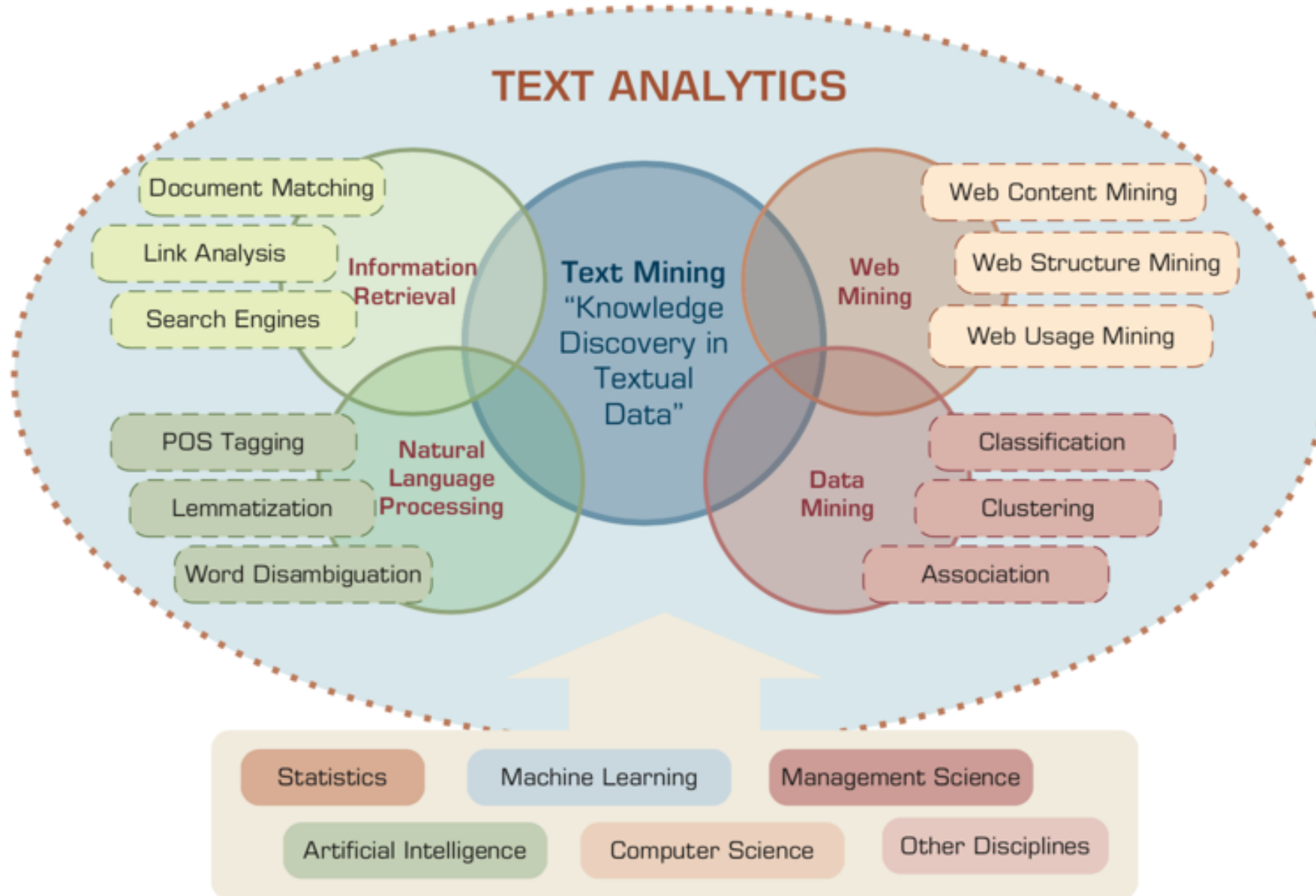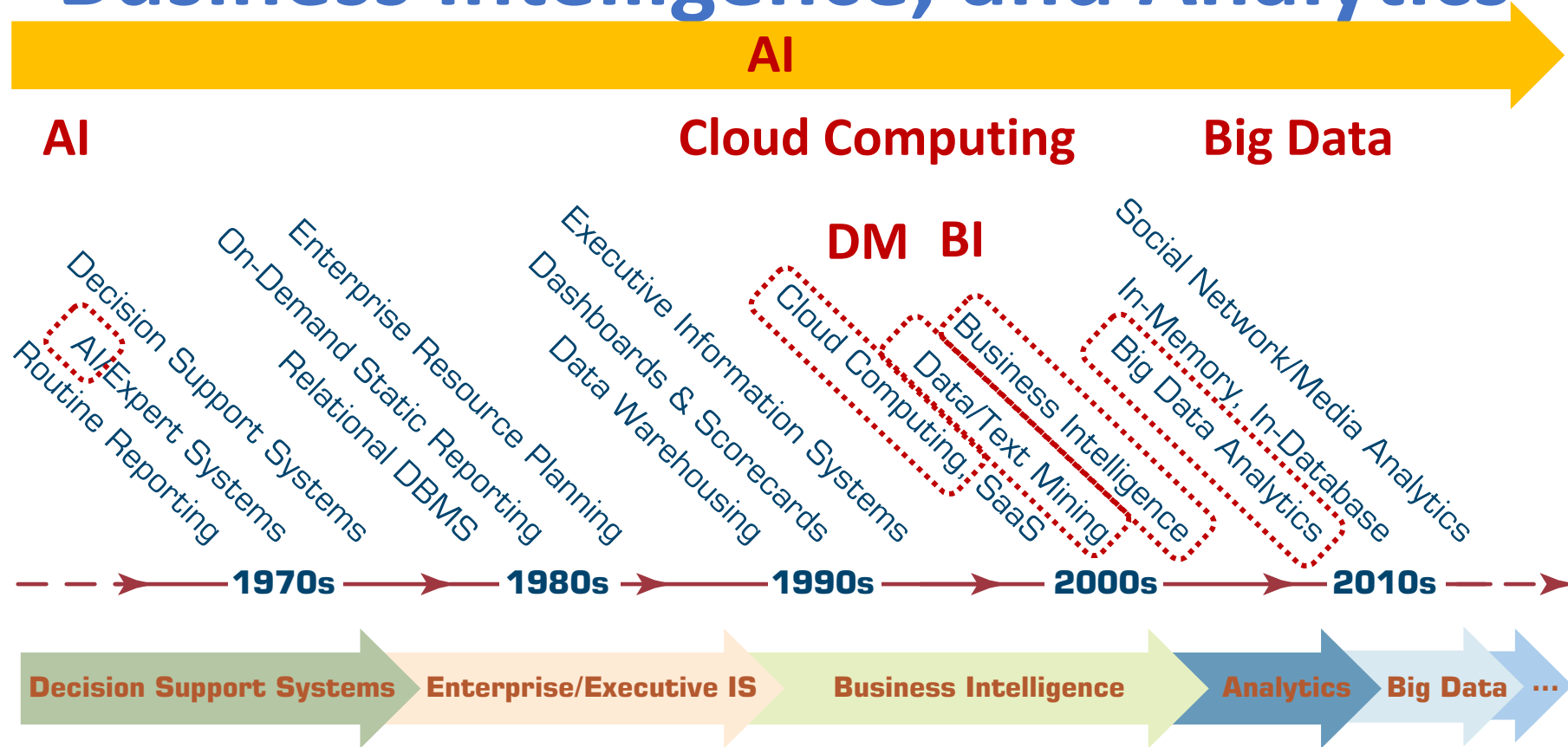
Artificial Intelligence (AI)

AI, NLP, ML, DL

Text Analytics and Text Mining

AI, Big Data, Cloud Computing

Evolution of Decision Support, Business Intelligence, and Analytics

AI

AI   Cloud Computing   Big Data

DM BI

Decision Support Systems / AI/Expert Systems / Routine Reporting — On-Demand Static Reporting — Enterprise Resource Planning / Relational DBMS — Executive Information Systems / Dashboards & Scorecards / Data Warehousing — Cloud Computing, SaaS — Data/Text Mining — Business Intelligence — Big Data Analytics — Social Network/Media Analytics / In-Memory, In-Database

1970s → 1980s → 1990s → 2000s → 2010s

Decision Support Systems → Enterprise/Executive IS → Business Intelligence → Analytics → Big Data → ...

14

The Rise of AI

AI is born

Focus on specific intelligence

Focus on specific problems

- The Turing Test
- Dartmouth College conference
- Information theory-digital signals
- Symbolic reasoning

- Expert systems & knowledge
- Neural networks conceptualized
- Optical character recognition
- Speech recognition

- Machine learning
- Deep learning: pattern analysis & classification
- Big data: large databases
- Fast processors to crunch data
- High-speed networks and connectivity

Dartmouth conference led by John McCarthy coins the term "artificial intelligence"
1956

Edward Feigenbaum develops the first Expert System, giving rebirth to AI
1975 – 1982

IBM's Watson Q&A machine wins Jeopardy!
Apple integrates Siri, a personal voice assistant into the iPhone
2011

2016
AlphaGo defeats Lee Sedol

2014
YouTube recognizes cats from videos

2000

1950   1960   1970   1980   1990   2010   2020

1964
Eliza, the first chatbot is developed by Joseph Weizenbaum at MIT

1997
IBM's Deep Blue defeats Garry Kasparov, the world's reigning chess champion

- Limited computer processing power
- Limited database storage capacity
- Limited network ability

- Real-world problems are complicated
  - Facial recognition, translation
  - Combinatorial explosion

- Disappointing results: failure to achieve scale
- Collapse of dedicated hardware vendors

AI Winter I

AI Winter II

Definition
of
Artificial Intelligence
(A.I.)

Artificial Intelligence

"… the **science** and **engineering** of making **intelligent machines**"
(John McCarthy, 1955)

Artificial Intelligence

"... technology that thinks and acts like humans"

Artificial Intelligence

"… **intelligence** exhibited by **machines** or **software**"

4 Approaches of AI

Thinking Humanly	**Thinking Rationally**
Acting Humanly	**Acting Rationally**

4 Approaches of AI

2. **Thinking Humanly:** **The Cognitive Modeling Approach**	**3.** **Thinking Rationally:** **The "Laws of Thought" Approach**
1. **Acting Humanly:** **The Turing Test Approach** **(1950)**	**4.** **Acting Rationally:** **The Rational Agent Approach**

AI Acting Humanly:
The Turing Test Approach
(Alan Turing, 1950)

- **Knowledge Representation**

- **Automated Reasoning**

- **Machine Learning (ML)**

  - **Deep Learning (DL)**

- **Computer Vision (Image, Video)**

- **Natural Language Processing (NLP)**

- **Robotics**

AI, ML, DL

Artificial Intelligence (AI)

Machine Learning (ML)

Supervised Learning

Unsupervised Learning

Deep Learning (DL)
CNN
RNN LSTM GRU
GAN

Semi-supervised Learning

Reinforcement Learning

Source: https://leonardoaraujosantos.gitbooks.io/artificial-intelligence/content/deep_learning.html

23

3 Machine Learning Algorithms

Source: Enrico Galimberti, http://blogs.teradata.com/data-points/tree-machine-learning-algorithms/

Machine Learning (ML)

Source: https://www.mactores.com/services/aws-big-data-machine-learning-cognitive-services/
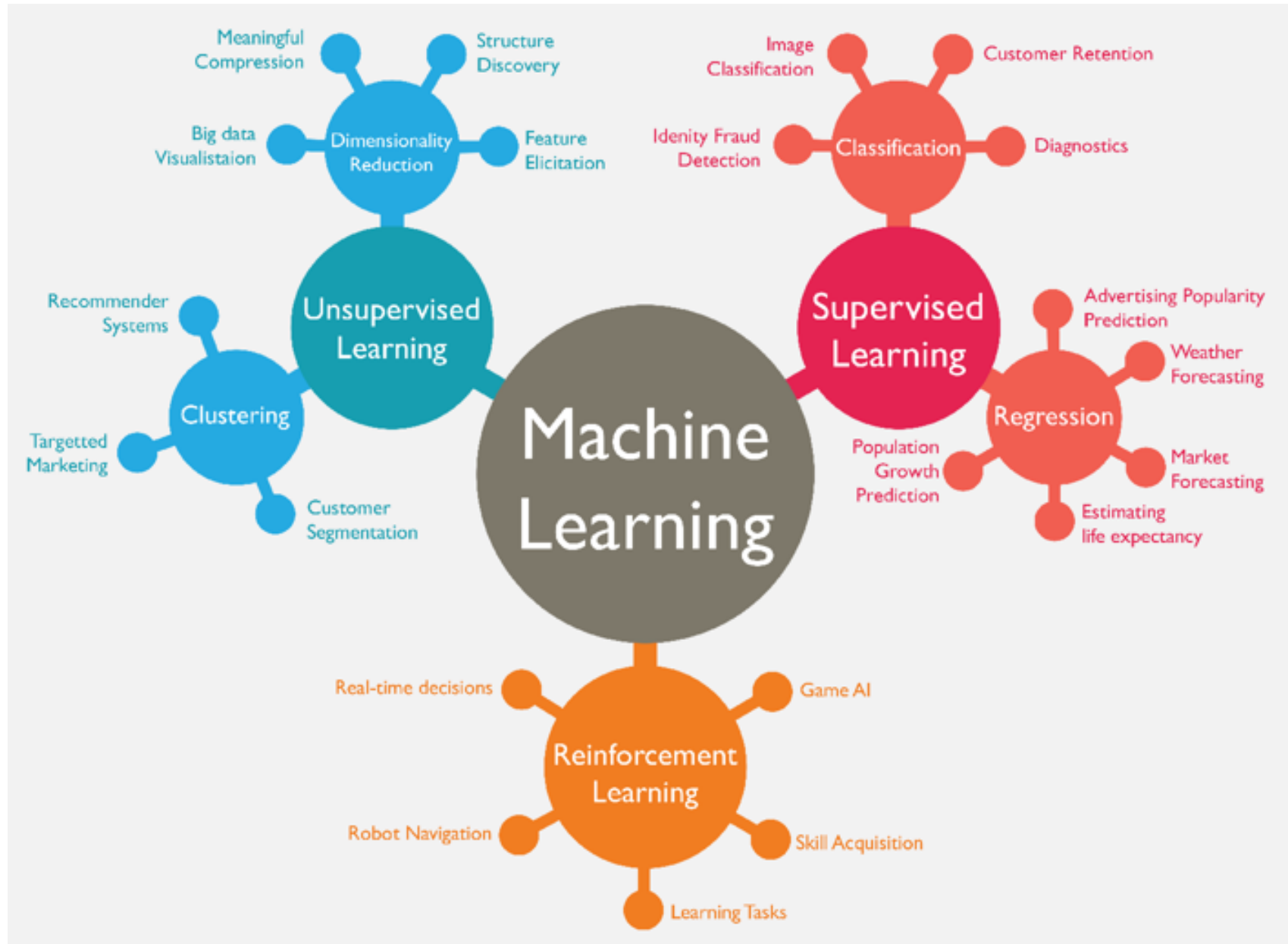
Cloud Computing Architecture for Artificial Intelligence

Cloud Computing Architecture for AI Machine Learning

- **Lots of data**

- **Computation / Algorithms**

- **Knowledge**

Artificial Intelligence and Machine Learning: AWS vs Azure vs GCP
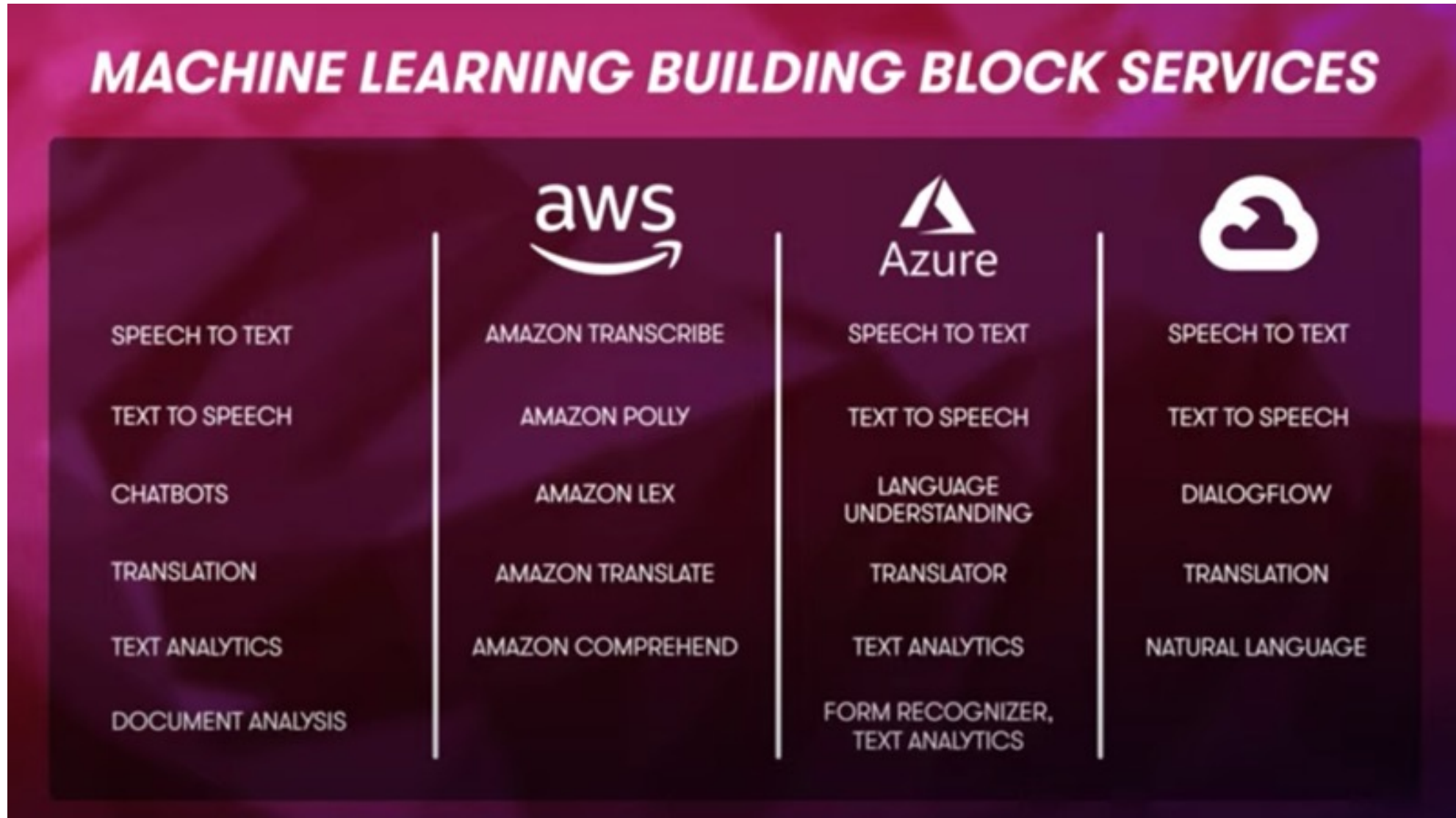
Artificial Intelligence and Machine Learning: AWS vs Azure vs GCP

MACHINE LEARNING BUILDING BLOCK SERVICES

	aws	Azure	GCP
IMAGE/VIDEO ANALYSIS	AMAZON REKOGNITION	COMPUTER VISION FACE INDEXER	VISION, VIDEO
ANOMALY DETECTION	AMAZON LOOKOUT FAMILY, FRAUD DETECTOR	ANOMALY DETECTOR, METRICS ADVISOR	CLOUD INFERENCE
PERSONALIZATION	AMAZON PERSONALIZE	PERSONALIZER	RECOMMENDATIONS AI
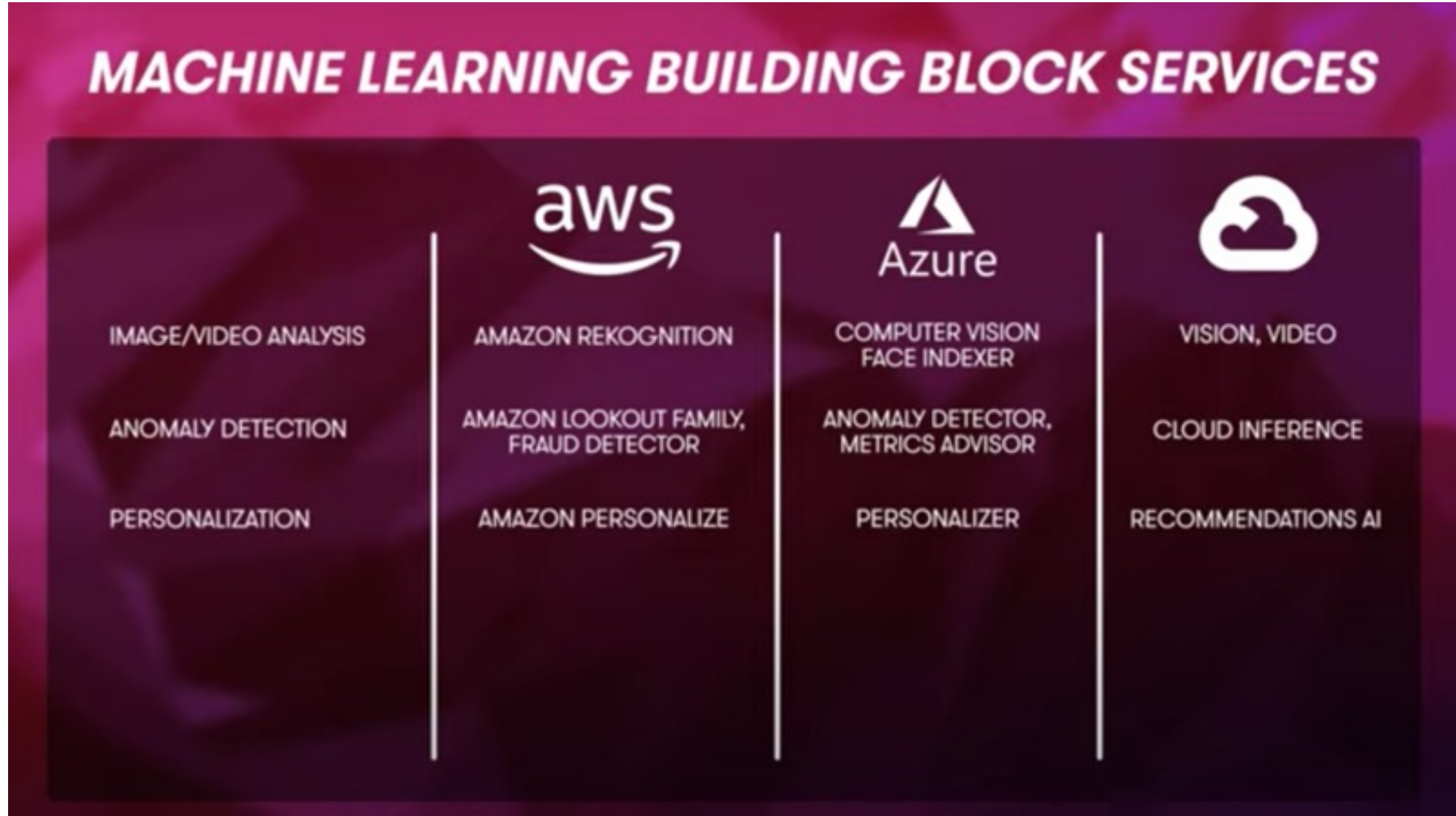
Artificial Intelligence and Machine Learning: AWS vs Azure vs GCP

MACHINE LEARNING PLATFORMS

	aws	Azure	(GCP)
JUPYTER NOTEBOOK	✓	✓	✓
EXTENSIVE FRAMEWORK SUPPORT	✓	✓	✓
SECURITY, COLLABORATION, DATA MANAGEMENT	✓	✓	✓

Artificial Intelligence and Machine Learning: AWS vs Azure vs GCP

Source: https://acloudguru.com/blog/engineering/aws-vs-azure-vs-gcp-artificial-intelligence-and-machine-learning
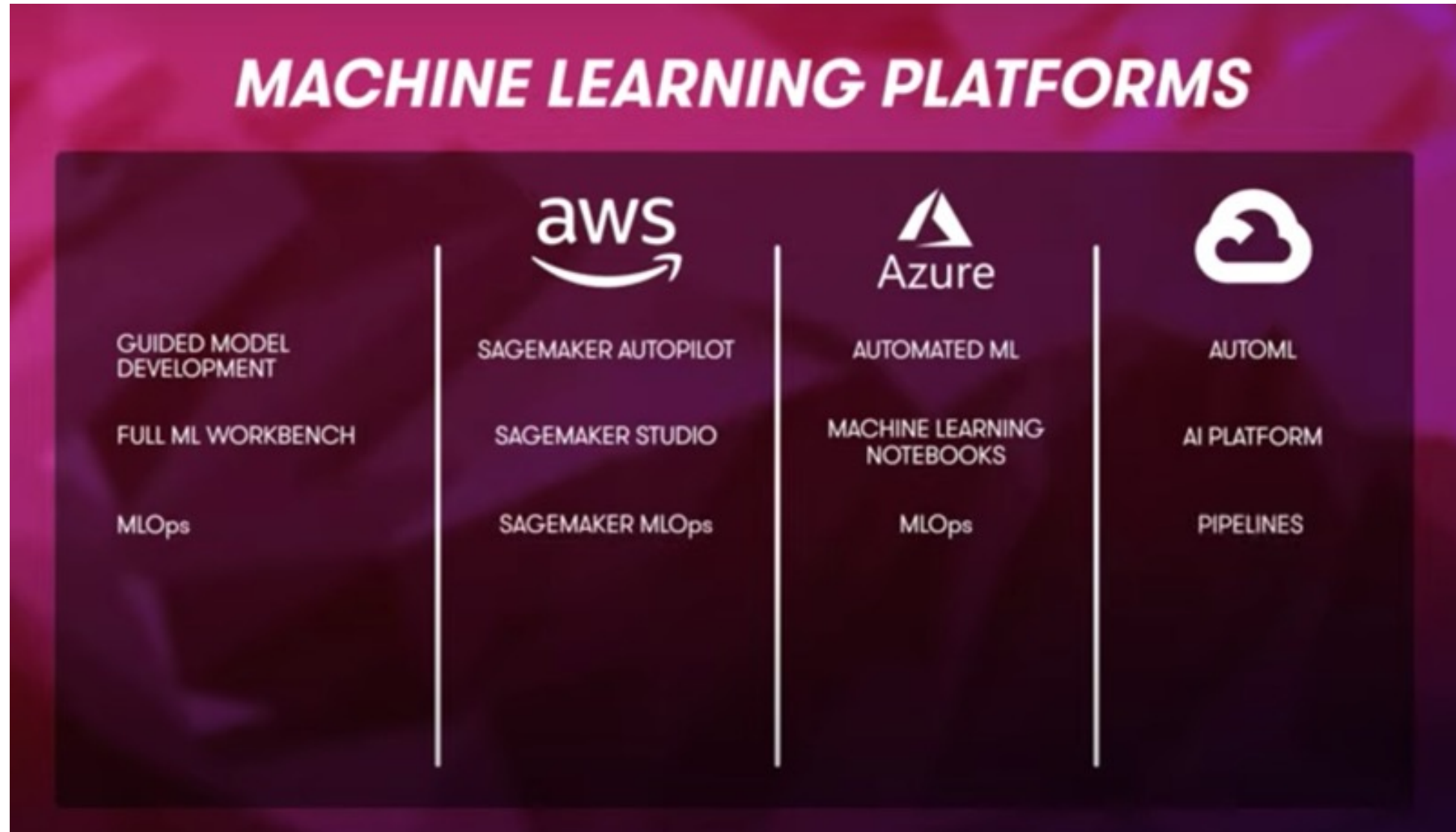
Machine learning building block services

- **Speech to text and text to speech**

- **Chatbots**

- **Translation**

- **Text Analytics**

- **Document Analysis**

- **Image and video analysis**

- **Anomaly detection**

- **Personalization**

Machine learning platforms

- **Guided model development**
- **Full ML workbench**
- **MLOps**
- **Augmented AI**
  - **AWS Augmented AI (Amazon A2I)**
    - The power of real, living, breathing humans to help improve your machine learning service

Machine Learning Infrastructure

- **Hardware**
  - **AWS: Habana Gaudi ASIC instances, custom processor AWS Trainium, optimized for model training.**
    Inferentia for machine learning inferences.
  - **Azure: FPGA-based virtual machines tuned specifically for machine learning workloads.**
  - **GCP: Tensor Processing Unit (TPU), ASIC-optimized for the TensorFlow framework.**
- **Machine learning explainability and bias**
  - **AWS: SageMaker Clarify**
  - **Azure: Responsible ML and Fairlearn SDK**
  - **GCP: AI Explanations**

AWS Machine Learning

Source: https://aws.amazon.com/
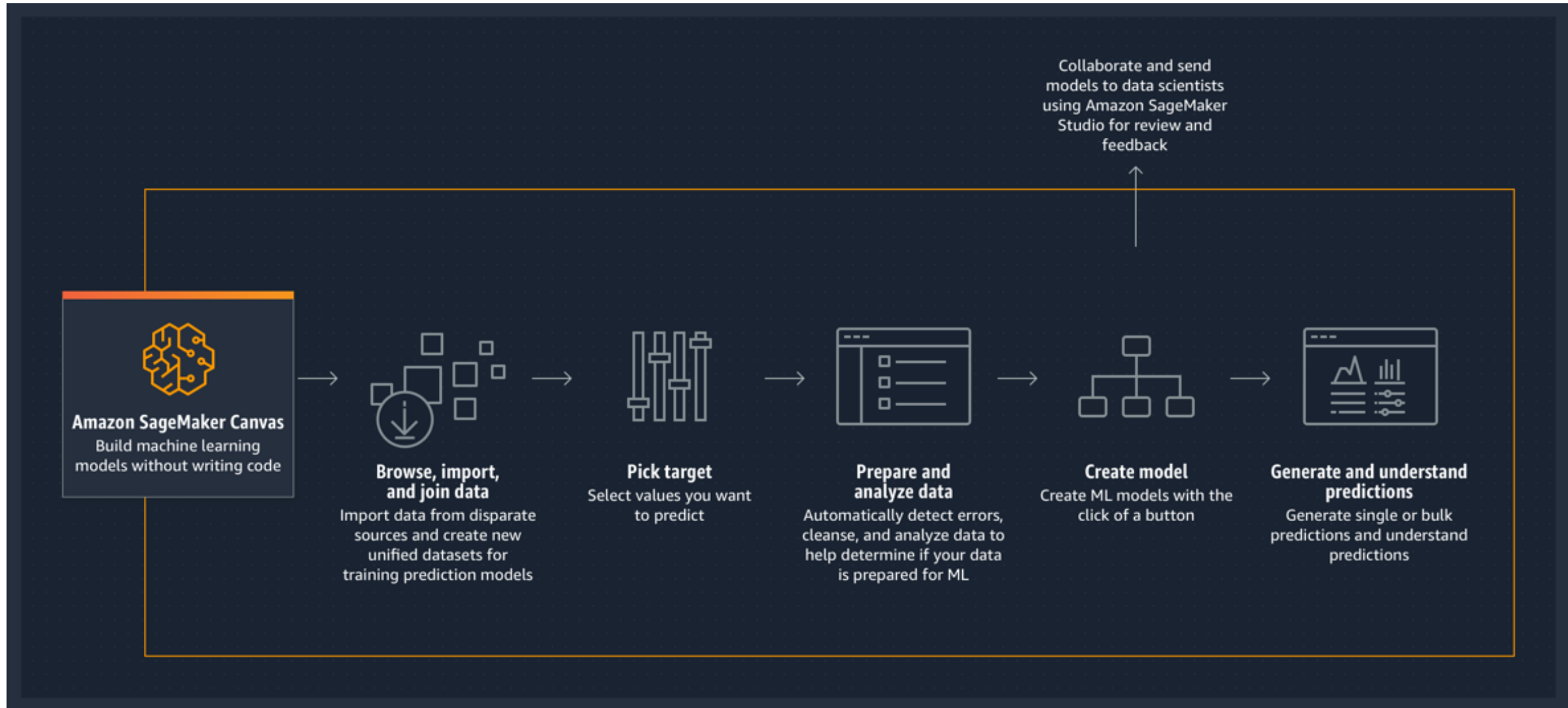
AWS Machine Learning
Amazon SageMaker

Amazon SageMaker is an ML service enabling data scientists, data engineers, MLOps engineers, and business analysts to build, train, and deploy ML models for any use case, regardless of ML expertise.
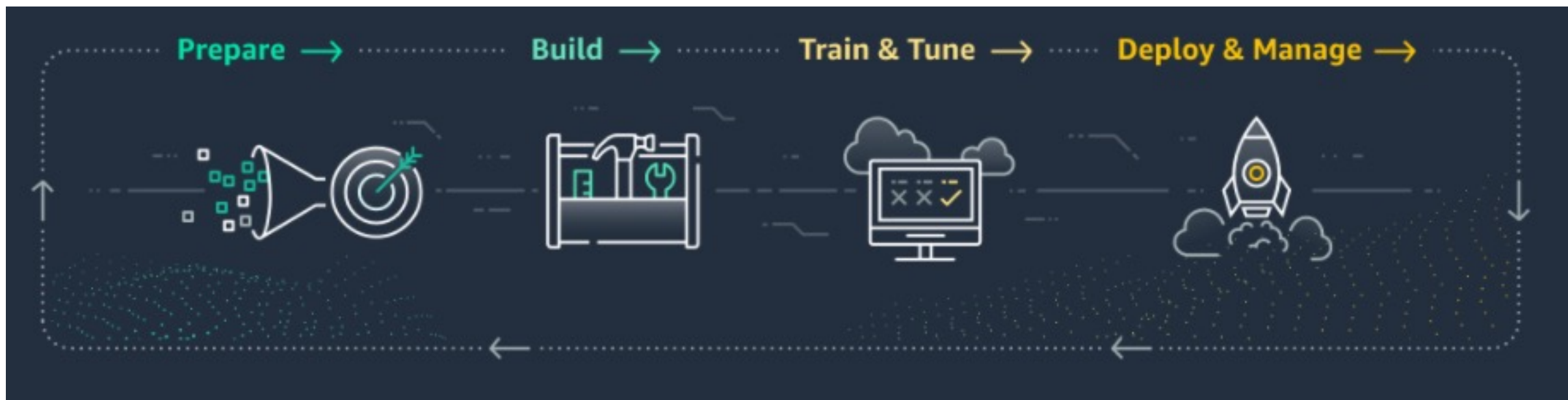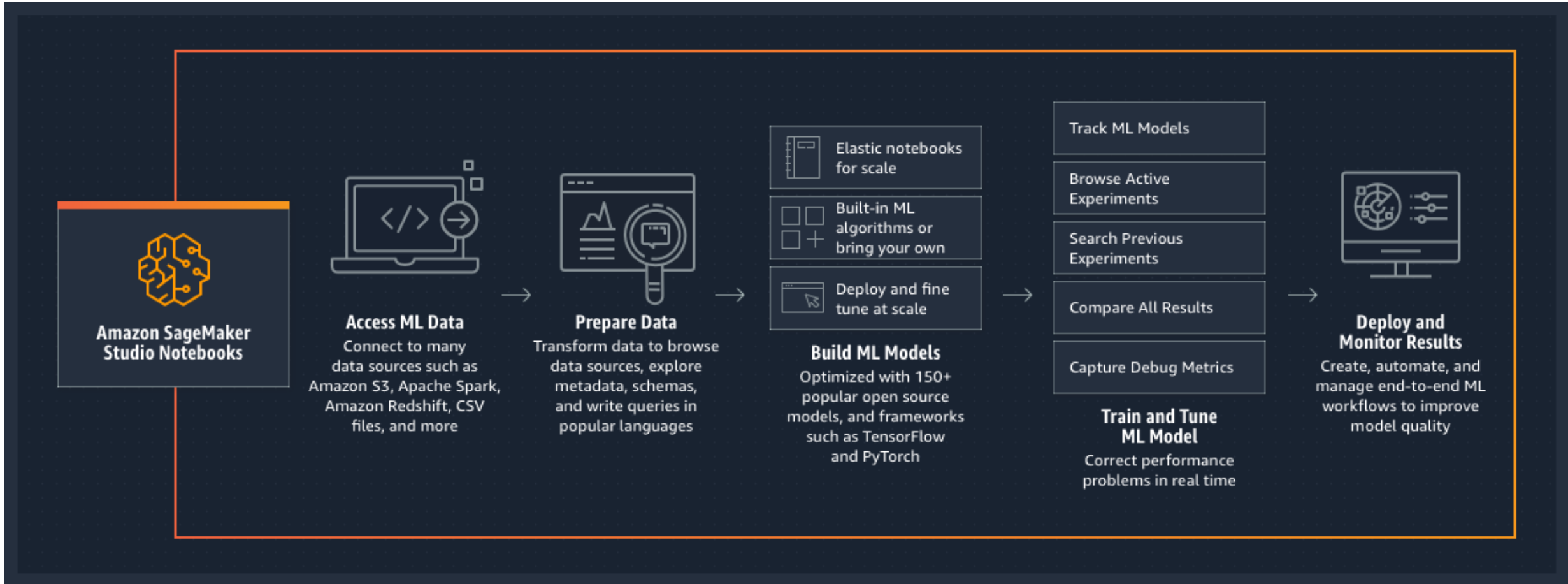
Amazon SageMaker for Business Analysts
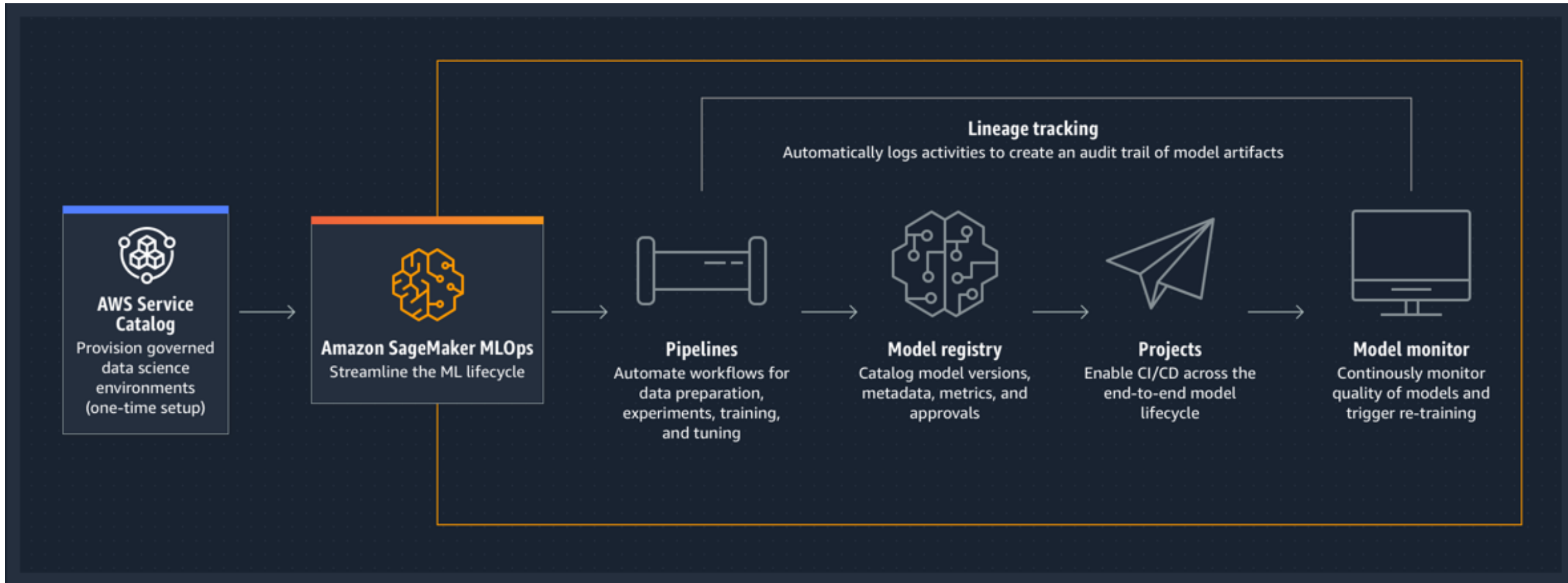# Amazon SageMaker Canvas

Amazon SageMaker for Data Scientists
Amazon SageMaker Studio Notebooks

Amazon SageMaker for ML Engineers
Amazon SageMaker MLOps

AWS Machine Learning AI Services

AWS Machine Learning AI Services Computer vision

Analyze images and videos

Catalog assets, automate workflows, and extract meaning from your media and applications.

Amazon Rekognition »

Detect defects and automate inspection

Identify missing product components, vehicle and structure damage, and irregularities for comprehensive quality control.

Amazon Lookout for Vision »

Utilize computer vision at the edge

Improve operations with automated monitoring to find bottlenecks and assess manufacturing quality and safety.

AWS Panorama »

AWS Machine Learning AI Services
Automated data extraction and analysis

Extract text and data

Pull valuable information from millions of documents at speed.

Amazon Textract »

Acquire insights

Maximize the value of unstructured text with natural language processing (NLP).

Amazon Comprehend »

Control quality

Add humans to the review process to ensure accuracy and compliance of sensitive data.

Amazon A2I »

AWS Machine Learning AI Services
Language AI

Build chatbots & virtual agents

Create automated conversation channels to improve customer service.

Amazon Lex »

Automate speech recognition

Enhance your applications and workflows with automatic speech recognition.

Amazon Transcribe »

Give your apps a voice

Convert text into life-like speech, improving user experience and accessibility.

Amazon Polly »

AWS Machine Learning AI Services
Improve customer experience

Find accurate information faster

Enhance websites and applications with natural language speech to help users quickly search for what they need.

Amazon Kendra »

Personalize online experiences

Use ML to customize applications and websites to each individual user.

Amazon Personalize »

Engage audiences in every language

Expand your reach and accessibility with fast, accurate, and customizable translation.

Amazon Translate »

AWS Machine Learning AI Services Business metrics

Forecast business metrics

Harness unique data types and time series data to create accurate end-to-end prediction models.

Amazon Forecast »

Detect online fraud

Stop adversaries and identify potential attacks with technology honed through years of use on Amazon.com.

Amazon Fraud Detector »

Identify data anomalies

Detect and identify root causes of unexpected changes in metrics such as revenue and retention.

Amazon Lookout for Metrics »

AWS Machine Learning AI Services Code and DevOps

Improve application availability

Simplify operational performance measurement and reduce application downtime.

Amazon DevOps Guru »

Automated code reviews

Detect bugs and assess critical issues and vulnerabilities fast for higher quality code.

Amazon CodeGuru Reviewer »

Eliminate costly inefficient code

Use runtime behavior analysis to improve application performance and decrease compute costs.

Amazon CodeGuru Profiler »

AWS Machine Learning AI Services Industrial AI

Detect abnormal machine conditions

Automatically detect abnormal machine conditions by analyzing sensor data

Amazon Lookout for Equipment »

Predictive maintenance

End-to-end predictive maintenance system that includes sensors, gateway, anomaly detection service and end-user application

Amazon Monitron »

AWS Machine Learning AI Services Healthcare

Store and analyze health data

Securely store, transfer, query, and analyze health data to offer a complete view of a patient's medical history

Amazon Healthlake »

Extract health data

Extract information from unstructured medical text accurately and quickly

Amazon Comprehend Medical »

AWS Products and Services

AWS Services

- **Amazon EC2**
  - **Virtual servers in the cloud**

- **Amazon Simple Storage Service (S3)**
  - **Scalable storage in the cloud**

- **Amazon Aurora**
  - **High performance managed relational database**

- **Amazon DynamoDB**
  - **Managed NoSQL database**

- **Amazon RDS**
  - **Managed relational database service for MySQL, PostgreSQL, Oracle, SQL Server, and MariaDB**

AWS Services

- **AWS Lambda**
  - **Run code without thinking about servers**

- **AWS Elastic Beanstalk**
  - **Run and manage web apps**

- **Amazon VPC**
  - **Isolated cloud resources**

- **Amazon Lightsail**
  - **Launch and manage virtual private servers**

- **Amazon SageMaker**
  - **Build, train, and deploy machine learning models at scale**

Available AWS Certifications

3 **SAP**

Professional

Two years of comprehensive experience designing, operating, and troubleshooting solutions using the AWS Cloud

aws certified — Solutions Architect Professional

aws certified — DevOps Engineer Professional

2 **SAA**

Associate

One year of experience solving problems and implementing solutions using the AWS Cloud

aws certified — Solutions Architect Associate — Architect

aws certified — SysOps Administrator Associate — Operations

aws certified — Developer Associate — Developer

1 **CLF**

Foundational

Six months of fundamental AWS Cloud and industry knowledge

Cloud Practitioner

aws certified — Cloud Practitioner

Specialty

Technical AWS Cloud experience in the Specialty domain as specified in the **exam guide**

aws certified — Advanced Networking Specialty

aws certified — Data Analytics Specialty **DA**

aws certified — Database Specialty

aws certified — Machine Learning Specialty **ML**

aws certified — Security Specialty

https://aws.amazon.com/certification/

Available AWS Certifications

3 專業級
兩年使用 AWS 雲端設計、操作及疑難排解解決方案的廣泛經驗

aws certified Solutions Architect Professional

SAP

aws certified DevOps Engineer Professional

專家級
考試指南中指定的專業領域中的 AWS 雲端技術經驗

aws certified Advanced Networking Specialty

aws certified Data Analytics Specialty

DA

2 助理級
一年使用 AWS 雲端解決問題和實作解決方案的經驗

aws certified Solutions Architect Associate

SAA

架構師

aws certified SysOps Administrator Associate

營運

aws certified Developer Associate

開發人員

aws certified Database Specialty

aws certified Machine Learning Specialty

ML

1 基礎
六個月的基礎 AWS 雲端和產業知識

雲端從業人員

aws certified Cloud Practitioner

CLF

aws certified Security Specialty

AWS Certification

AWS Certification

AWS Certification

AWS Certification

Format
65 questions; either multiple choice or multiple response

Type
Foundational

Delivery Method
Testing center or online proctored exam

Time
90 minutes to complete the exam

Cost
100 USD (Practice Exam: 20 USD)

Language
Available in English, Indonesian (Bahasa), Japanese, Korean, and Simplified Chinese

Foundational

Six months of fundamental AWS Cloud and industry knowledge

Cloud Practitioner

aws certified
Cloud Practitioner

https://aws.amazon.com/certification/

AWS Certification

Format
65 questions; either multiple choice or multiple response

Type
Associate

Delivery Method
Testing center or online proctored exam

Associate
One year of experience solving problems and implementing solutions using the AWS Cloud

aws certified
Solutions Architect
Associate

Architect

aws certified
SysOps Administrator
Associate

Operations

aws certified
Developer
Associate

Developer

Time
130 minutes to complete the exam

Cost
150 USD (Practice exam: 20 USD)

Language
Available in English, Japanese, Korean, and Simplified Chinese

https://aws.amazon.com/certification/

AWS Certification

Professional

Two years of comprehensive experience designing, operating, and troubleshooting solutions using the AWS Cloud

aws certified
Solutions Architect
Professional

aws certified
DevOps Engineer
Professional

Format
75 questions; either multiple choice or multiple response

Type
Professional

Delivery Method
Testing center or online proctored exam

Time
180 minutes to complete the exam

Cost
300 USD (Practice Exam: 40 USD)

Language
Available in English, Japanese, Korean, and Simplified Chinese

https://aws.amazon.com/certification/

AWS Certification

Associate

One year of experience solving problems and implementing solutions using the AWS Cloud

aws certified
Solutions Architect
Associate

Architect

aws certified
SysOps Administrator
Associate

Operations

aws certified
Developer
Associate

Developer

Format
65 questions; either multiple choice or multiple response

Type
Associate

Delivery Method
Testing center or online proctored exam

Time
130 minutes to complete the exam

Cost
150 USD (Practice exam: 20 USD)

Language
Available in English, Japanese, Korean, and Simplified Chinese

https://aws.amazon.com/certification/

AWS Certification

Format
65 questions; either multiple choice or multiple response

Type
Associate

Delivery Method
Testing center or online proctored exam

Time
130 mins to complete the exam

Cost
150 USD (Practice exam: 20 USD)

Language
Available in English, Japanese, Korean, and Simplified Chinese

Associate

One year of experience solving problems and implementing solutions using the AWS Cloud

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Associate

Architect

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SysOps Administrator
Associate

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https://aws.amazon.com/certification/

AWS Certification

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Professional

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DevOps Engineer
Professional

Format
75 questions; either multiple choice or multiple response

Type
Professional

Delivery Method
Testing center or online proctored exam

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180 minutes to complete the exam

Cost
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Available in English, Japanese, Korean, and Simplified Chinese

https://aws.amazon.com/certification/

AWS Certification

Specialty

Technical AWS Cloud experience in the Specialty domain as specified in the **exam guide**

aws certified
Advanced Networking
Specialty

aws certified
Data Analytics
Specialty

aws certified
Database
Specialty

aws certified
Machine Learning
Specialty

aws certified
Security
Specialty

Format
65 questions; either multiple choice or multiple response

Type
Specialty

Delivery Method
Testing center or online proctored exam

Time
180 minutes to complete the exam

Cost
300 USD (Practice exam: 40 USD)

Language
Available in English, Japanese, Korean, and Simplified Chinese

https://aws.amazon.com/certification/

AWS Certified Cloud Practitioner

- Level: **Foundational**

- Length: **90 minutes** to complete the exam

- Cost: **100 USD**

- Format: **65 questions**;
either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI;
testing center or online proctored exam

https://aws.amazon.com/certification/certified-cloud-practitioner/

AWS Certified Solutions Architect – Associate

- Level: **Associate**

- Length: **130 minutes** to complete the exam

- Cost: **150 USD**

- Format: **65 questions**;
either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI;
testing center or online proctored exam

AWS Certified SysOps Administrator - Associate

- Level: **Associate**

- Length: **180 minutes** to complete the exam

- Cost: **150 USD**

- Format: **65 scoring** opportunities that may be multiple choice, multiple response, or exam lab

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

https://aws.amazon.com/certification/certified-sysops-admin-associate

AWS Certified Solutions Architect – Associate

- Level: **Associate**

- Length: **130 minutes** to complete the exam

- Cost: **150 USD**

- Format: **65 questions**;
either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI;
testing center or online proctored exam

AWS Certified Solutions Architect - Professional

- Level: **Professional**

- Length: **180 minutes** to complete the exam

- Cost: **300 USD**

- Format: **75 questions**; either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

AWS Certified DevOps Engineer - Professional

- Level: **Professional**

- Length: **180 minutes** to complete the exam

- Cost: **300 USD**

- Format: **75 questions**; either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

https://aws.amazon.com/certification/certified-devops-engineer-professional

AWS Certified Security - Specialty

- Level: **Specialty**

- Length: **170 minutes** to complete the exam

- Cost: **300 USD**

- Format: **65 questions**; either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

AWS Certified Database - Specialty

- Level: **Specialty**

- Length: **180 minutes** to complete the exam

- Cost: **300 USD**

- Format: **65 questions**; either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

https://aws.amazon.com/certification/certified-database-specialty

AWS Certified Machine Learning – Specialty

- Level: **Specialty**

- Length: **180 minutes** to complete the exam

- Cost: **300 USD**

- Format: **65 questions**; either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

https://aws.amazon.com/certification/certified-machine-learning-specialty/

AWS Certified Data Analytics - Specialty

- Level: **Specialty**

- Length: **180 minutes** to complete the exam

- Cost: **300 USD**

- Format: **65 questions**; either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

AWS Certified Advanced Networking - Specialty

- Level: **Specialty**

- Length: **170 minutes** to complete the exam

- Cost: **300 USD**

- Format: **65 questions**; either multiple choice or multiple response

- Delivery method: **Pearson VUE** and PSI; testing center or online proctored exam

AWS Certifications Roadmap

aws certified Cloud Practitioner

aws certified Solutions Architect — Associate

aws certified Developer — Associate

aws certified SysOps Administrator — Associate

aws certified DevOps Engineer — Professional

aws certified Solutions Architect — Professional

aws certified Security — Specialty

aws certified Advanced Networking — Specialty

aws certified Database — Specialty

aws certified Data Analytics — Specialty

aws certified Machine Learning — Specialty

https://aws.amazon.com/certification/

AWS Certifications Roadmap
Cloud Architect

AWS Certifications Roadmap
Cloud Developer

AWS Certifications Roadmap
DevOps

AWS Certifications Roadmap
Data Analytics / Machine Learning

aws certified
Cloud Practitioner

aws certified
Solutions Architect
Associate

aws certified
Developer
Associate

aws certified
Database
Specialty

aws certified
Data Analytics
Specialty

aws certified
Machine Learning
Specialty

https://aws.amazon.com/certification/

AWS Certifications Roadmap
Security

AWS Certified Cloud Practitioner (CLF-C01)

AWS Certified Cloud Practitioner

- **This certification provides individuals in a larger variety of cloud and technology roles with a way to validate their AWS Cloud knowledge and enhance their professional credibility.**

- **This exam covers four domains, including cloud concepts, security, technology, and billing and pricing.**

https://aws.amazon.com/certification/certified-cloud-practitioner/

AWS Certified Solutions Architect – Associate (SAA-C02)

AWS Certified Solutions Architect – Associate

- **This certification validates your ability to effectively demonstrate knowledge of how to architect and deploy secure and robust applications on AWS technologies.**

- **This exam is for anyone with at least one year of hands-on experience designing available, cost-efficient, fault-tolerant, and scalable and distributed systems on AWS.**

https://aws.amazon.com/certification/certified-solutions-architect-associate/

AWS Academy and Certifications

- **AWS Academy Cloud Foundations (ACF)**

  - **AWS Certified Cloud Practitioner (CLF-C01)**

    - **https://aws.amazon.com/certification/certified-cloud-practitioner/**

1

- **AWS Academy Cloud Architecting (ACA)**

  - **AWS Certified Solutions Architect – Associate (SAA-C02)**

    - **https://aws.amazon.com/certification/certified-solutions-architect-associate/**

2

https://aws.amazon.com/training/awsacademy/

AWS Certified Cloud Practitioner (CLF-C01)

Domain	% of Examination
Domain 1: Cloud Concepts	26%
Domain 2: Security and Compliance	25%
Domain 3: Technology	33%
Domain 4: Billing and Pricing	16%
TOTAL	100%

AWS Certified Solutions Architect – Associate (SAA-C02)

Domain	% of Examination
Domain 1: Design Resilient Architectures	30%
Domain 2: Design High-Performing Architectures	28%
Domain 3: Specify Secure Applications and Architectures	24%
Domain 4: Design Cost-Optimized Architectures	18%
TOTAL	100%

AWS Certified Cloud Practitioner (CLF-C01)

AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 1: Cloud Concepts**

  - **1.1 Define the AWS Cloud and its value proposition**

  - **1.2 Identify aspects of AWS Cloud economics**

  - **1.3 List the different cloud architecture design principles**

AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 2: Security and Compliance**

  - **2.1 Define the AWS shared responsibility model**

  - **2.2 Define AWS Cloud security and compliance concepts**

  - **2.3 Identify AWS access management capabilities**

  - **2.4 Identify resources for security support**

AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 3: Technology**

  - **3.1 Define methods of deploying and operating in the AWS Cloud**

  - **3.2 Define the AWS global infrastructure**

  - **3.3 Identify the core AWS services**

  - **3.4 Identify resources for technology support**

Source: https://aws.amazon.com/certification/certified-cloud-practitioner/

AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 4: Billing and Pricing**

  - **4.1 Compare and contrast the various pricing models for AWS**

  - **4.2 Recognize the various account structures in relation to AWS billing and pricing**

  - **4.3 Identify resources available for billing support**

AWS Certified Solutions Architect – Associate (SAA-C02)

AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 1: Design Resilient Architectures**
  - **1.1 Design a multi-tier architecture solution**
  - **1.2 Design highly available and/or fault-tolerant architectures**
  - **1.3 Design decoupling mechanisms using AWS services**
  - **1.4 Choose appropriate resilient storage**

AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 2: Design High-Performing Architectures**

  - **2.1 Identify elastic and scalable compute solutions for a workload**

  - **2.2 Select high-performing and scalable storage solutions for a workload**

  - **2.3 Select high-performing networking solutions for a workload**

  - **2.4 Choose high-performing database solutions for a workload**

AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 3: Design Secure Applications and Architectures**
  - **3.1 Design secure access to AWS resources**
  - **3.2 Design secure application tiers**
  - **3.3 Select appropriate data security options**

AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 4: Design Cost-Optimized Architectures**
  - **4.1 Identify cost-effective storage solutions**
  - **4.2 Identify cost-effective compute and database services**
  - **4.3 Design cost-optimized network architectures**

AWS Certifications
Exam Pricing

Exam Type	Price in USD
Foundational	$100
Associate	$150
Professional	$300
Specialty	$300

Web Application with AWS Core Services
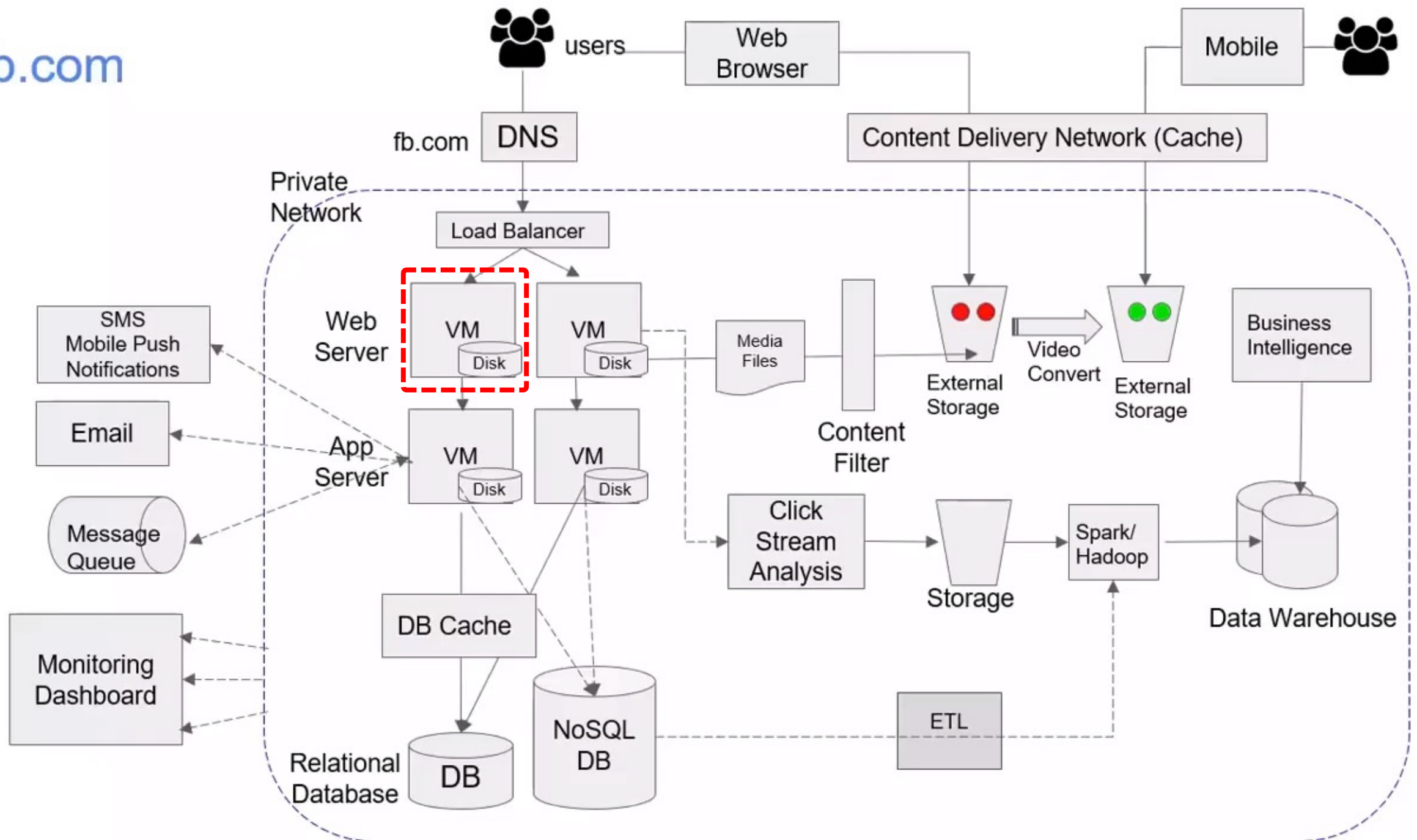
fb.com on AWS
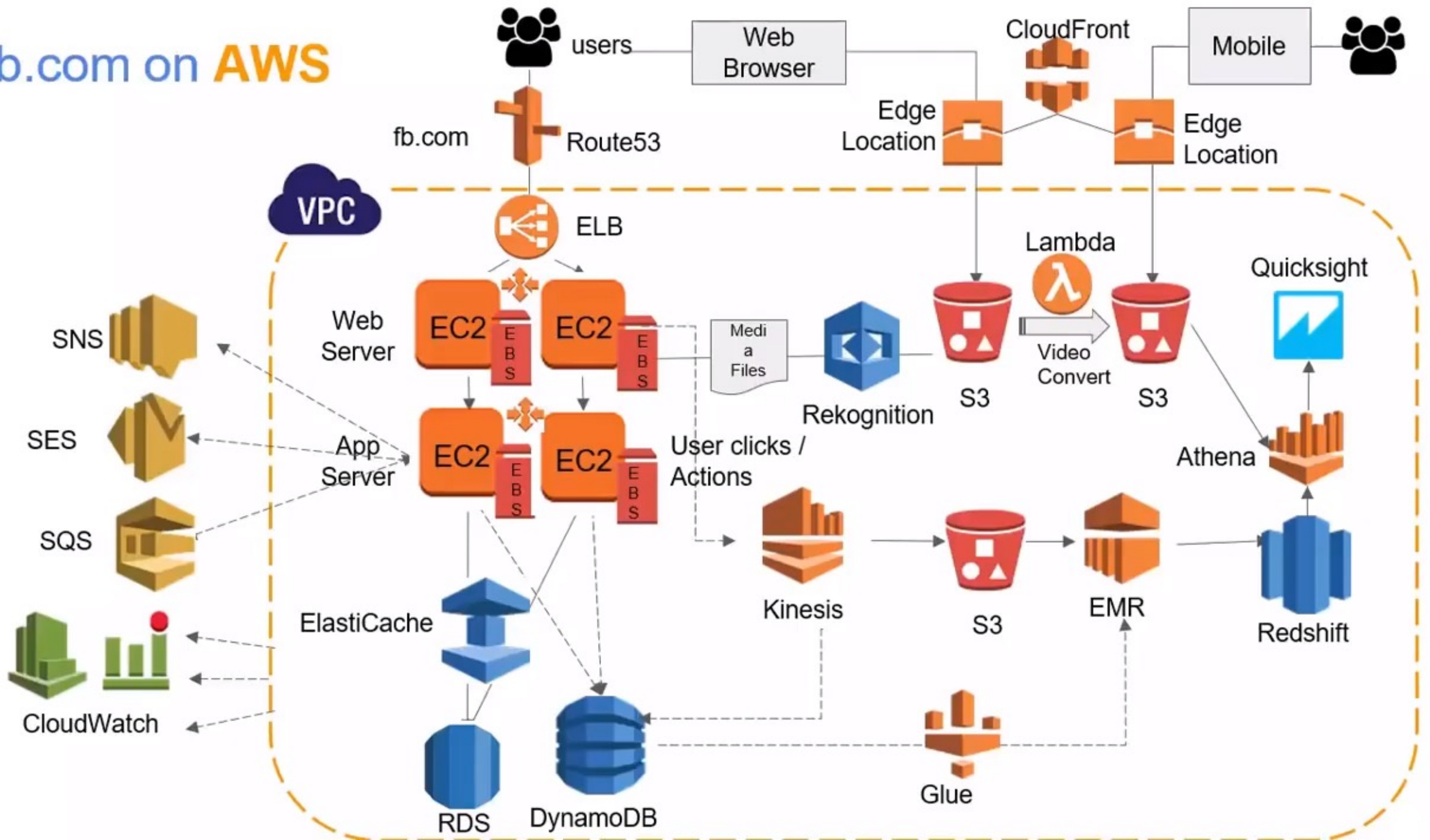
fb.com on AWS
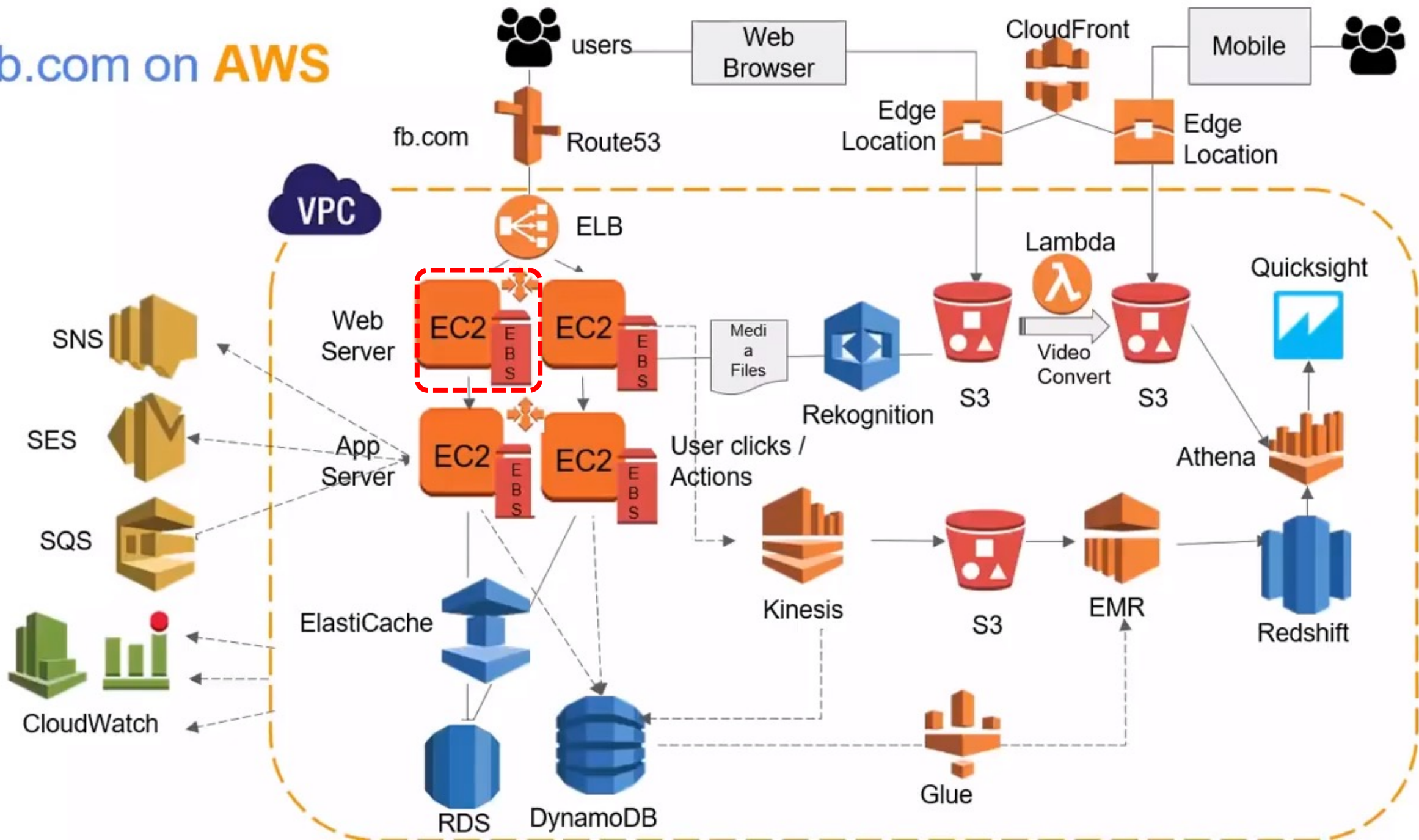
fb.com on AWS
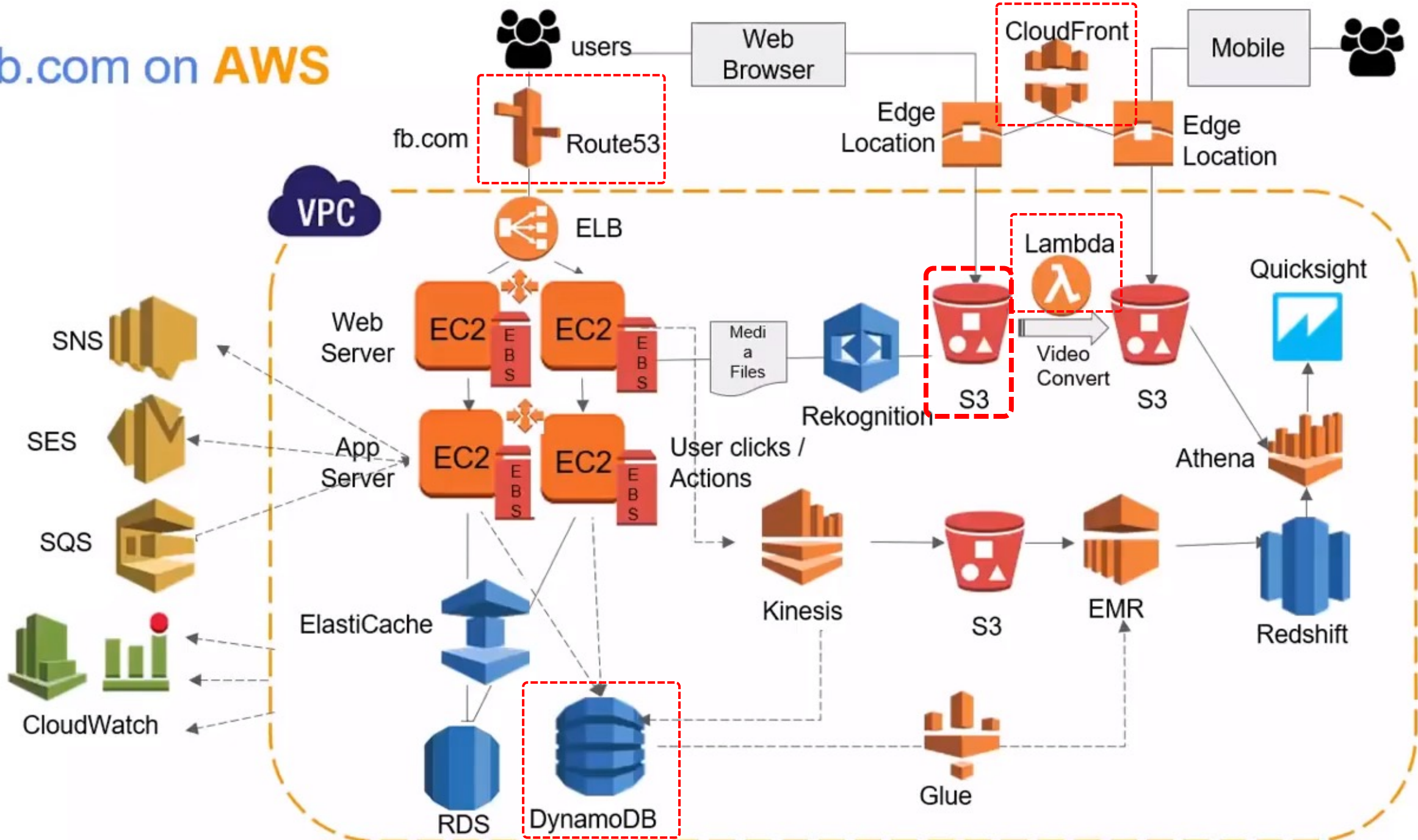
AWS Application Services
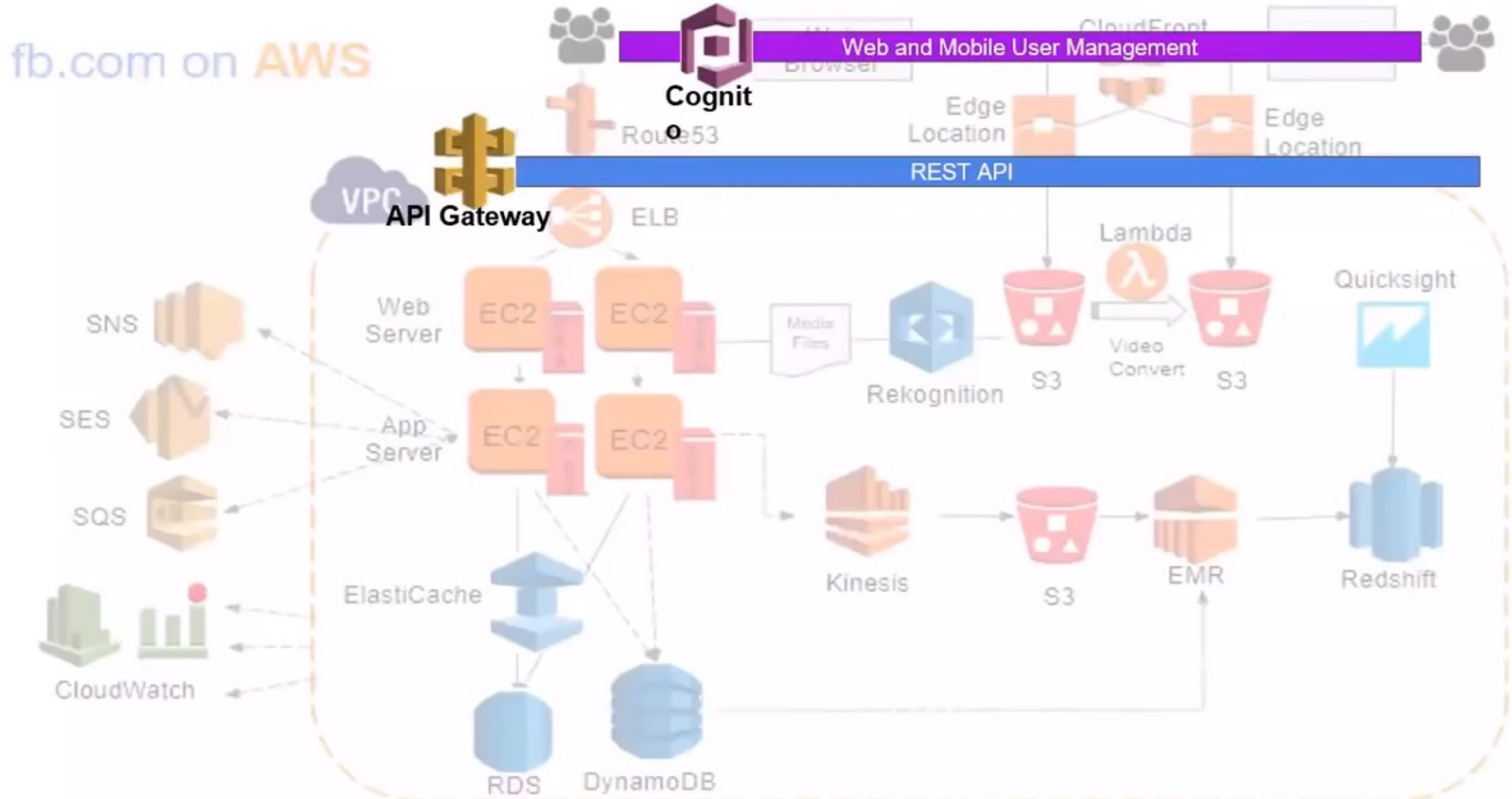
AWS Security Services
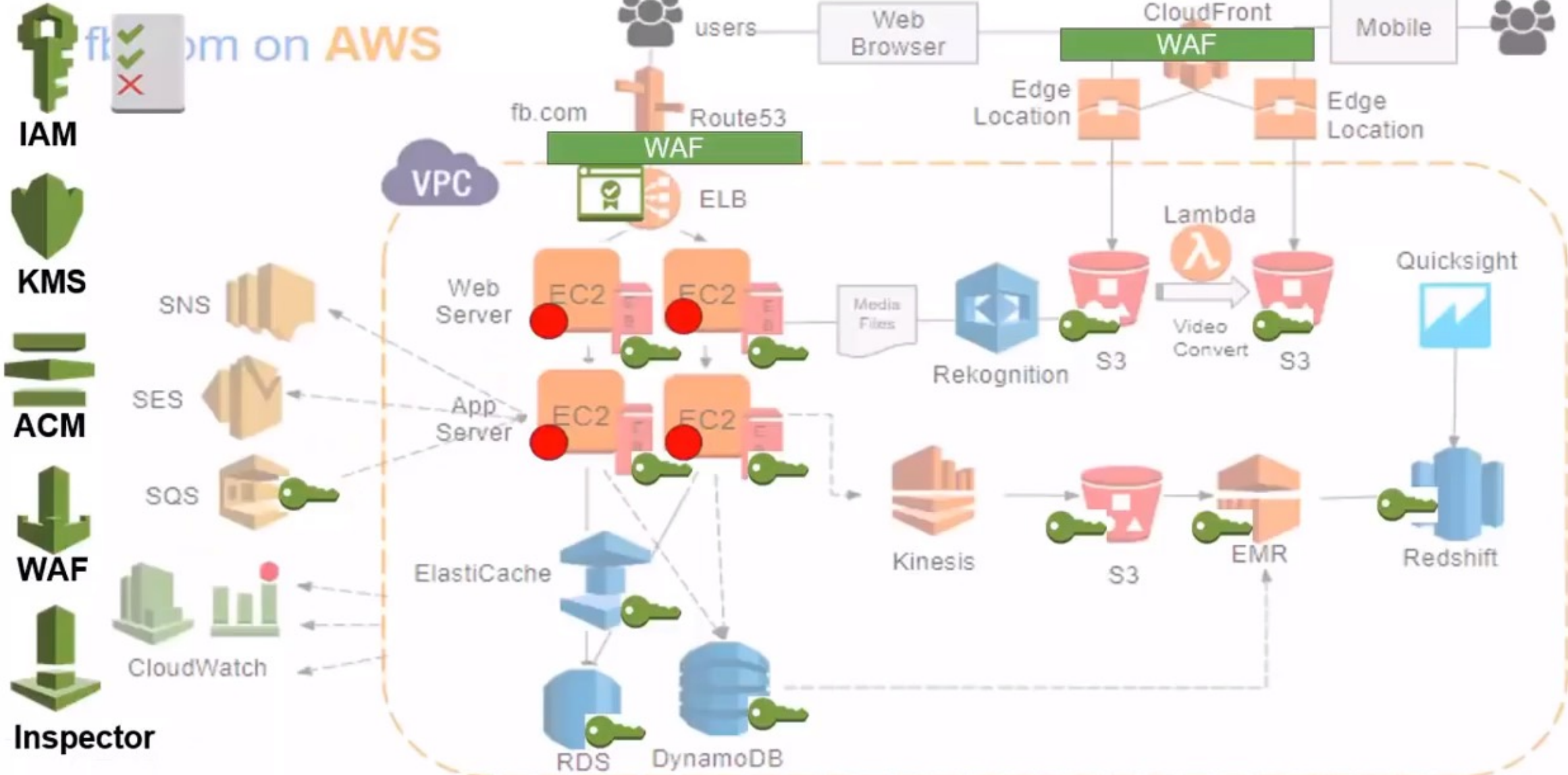
AWS Development and DevOps Services

AWS Serverless Architecture
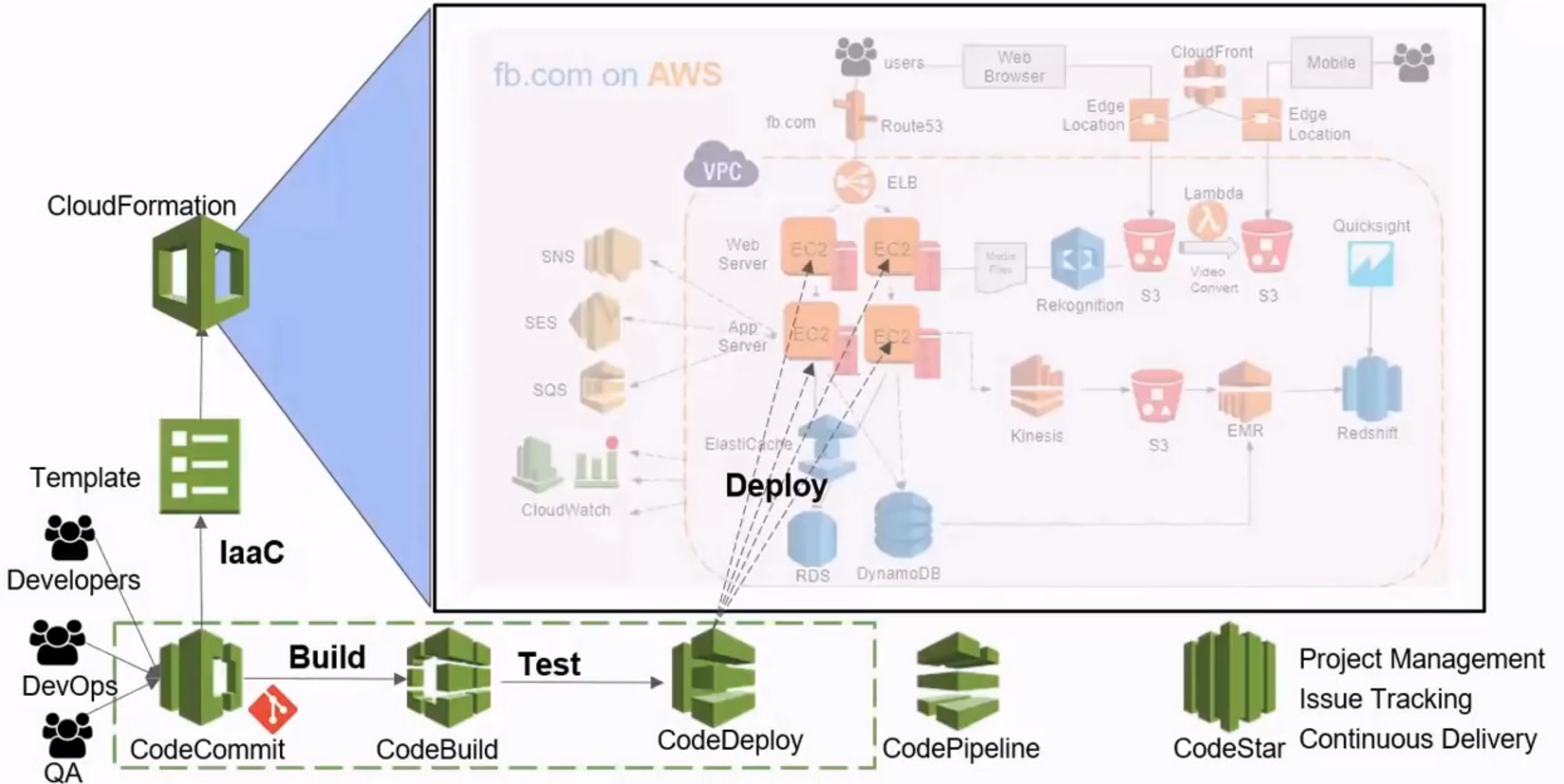
AWS Serverless Airline Booking
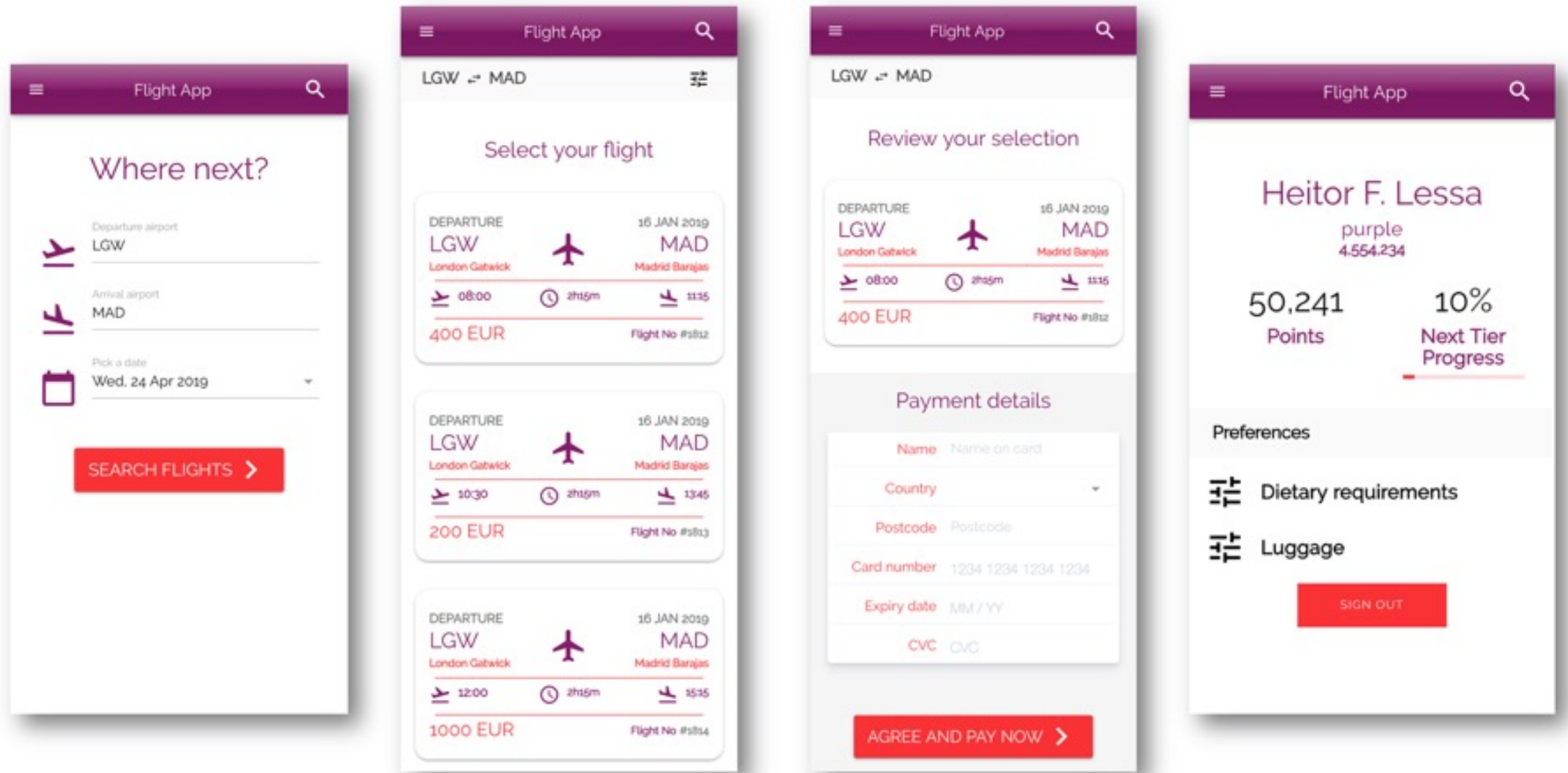
AWS Serverless Airline Booking Stack

UI/UX

Quasar framework

Vue.js

AWS Amplify

Stripe Elements

Data/Lang
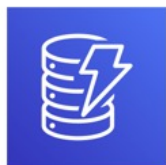
Amazon DynamoDB

Python

Typescript

JavaScript

API/Auth
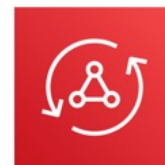
AWS AppSync

Amazon API Gateway
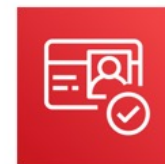
Amazon Cognito

Messaging

Amazon SNS

AWS Step Functions

Source: https://github.com/aws-samples/aws-serverless-airline-booking

AWS Serverless Airline Booking
High level infrastructure architecture
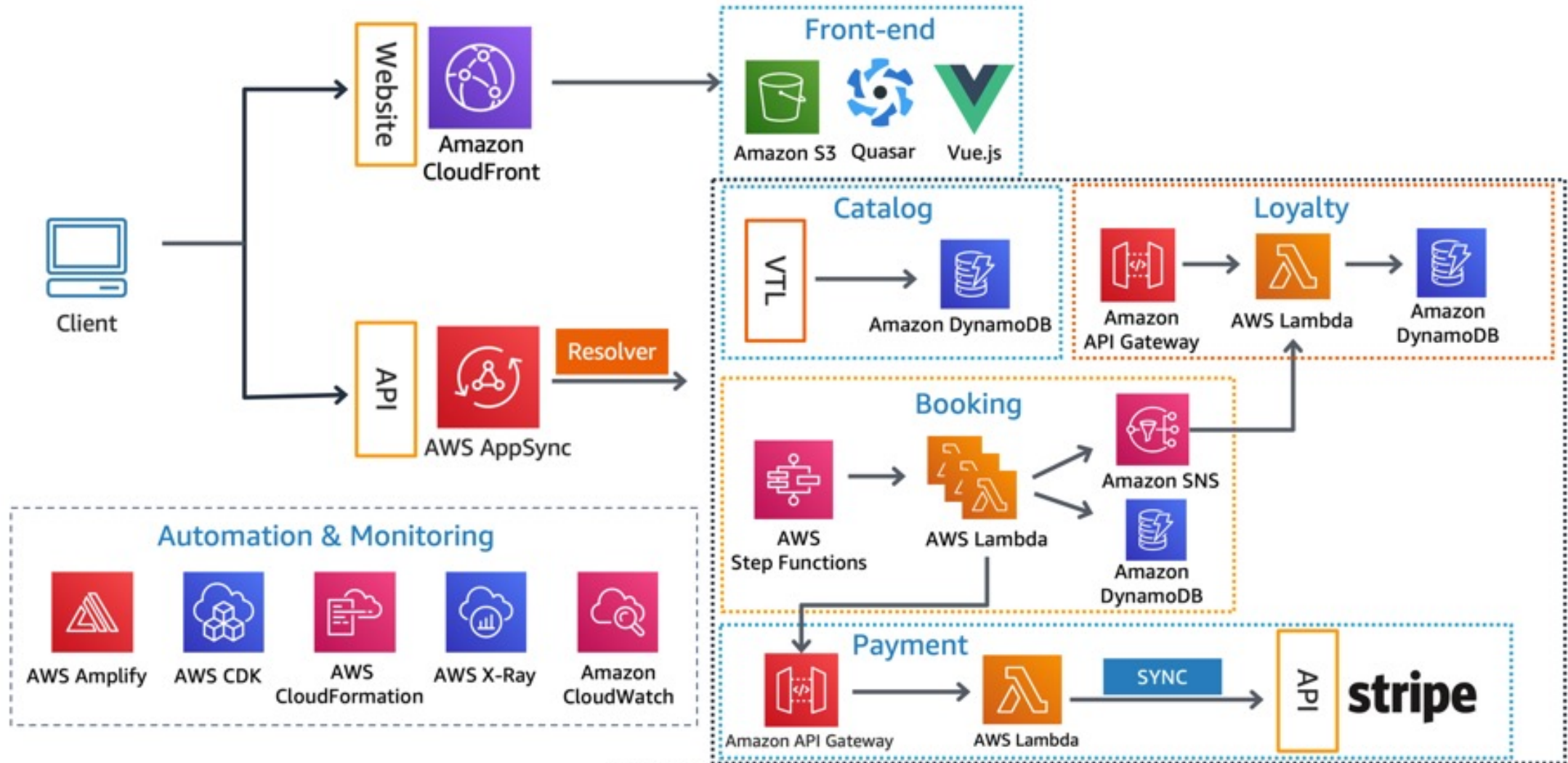
Source: https://github.com/aws-samples/aws-serverless-airline-booking

AWS Serverless Architecture
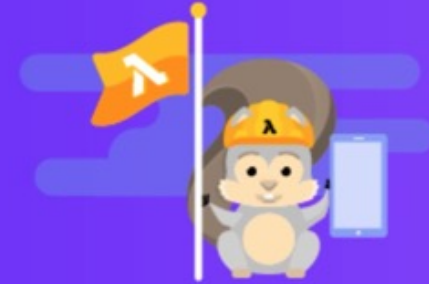# AWS Operational Responsibility Models
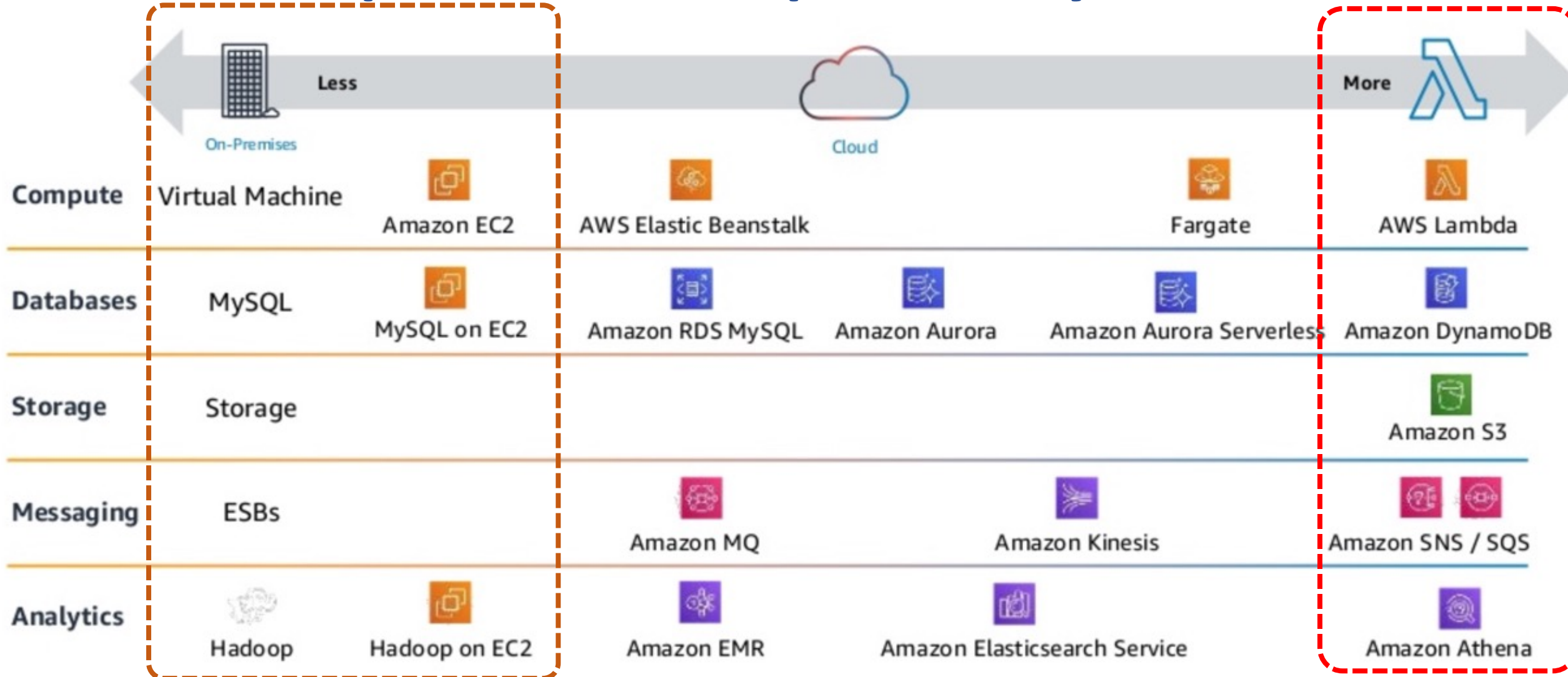
Build
a
Serverless
Web Application

Build a Serverless Web Application

Projects on AWS:

Build a Serverless Web Application

with AWS Lambda, Amazon API Gateway, Amazon S3, Amazon DynamoDB, and Amazon Cognito

| Introduction | 1 Host a static website | 2 Manage users | 3 Build a serverless backend | 4 Deploy a RESTful API | 5 Terminate resources |

Overview

In this tutorial, you'll create a simple serverless web application that enables users to request unicorn rides from the Wild Rydes fleet. The application will present users with an HTML based user interface for indicating the location where they would like to be picked up and will interface on the backend with a RESTful web service to submit the request and dispatch a nearby unicorn. The application will also provide facilities for users to register with the service and log in before requesting rides.
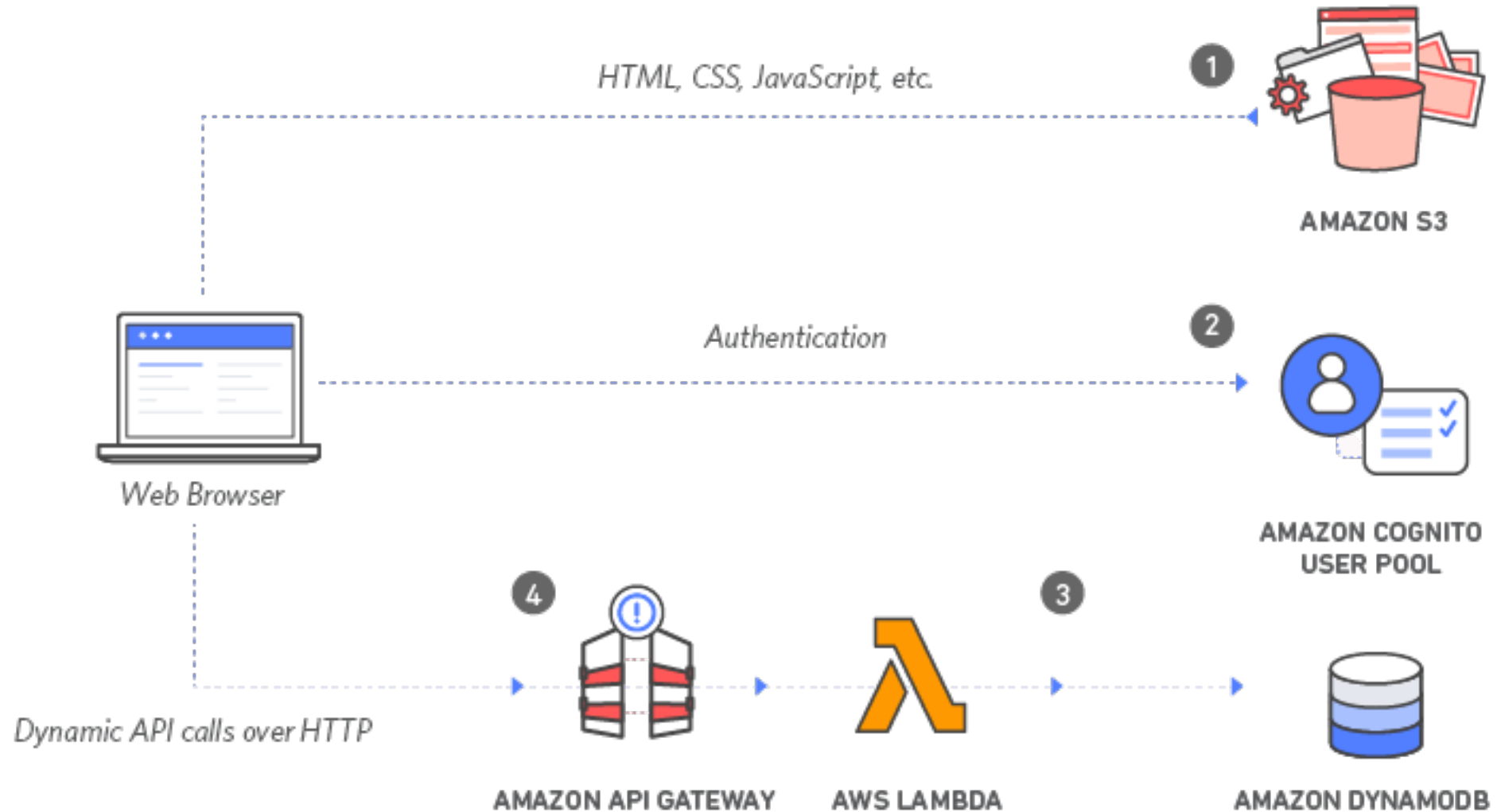
AWS Experience: Beginner

Time to complete: 2 hours

Cost to complete: Each service used in this architecture is eligible for the AWS Free Tier. If you are outside the usage limits of the Free Tier, completing this tutorial will cost you less than $0.25*.

Application Architecture

Build a Serverless Web Application

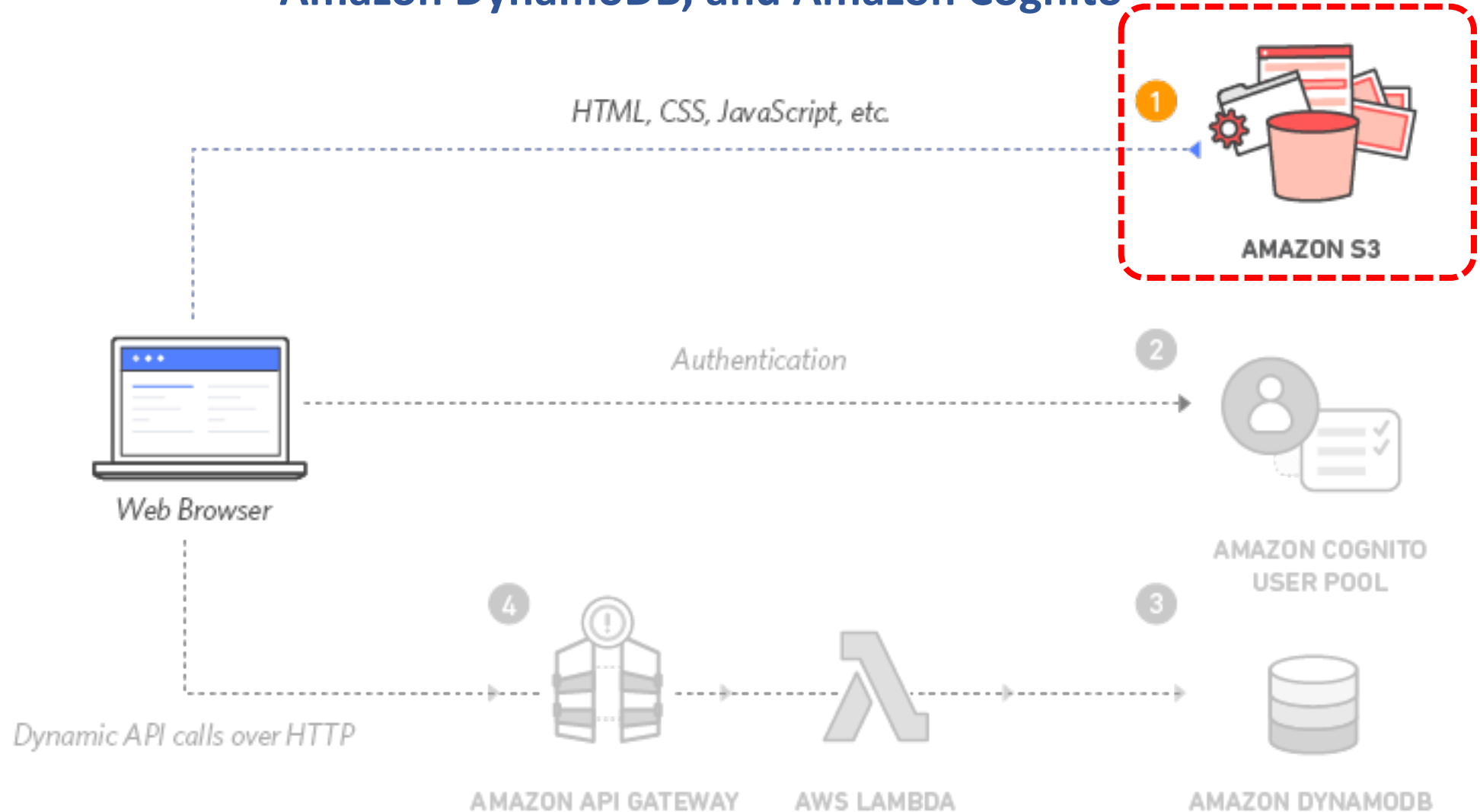## with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

HTML, CSS, JavaScript, etc.

AMAZON S3

Web Browser

Authentication

AMAZON COGNITO USER POOL

Dynamic API calls over HTTP

AMAZON API GATEWAY

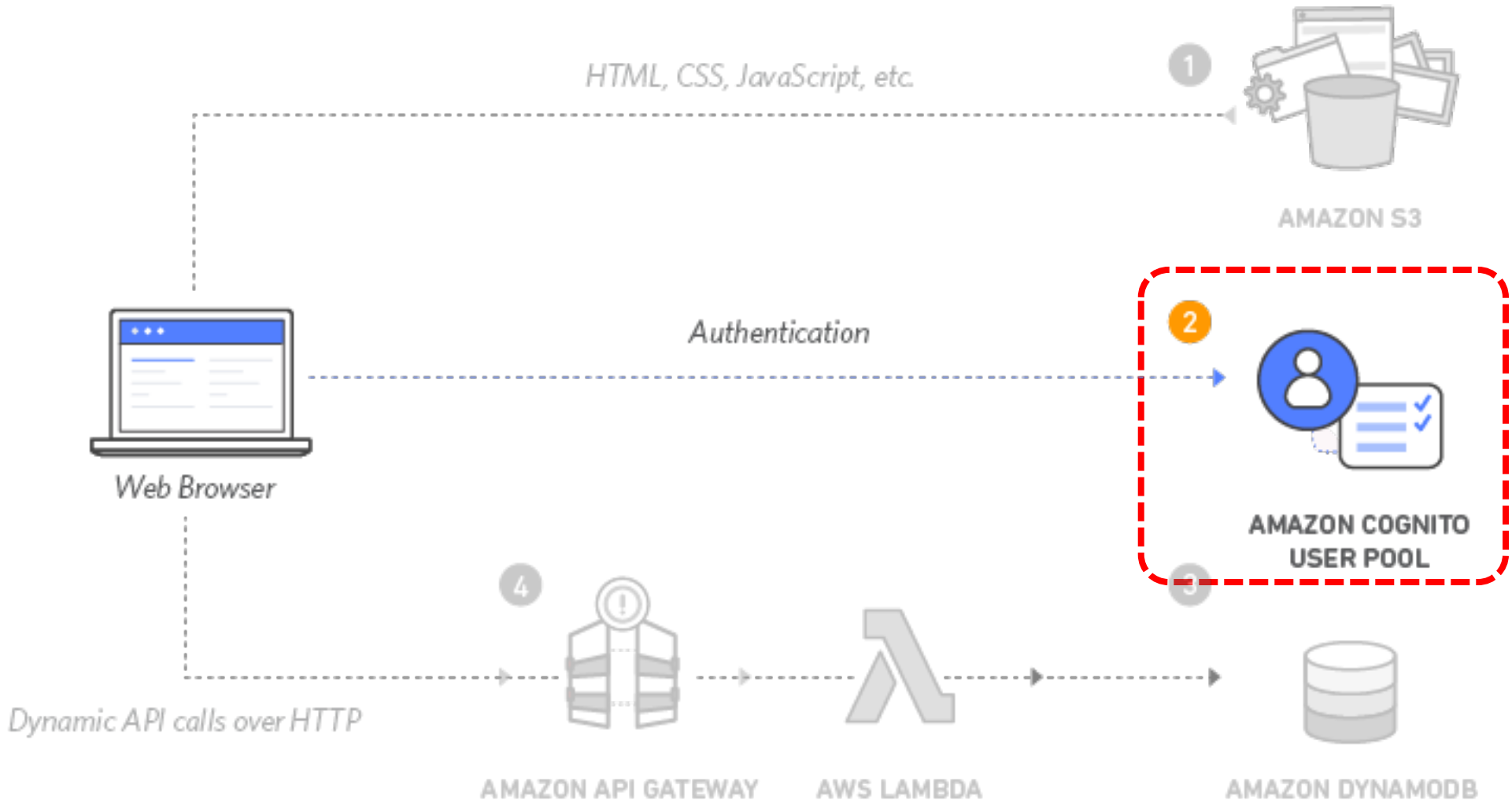**AWS LAMBDA**

AMAZON DYNAMODB

Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

1

Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

1

HTML, CSS, JavaScript, etc.

AMAZON S3

Static Web Hosting

Amazon S3 hosts static web resources including HTML, CSS, JavaScript, and image files which are loaded in the user's browser.

AMAZON COGNITO USER POOL

AMAZON DYNAMODB

Build a Serverless Web Application

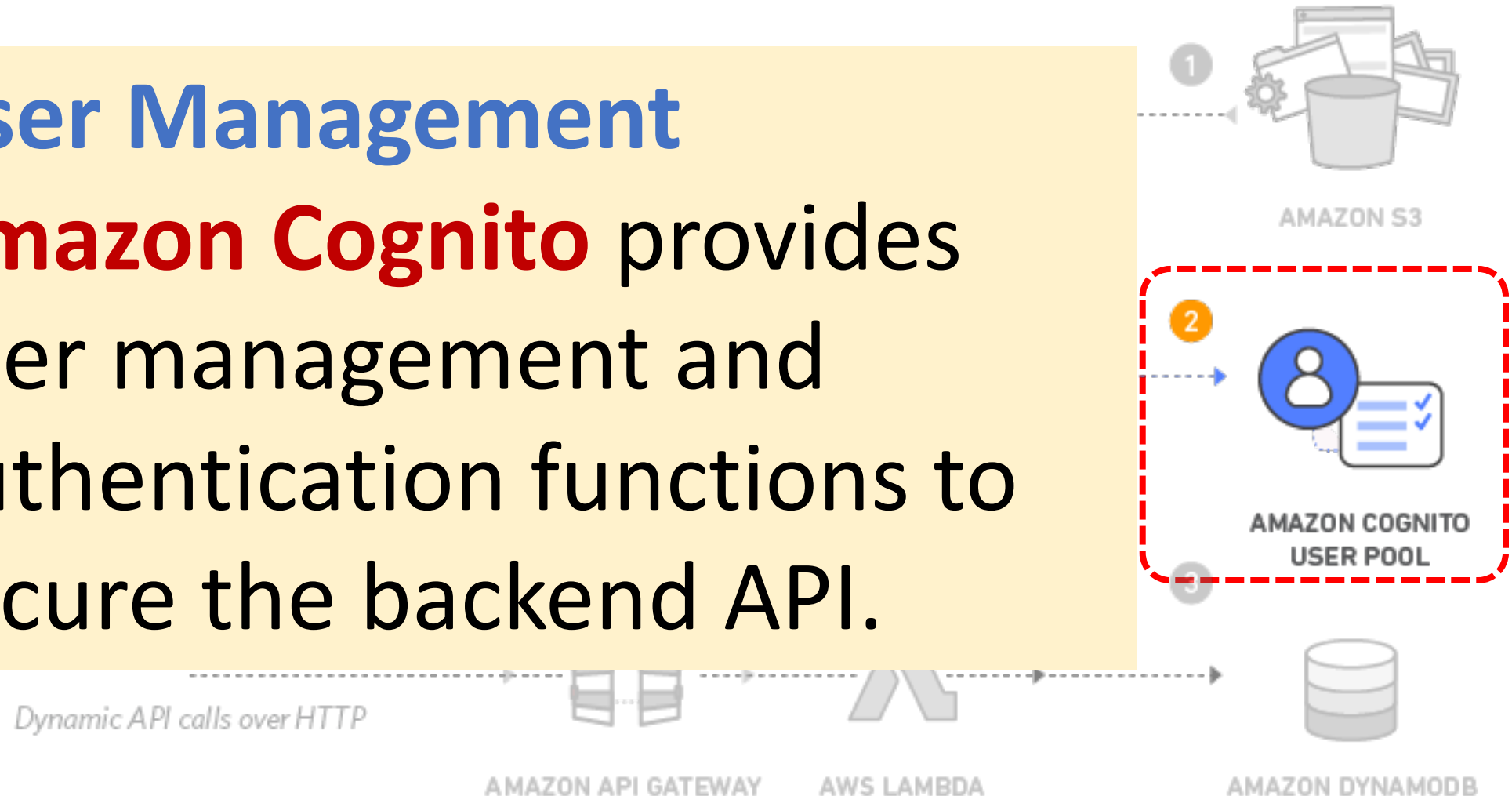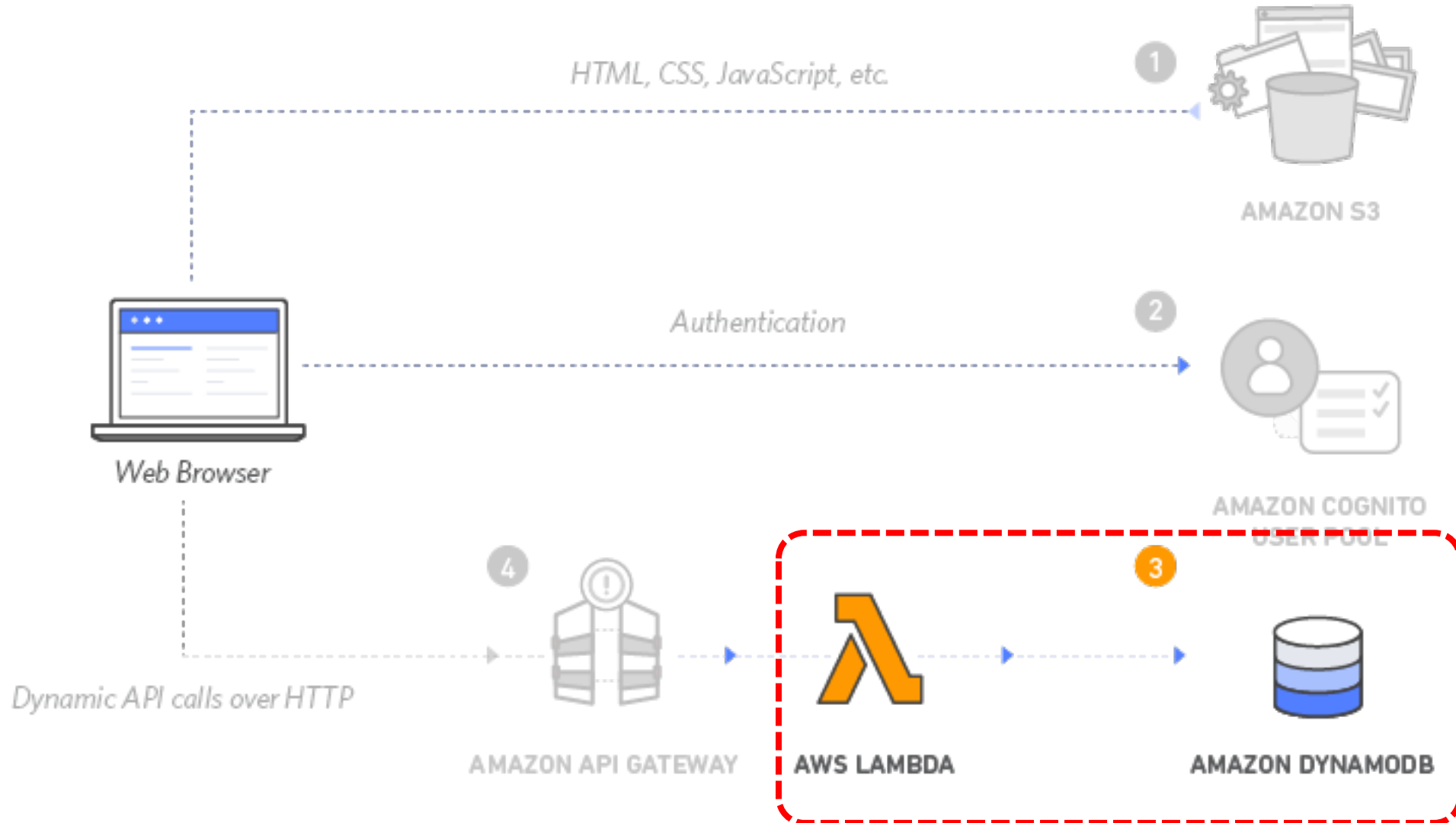## with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

2

Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

2

User Management

Amazon Cognito provides user management and authentication functions to secure the backend API.

AMAZON S3

AMAZON COGNITO USER POOL

Dynamic API calls over HTTP

AMAZON API GATEWAY   AWS LAMBDA   AMAZON DYNAMODB

Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito
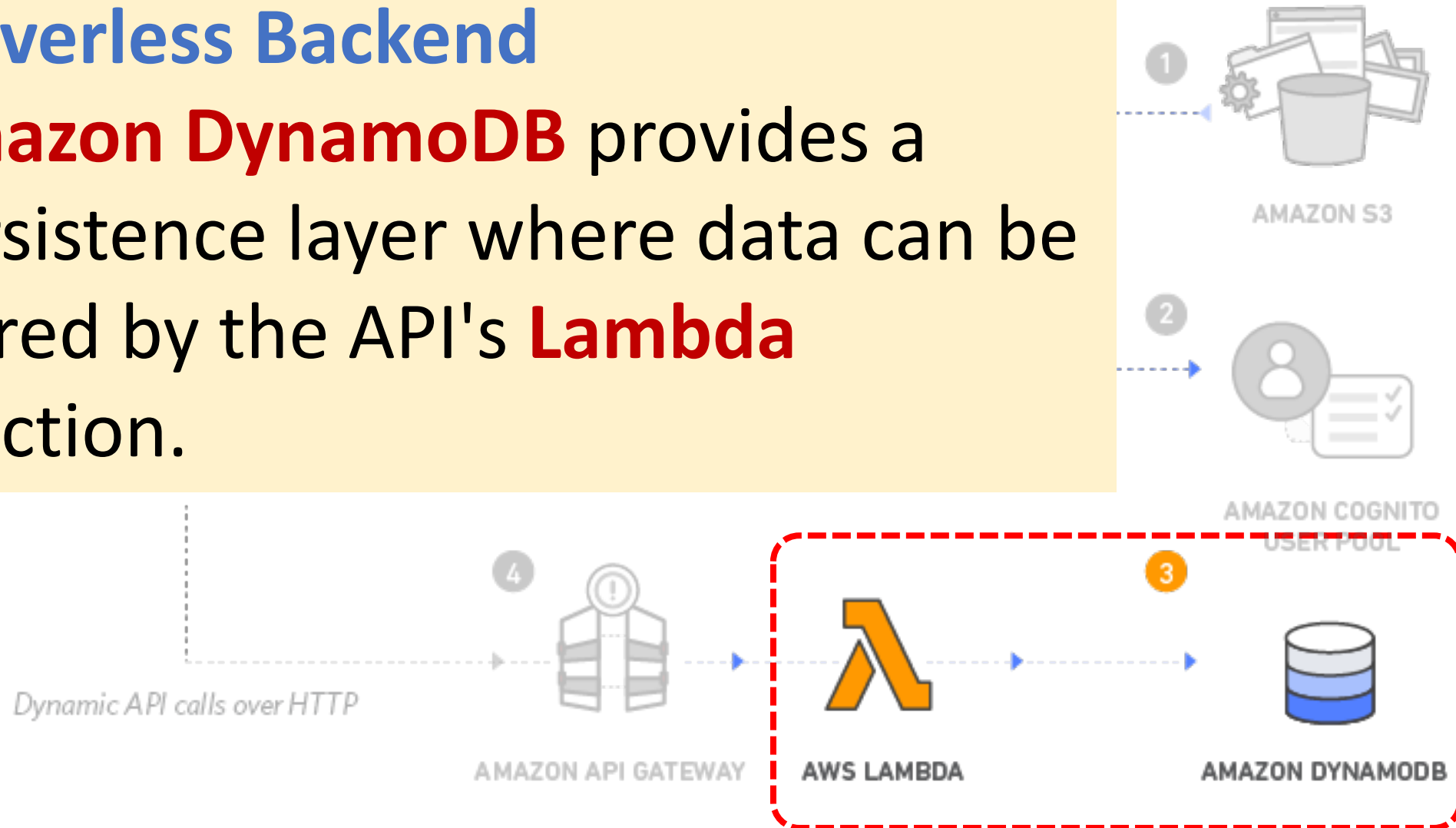
3

Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

3 Serverless Backend

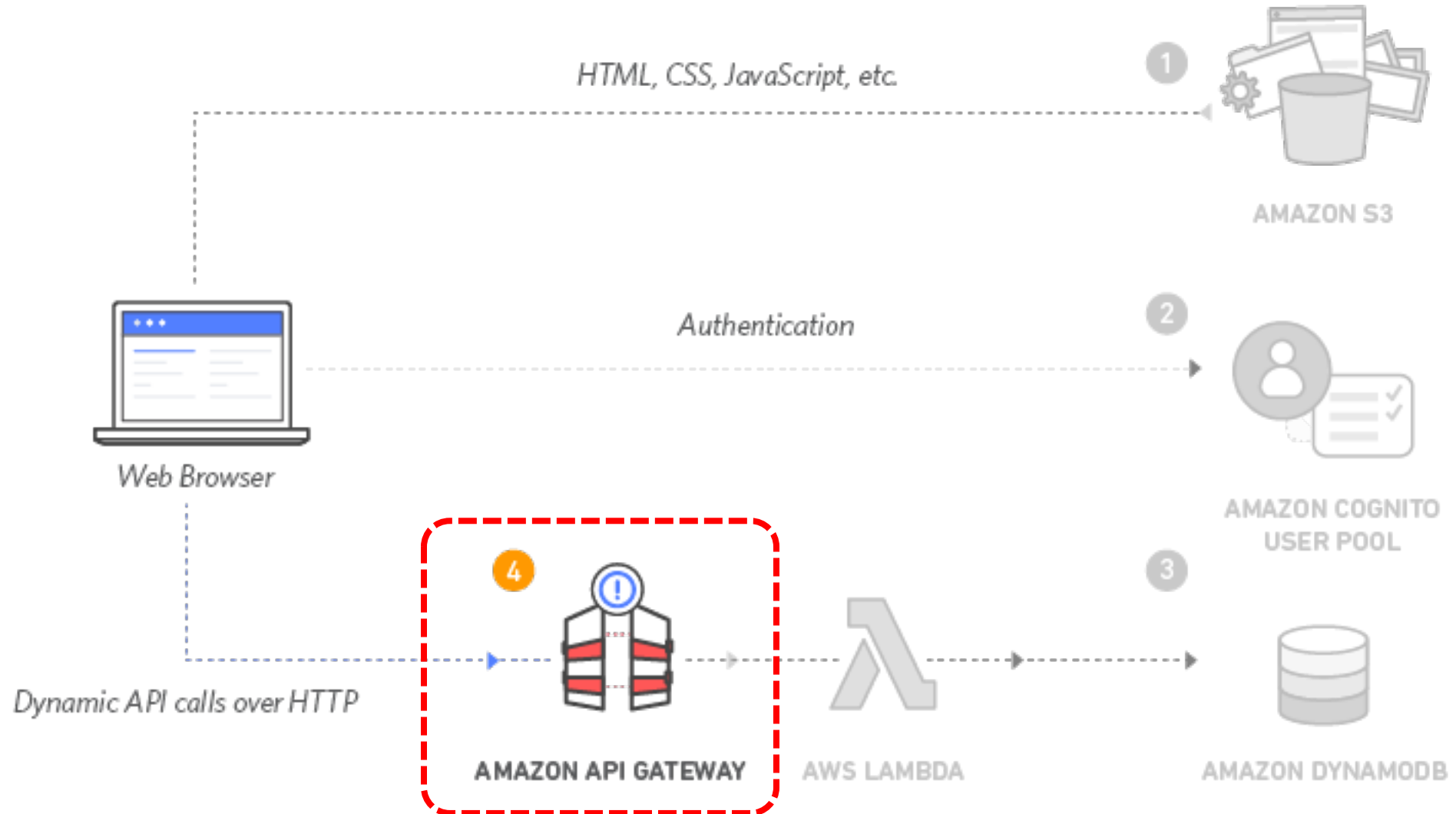**Amazon DynamoDB** provides a persistence layer where data can be stored by the API's **Lambda** function.

Build a Serverless Web Application

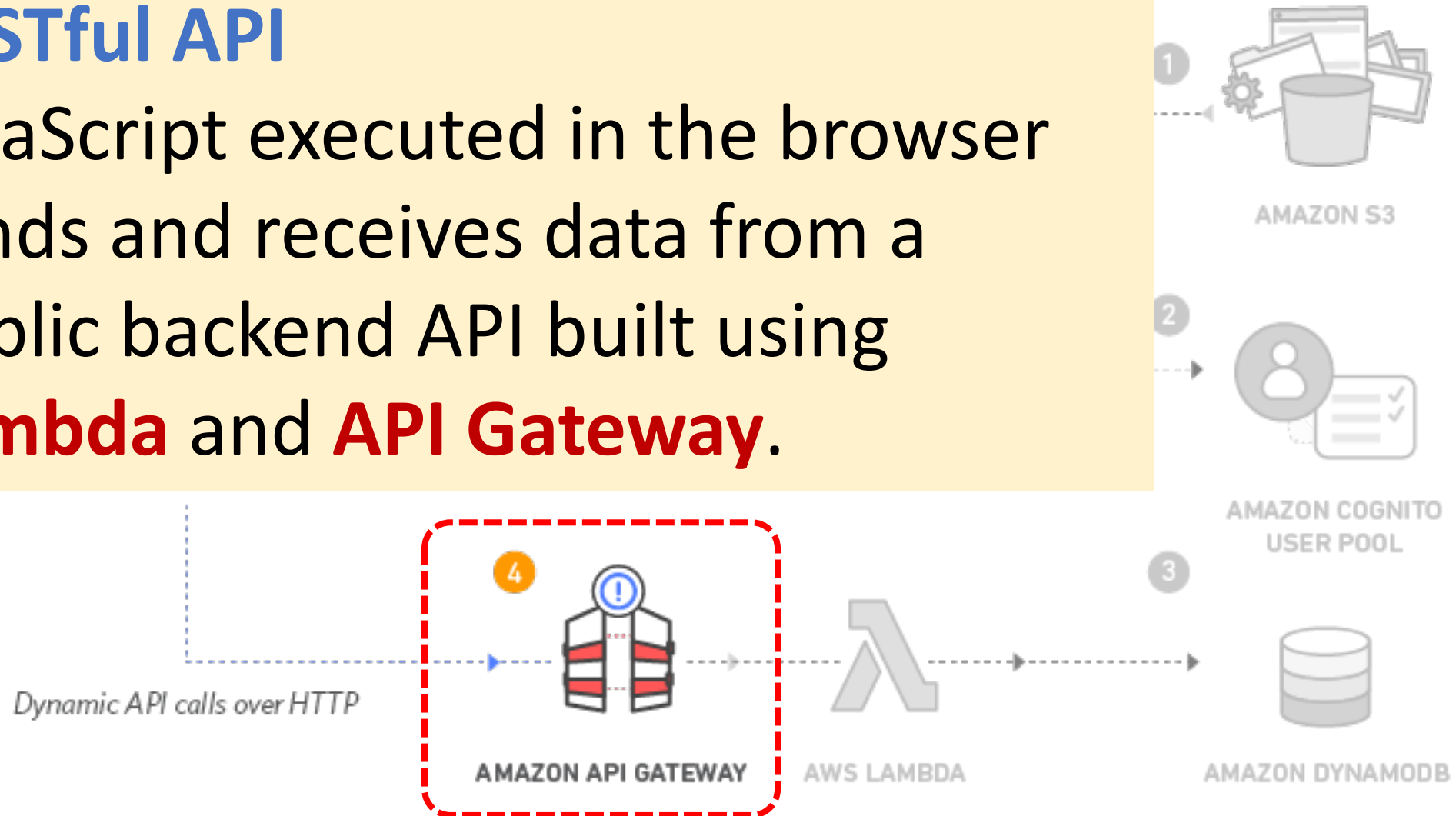## with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

4

HTML, CSS, JavaScript, etc.

AMAZON S3

Web Browser

Authentication

AMAZON COGNITO USER POOL

Dynamic API calls over HTTP

AMAZON API GATEWAY

AWS LAMBDA

AMAZON DYNAMODB

Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

4 RESTful API

JavaScript executed in the browser sends and receives data from a public backend API built using **Lambda** and **API Gateway**.

AMAZON S3

AMAZON COGNITO USER POOL

Dynamic API calls over HTTP

AMAZON API GATEWAY

AWS LAMBDA

AMAZON DYNAMODB

5

Terminate resources

Resource Cleanup

You will terminate an **Amazon S3** bucket, an **Amazon Cognito** User Pool, an **AWS Lambda** function, an **IAM** role, a **DynamoDB** table, a **REST API**, and a **CloudWatch** Log.

It is a best practice to delete resources you are no longer using to avoid unwanted charges.

Summary

- **Cloud Computing Architecture for AI**
- **AWS Certifications Roadmap for Machine Learning**
- **AWS Serverless Architecture**

References

- **https://aws.amazon.com/certification/**

- **https://www.aws.training/**

- **https://aws.amazon.com/training/awsacademy/**

- **https://aws.amazon.com/education/awseducate/**

- **AWS Certified Cloud Practitioner**

    - https://aws.amazon.com/certification/certified-cloud-practitioner/

- **AWS Certified Solutions Architect – Associate**

    - https://aws.amazon.com/certification/certified-solutions-architect-associate/

- **AWS Cloud Practitioner Essentials (Second Edition)**

    - https://aws.amazon.com/training/course-descriptions/cloud-practitioner-essentials/

- **Architecting on AWS**

    - https://aws.amazon.com/training/course-descriptions/architect/