Cloud Applications Architecture

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Course 1 - Intro (Course & Cloud)

Why Would You Be Interested?

Cloud is similar to the whole IT industry - relevant for all other industries.

Consistently in top 3 most demanded (hard - as opposed to soft) skills.

It will be useful no matter what you choose to do after.

We will have fun.

What Does CAA Mean?

Designing and building applications (IT systems) which leverage the possibilities (services) offered by cloud environments to achieve greater:

- Scalability
- Security
- Cost Efficiency
- Availability
- Productivity

In other words, build systems we can trust and have a good time while doing it.

General Info

Course
- Focused on theoretical concepts, case studies, and demos
- Probably 50% of final grade
- Involvement is worth more than learning for the exam
- Most likely quiz exam using Moodle (maybe some oral questions?)

Lab
- Hands-on with AWS
- Migrate an app from **on-premises** to **cloud**
- 50% of final grade
- Architecture design quiz

General Info

- **Topics Overview**

What Is the Traditional Approach?

- For individuals and small companies: develop a monolithic app, contact a hosting company, rent a server, install and configure relevant tools, copy the app with FTP, run the app.

- For large corporations: Discuss the budget, approve the budget, build a data center, go over the budget, hire people to manage the data center, deploy apps, upgrade data center.

Cloud Intro

What does Cloud mean?

In simple terms, cloud computing means on-demand availability of various computing resources. Typical benefits of using the cloud include:

- Flexibility
- Cost
- Speed
- Security
- Performance
- Reliability
- ...

History

First public offering came from a large company (Amazon) as a result of over-provisioning (to handle holiday sales) in 2006.

In 2008, Google launched App Engine, one of the first public PaaS solutions.

Main Providers

Gartner Magic Quadrant

Figure 1. Magic Quadrant for Cloud Infrastructure and Platform Services

Figure 1. Magic Quadrant for Cloud AI Developer Services

Cloud Classification

Deployment Models:
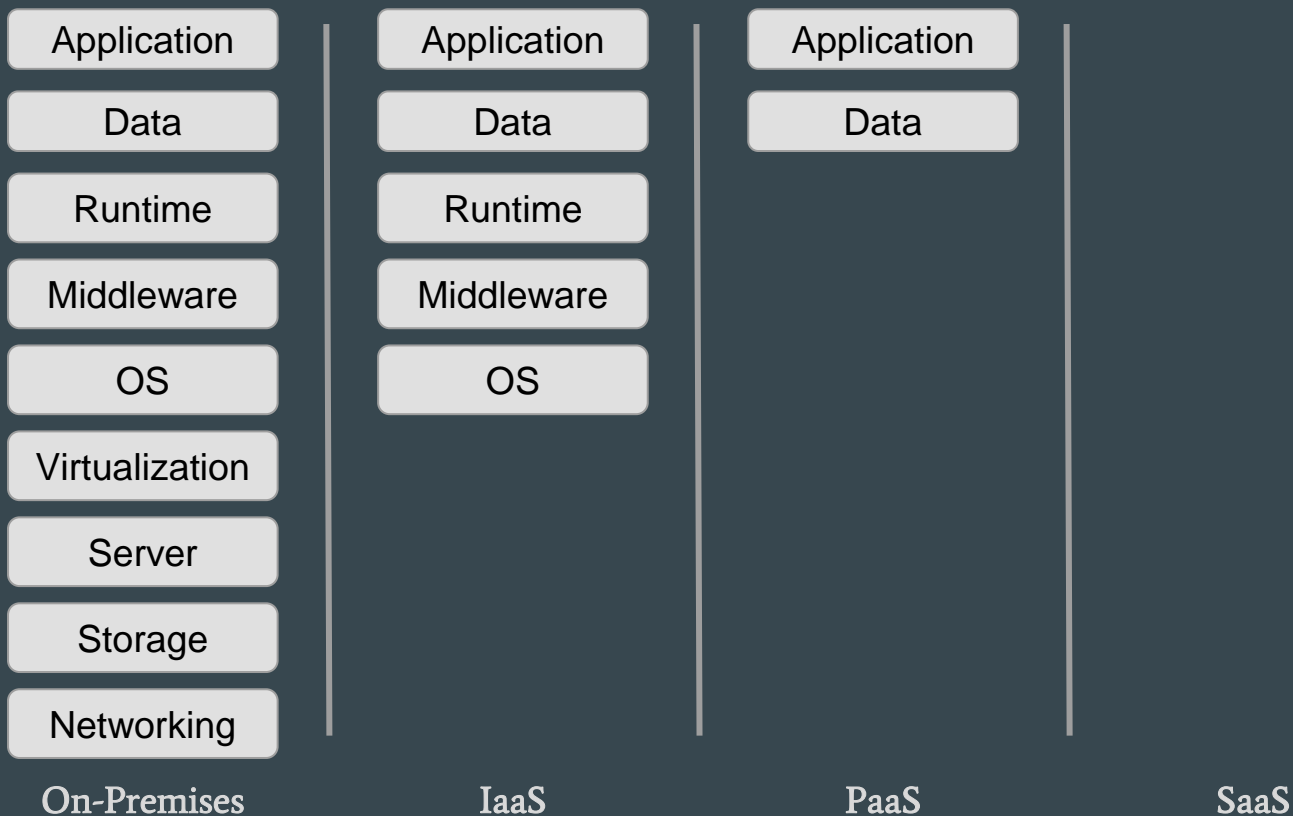
- **Public**
- Private
- Community
- Hybrid

Service Models:

- **IaaS (infrastructure** as a service**)**
- **PaaS (platform** as a service**)**
- **SaaS (software** as a service**)**

Many *aaS nowadays: BaaS, DBaaS, FaaS (most of them are PaaS)

The NIST Model

IaaS, PaaS, SaaS - What We Manage

On-Premises	IaaS	PaaS	SaaS
Application	Application	Application	
Data	Data	Data	
Runtime	Runtime		
Middleware	Middleware		
OS	OS		
Virtualization			
Server			
Storage			
Networking			

Examples for Each Service Model

IaaS

Usually virtual machine services. Other service models are built on top of them.

E.g. Amazon EC2, Google's GCE etc.

PaaS

Services that let you develop your solution without worrying about how the system runs.

E.g. Cloudfoundry, Google App Engine, Azure App Service, managed databases (RDS, CloudSQL etc.)

SaaS

No implementation, you just use the provided functionality. Interact with them through UI or API.

E.g. Google Suite, Office365, Stripe, Dropbox, Mailgun

Working with the Cloud

1. Create an account
2. Setup billing
   a. Most providers offer decent free tiers
3. Configure and launch resources
   a. From the web console
   b. Using the CLI
   c. **I**nfrastructure **a**s **C**ode
4. *Stop/terminate them when not used
   a. Usually billing stops when stopping the resources

Standards/Compliance

Assure customers best practices are followed

- CSA (Cloud Security Alliance) - Best practices for cloud security
- ISO 9001 - Global Quality Standard
- ISO 27001 - Information Security Management
- ISO 27017 - 27001 in the context of cloud
- ISO 27018 - Personal data protection in cloud
- PCI DSS - Card payments security
- HIPAA - Health information protection

Running on complaint infrastructure makes our products also compliant

Pricing Models

Most services are billed based on the actual usage:

- **Time based**: pay per second/hour etc of the service being online
  - Usually applies to IaaS and PaaS offerings
- **Usage based**: pay per processing unit (request, transaction, read, write etc)
  - Mostly for PaaS/SaaS

Prices can be **fixed**, **tiered** and/or **dynamic**.

There is also the **subscription** based model: agree to pay each month a certain price and have access to the agreed services. Usually applies to SaaS offerings and some providers - e.g. SAP offers both

Pricing Models - Time vs Usage

Time Based

Usually applies to virtual machines, (relational) databases and general PaaS services (e.g. Cloudfoundry).

You pay the same for any amount of traffic.

Easy to control costs.

Usage Based

Usually applies to fully managed services (FaaS, DBaaS - usually NoSQL) and storage services.

You pay based on the traffic.

You cannot throttle the usage without stopping the service.

Some services offer both - e.g.
Azure API Management

Pricing Models - Fixed, Tiered, Dynamic

Fixed

You pay the same no matter what. Usually applies to on-demand virtual machines

Instance	vCPU(s)	RAM	Temporary storage	Pay as you go
B1S	1	1 GiB	4 GiB	€0.0135/hour
B1MS	1	2 GiB	4 GiB	€0.0234/hour
B2S	2	4 GiB	8 GiB	€0.0473/hour

Azure Windows Virtual Machines Pricing

Tiered

You pay less per unit the more you use it. Usually applies to storage services and bandwidth cost.

	Storage pricing
S3 Standard - General purpose storage for any type of data, typically used for frequently accessed data	
First 50 TB / Month	$0.023 per GB
Next 450 TB / Month	$0.022 per GB
Over 500 TB / Month	$0.021 per GB

Dynamic

Usually based on supply and demand. More spare capacity, smaller prices.

	Linux/UNIX Usage	Windows Usage
General Purpose - Current Generation		
a1.medium	$0.0084 per Hour	N/A*
a1.large	$0.0234 per Hour	N/A*
a1.xlarge	$0.0336 per Hour	N/A*
a1.2xlarge	$0.0672 per Hour	N/A*
a1.4xlarge	$0.1343 per Hour	N/A*
a1.metal	$0.13	
t2.micro	$0.00	
t2.small	$0.00	

	Linux/UNIX Usage	Windows Usage
General Purpose - Current Generation		
a1.medium	$0.005 per Hour	N/A*
a1.large	$0.0098 per Hour	N/A*
a1.xlarge	$0.0197 per Hour	N/A*
a1.2xlarge	$0.0394 per Hour	N/A*
a1.4xlarge	$0.0788 per Hour	N/A*
a1.metal	$0.0788 per Hour	N/A*
t2.micro	$0.0035 per Hour	$0.0081 per Hour
t2.small	$0.0069 per Hour	$0.0159 per Hour

Pricing Models - Discounts

Credits

Most providers offer **sign-up** credits, **educational** credits and **start-up** credits. You can also earn them from various contests or partnerships.

They also provide always free service tiers.

Reservation

If you know you will be using a certain service for a long time, you can commit to it and get a considerable price cut.

E.g. AWS Reserved Instances and Savings Plans can reduce the cost by 30 to 70%

Sustained Use

Some providers will automatically apply discounts to your bill if you use certain resources continuously.

E.g. Google Cloud sustained use discounts for GCE and App Engine (30% if the instance is running the entire month)

Guidelines & Principles

Architecture Frameworks

AWS Well-Architected

Google Architecture Framework

Azure Well-Architected

Operational Excellence
- ○ Automation, Monitoring, Testing

Security
- ○ IAM, Defence in depth, Traceability

Reliability
- ○ Monitoring, Scaling, Testing

Performance
- ○ Scaling, Choosing right, Design

Cost Optimization
- ○ Choosing right, scaling, Understanding the services and offers

The 12-Factor App   Link

Codebase	Port Binding
Dependencies	Concurrency
Config	Disposability
Backing Services	Dev/Prod Parity
Build, release, run	Logs
Processes	Admin Processes

Pragmatic video about it

Relevant Links

1. List with engineering blogs from top companies (most relevant: Netflix, Uber, Atlassian)
2. AWS re:Invent 2019 Playlist
3. Google Cloud Next `19 Playlist
4. Microsoft Developer Youtube Channel
5. Last Week in AWS

Summary

1. Why you would care
2. Involvement is important
3. The cloud and how it compares to on-premises
4. Providers
5. Cloud classification
6. Standards
7. Pricing models
8. Principles