

HARVARD  
Extension School

Week 1

Introduction to the Cloud and DevOps

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# What and Why this course?

- Not about AWS DevOps certificate
- Learning the common devops tools and methodologies
- Bridge the gap between operation and development
- Use those tools in actual projects
- Learn together a rapid evolving subject called DevOps

# Questions

- How many of you have a degree in computer science?
- How many took computer OS classes?
- How many have system admin skills (linux admin skills)?
- How many have programming skills?
- How many used the cloud?
- What do you know about DevOps?
- Who likes soccer?

# What is the cloud?

- The cloud is all about Storing Data and accessing computers over the internet
- A servers farm provides Storage, compute, artificial intelligence, machine learning, all different types of services over the internet.
- It is a physical or virtual machine somewhere
- The cloud is infinitely scalable
- Lower downtime if architected infrastructure is optimized

# History of the cloud



1960

Mainframe and timesharing



1968 - 1970

development of ARPANET and Virtualization



1997

the term "Cloud Computing"



2003

first public release of Xen



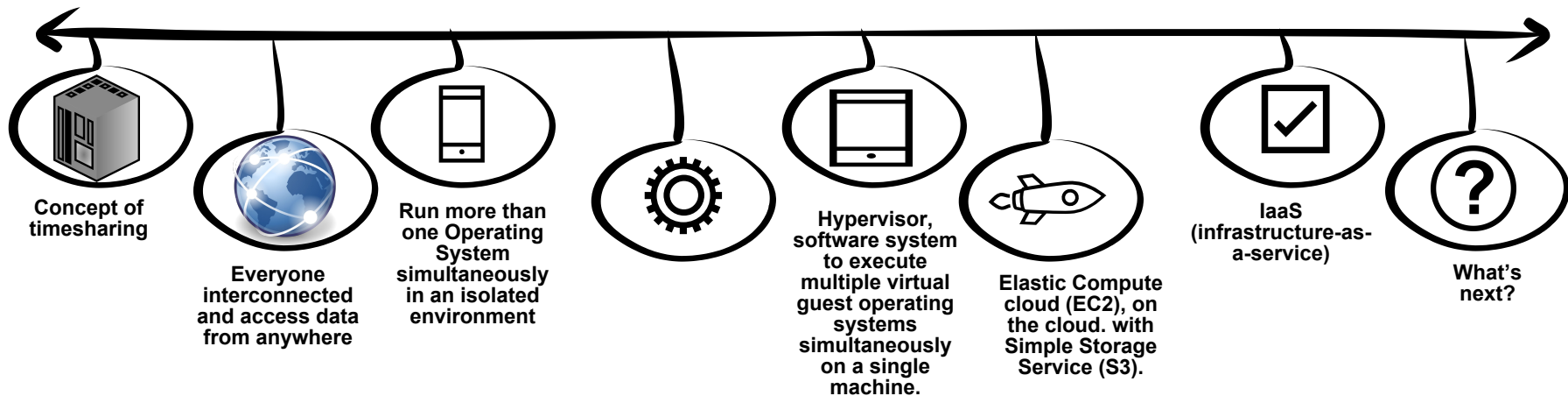
2006

Amazon expanded its cloud services pay-as-you-go model



2013

Worldwide Public Cloud Services Market



# Build a server

Old Days	Data Centers (Outsourcing)	The cloud
Buy a server machine	Contact the data center	In minutes you can spin up a server
Plug it in	Provide the infrastructure support	All infrastructure support is covered by default with redundancy
Set it up	Provide power, heating, cooling, physical security	Control expenses as needed
Connect it to the internet, Keep it running 24/7	Provide additional support of DB, maintenance if requested	Focus on the code rather than infrastructure
Expensive	Expensive and requires commitment and could take weeks or more	Pay as you go!

# Who are the different cloud providers?

- Amazon is the fastest growing computing platform so far as it's the largest public cloud computing platform taking the majority of the world's compute capacity
- Microsoft Azure
- Google: focusing on big data analysis knowing that it's the future
- IBM
- Alibaba
- etc



# Amazon AWS

2002 : Official launch

2006 : AWS officially combined the three initial service offerings of Amazon S3 cloud storage, EC2 and SQS.

2009 : Virtual Private Cloud VPC

2012: First Re-Invent Conference

# Microsoft Azure

2008 : Announced the Windows Azure Platform.

2009 – Announced SQL Azure Relational Database.

2010: Azure was released as "Windows Azure".

2011 – Released Traffic manager, SQL Azure reporting, HPC scheduler.

2012 – Websites, Virtual machines for Windows and **Linux!!!**, Python SDK, new portal, locally redundant storage.

2014: was renamed "Microsoft Azure".

2015 – Azure Cloud Switch introduced as a cross-platform Linux distribution.

2015 – Azure ARM Portal released.

# Google Cloud PlatForm (GCP)

2008: Google App Engine was released as a preview.

2010 – Google Cloud Storage launched.

2013 – BigQuery, first presented.

2013 – **Google Compute Engine** was released.

2014 – Google Cloud SQL was released.

2014 – Google announced Managed Virtual Machines.

2016 – Google Cloud Functions, Dataproc and Nomulus top-level domain registry announced.

2016 – Google Cloud Jobs API enters is released.

2017 – Google Cloud Machine Learning Engine is released.

# Gartner Magic Quadrants

- Gartner is an information technology (IT) research and consultancy company.
- Gartner produces a Magic Quadrants on yearly basis to compare Cloud vendors based on Gartner's standard criteria and methodology.
- Magic Quadrant graphic is a two-dimensional matrix that evaluates vendors based on their Completeness of Vision and Ability to Execute.

Figure 1. Magic Quadrant for Cloud Infrastructure as a Service, Worldwide



# Cloud Services types

- Infrastructure as a service (IaaS): AWS EC2 , Google CE, Storage
- Platform as a Service (PaaS): AWS Beanstalk , databases, web servers,
- Software as a service (SAAS): Gmail , Office 365, Virtual Desktop
- Function as a service (FaaS): AWS Lambda, Azure Functions, Google Cloud Functions
- What Else :
  - DataBase as a Service DBaaS: AWS RDS
  - Container as a Service CaaS: AWS ECS , Google Kubernetes Engine

# Infrastructure as a service (IaaS)

- Hypervisor is a process that separates a computer's operating system and applications from the underlying physical hardware.
- What is IaaS:
  - With a Hypervisor you can provision virtual machines
  - Renting the physical service itself
  - Allows to host an operating system on the cloud to own and manage
- With IaaS you only pay for what you use with no long term contract

# Platform as a Service (PaaS)

Is like AWS Elastic Beanstalk, you have your code but you don't necessarily know what resources are required to provision, so PaaS is used to provision the necessary resources for you like Elastic Load Balancers with the necessary type of EC2 instances, databases, etc.

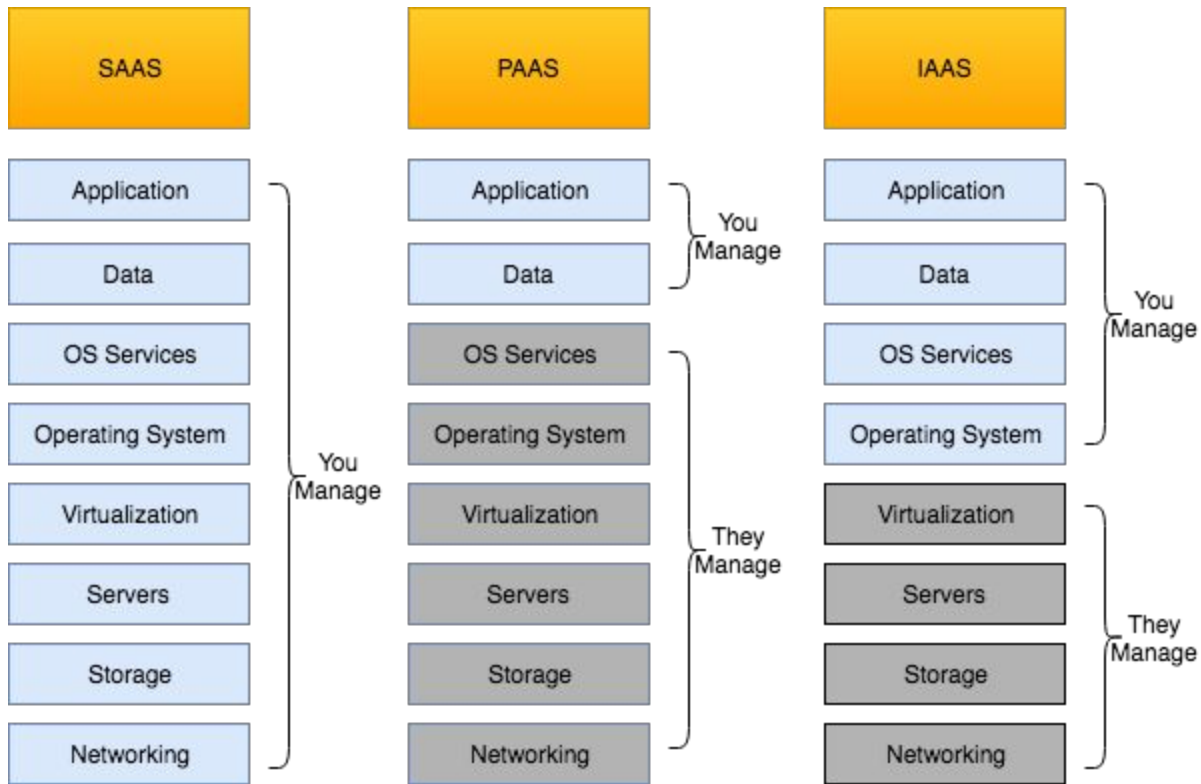


# Software as a service (SaaS)

Similar to Gmail where you worry about what the software provides you rather than the underlying service, high availability.

# Function as a service (FaaS)

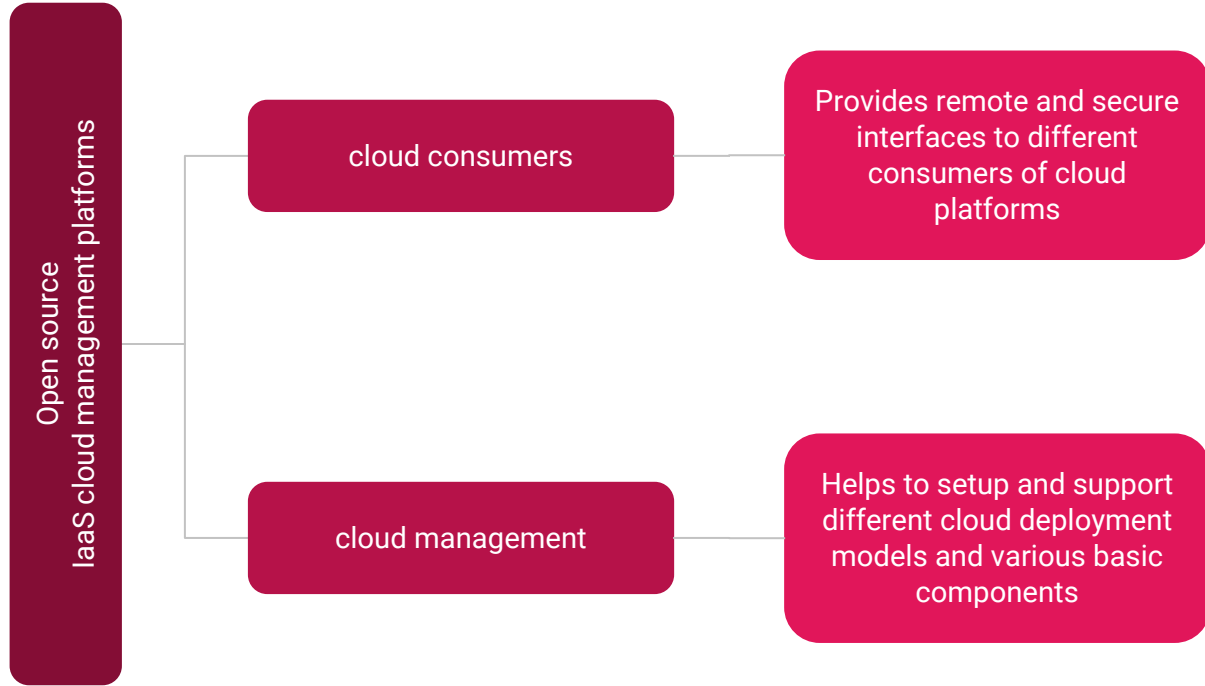
Pay for a function that has been developed by someone and then use and recycle it into your application code.



# What is Open Cloud Management Platforms?

- Infrastructure-as-a-Service (IaaS) Open source platform
- Provision virtualized infrastructure resources to users, removing the need for users to own and operate these resources.
- Control and configure the cloud architecture as private and hybrid.
- Lower costs and improved performance.

External IaaS (e.g. AWS)	Users can use AWS services from Amazon to control and configure their infrastructure resources on Amazon's ecosystem.	Relatively high costs, and may not be suitable for many enterprises or organizations and their applications.
Internal IaaS open source cloud platforms	Leverage the value of cloud computing using on-premises systems that are directly controlled by	Better utilize existing computer resources, thus reducing costs sometimes. So in other words, private



# Virtualization and Open Cloud Management Platforms

VMWare?

Kernel-based Virtual Machine - KVM?

Xen

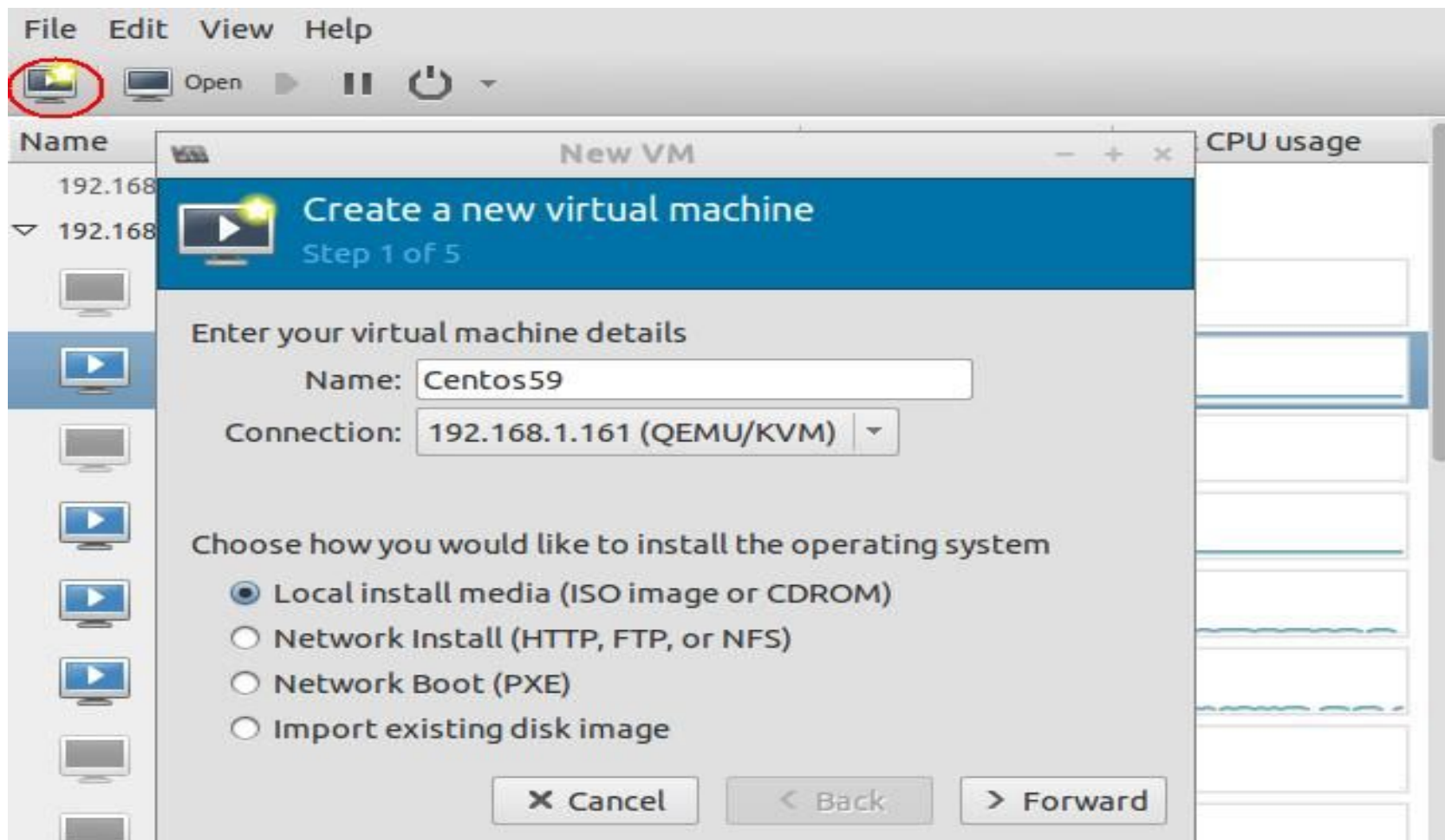
Eucalyptus

OpenStack

Open Nebula

CloudStack

# KVM



# VMWare

The screenshot displays the VMware vSphere Client interface. The top menu bar includes File, Edit, View, Inventory, Administration, Plug-ins, and Help. The breadcrumb navigation shows Home > Inventory > Hosts and Clusters. A search bar is located on the right. The left sidebar shows the inventory tree with VC4, vSphere, and two ESX hosts. The main pane shows the configuration for 'cl-167.eng.vmware.com VMware ESX, 4.0.0, 164009 | Evaluation (60 days remaining)'. The 'General' tab is selected, showing host details like Manufacturer (VMware, Inc.), Model (VMware Virtual Platform), CPU Cores (2 CPUs x 1.854 GHz), Processor Type (Intel(R) Xeon(R) CPU E5320 @ 1.86GHz), License (Evaluation Mode), Processor Sockets (2), Cores per Socket (1), Logical Processors (2), Hyperthreading (Inactive), Number of NICs (2), State (Connected), Virtual Machines and Templates (0), VMotion Enabled (no), VMware EVC Mode (Disabled), Fault Tolerance Enabled (no), Active Tasks, Host Profile, and Profile Compliance (N/A). The 'Resources' tab is also visible, showing CPU usage (427 MHz), Memory usage (706.00 MB), and a table of Datastores (Storage1 (1) with 30.75 GB capacity). The 'Recent Tasks' table at the bottom shows a completed task 'Add standalone host'.

VC4 - vSphere Client

File Edit View Inventory Administration Plug-ins Help

Home Inventory Hosts and Clusters Search Inventory

VC4

vSphere

cl-167.eng.vmware.com

cl-168.eng.vmware.com

esx4

vm1

cl-167.eng.vmware.com VMware ESX, 4.0.0, 164009 | Evaluation (60 days remaining)

Summary Virtual Machines Resource Allocation Performance Configuration Tasks & Events Alarms Permissions Maps Storage Views

**General**

Manufacturer: VMware, Inc.

Model: VMware Virtual Platform

CPU Cores: 2 CPUs x 1.854 GHz

Processor Type: Intel(R) Xeon(R) CPU E5320 @ 1.86GHz

License: Evaluation Mode

Processor Sockets: 2

Cores per Socket: 1

Logical Processors: 2

Hyperthreading: Inactive

Number of NICs: 2

State: Connected

Virtual Machines and Templates: 0

VMotion Enabled: no

VMware EVC Mode: Disabled

Fault Tolerance Enabled: no

Active Tasks:

Host Profile:

Profile Compliance: N/A

**Resources**

CPU usage: 427 MHz Capacity 2 x 1.854 GHz

Memory usage: 706.00 MB Capacity 2047.94 MB

Datastore	Status	Capacity
Storage1 (1)	Normal	30.75 GB

Network	Type
VM Network	Standard switch network

**Recent Tasks**

Name	Target	Status	Initiated by	vCenter Server	Requested Start Time	Start Time	Completed Time
Add standalone host	vSphere	Completed	Administrator	VC4	5/3/2009 8:17:13 PM	5/3/2009 8:17:13 PM	5/3/2009 8:17:38 PM

Tasks Alarms Evaluation Mode: 51 days remaining Administrator



# Eucalyptus

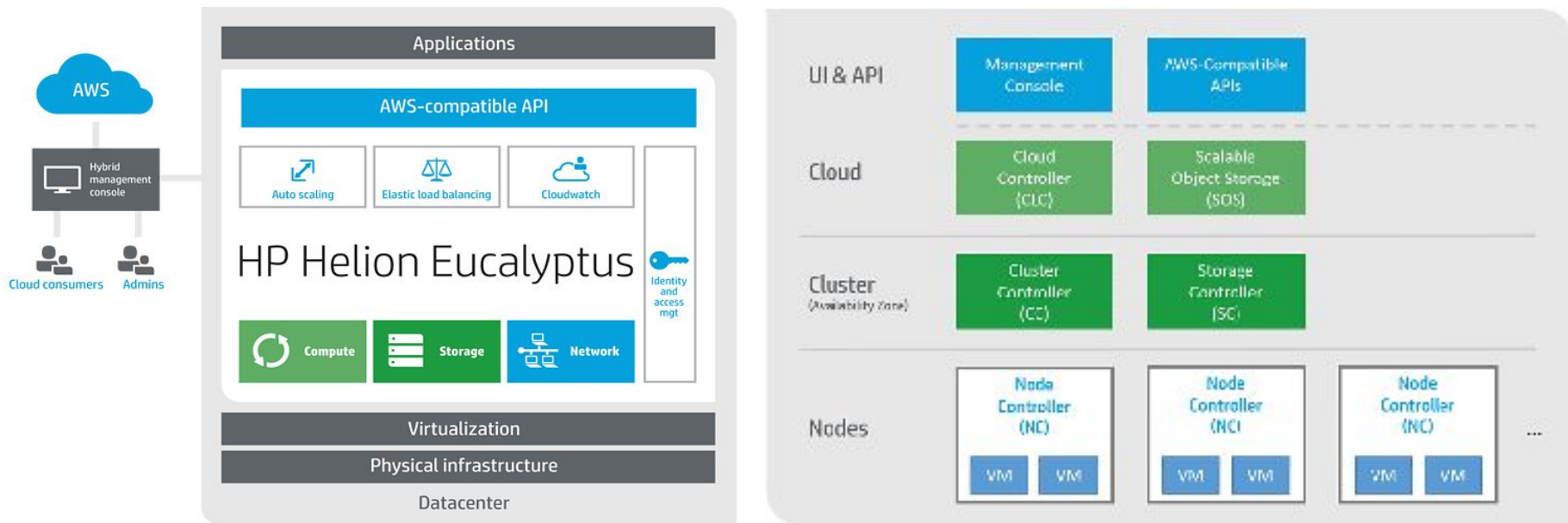
Elastic Utility Computing Architecture for Linking Your Programs To Useful Systems (Eucalyptus).

Replicates the EC2 interfaces and functionality by providing an EC2 compatible cloud computing platform and S3 compatible cloud storage platform.

Eucalyptus has been incorporated into many virtualization technologies such as KVM, VMware, Xen, and multiple varieties of Linux, and provides API to this layer which makes it look similar to EC2, allowing native integration with Amazon services.

# Eucalyptus

<https://github.com/eucalyptus>



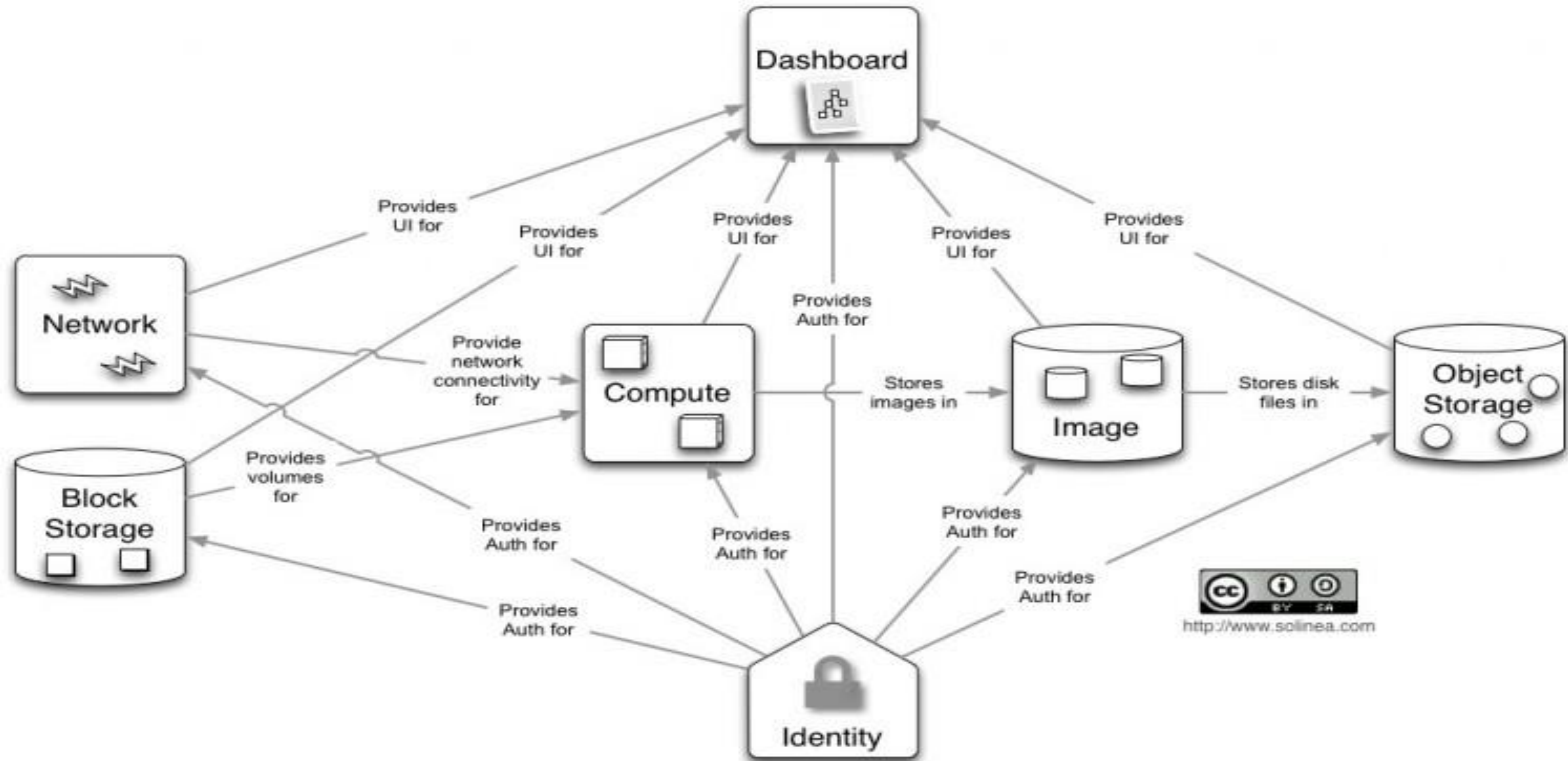
# OpenStack

OpenStack software is designed to control large pools of compute, storage, and networking resources throughout a data centre, managed through a dashboard or via the OpenStack API. It aims to create a scalable, flexible open source cloud computing platform of public and private IaaS architectures.

OpenStack, free under the Apache 2.0 license, is often referred to in the media as the Linux of the Cloud and is compared to Eucalyptus and the Apache CloudStack projects (discussed next).

OpenStack consists of a series of interrelated projects delivering various components for a cloud infrastructure solution.

# Open Stack



# OpenNebula

Build simple, cost-effective, reliable, open enterprise clouds on existing IT infrastructure.

The design is flexible and modular to allow integration with different storage and network infrastructure (private, public and hybrid) and hypervisor technologies (like KVM, Xen, and VMware).

# CloudStack

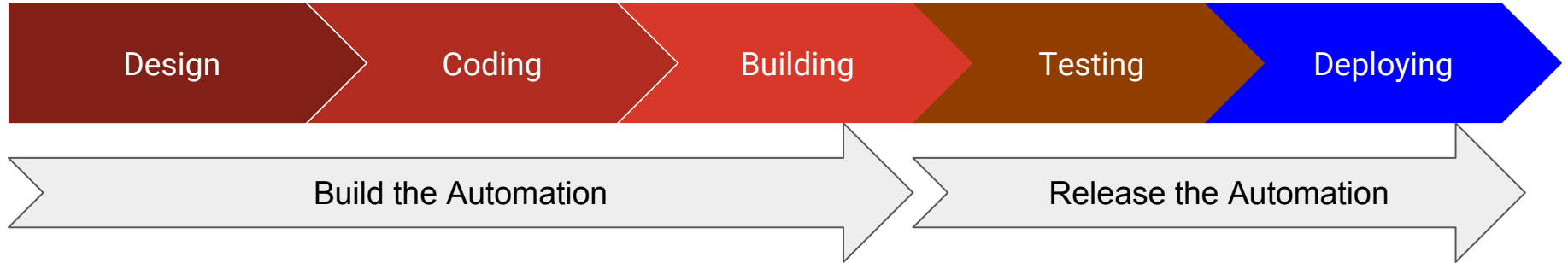
CloudStack is a software package that can be used to build both public and private clouds. It supports most common hypervisors and operating systems, and its infrastructure is hierarchical in order to enable the management of multiple physical nodes by a single interface. First developed by Cloud.com in 2010 under GNUv3 license, it was acquired by Citrix in 2011, and was released to the Apache Software Foundation (ASF) in 2012. Its code is now available under an Apache 2.0 license.

# Why the cloud?

- Self Service
- Flexibility
  - Scale up and scale down
- Availability
  - It is always on
- Mobility
  - Accessibility
- Easy to implement and less operation
  - It is a whole company job to run the cloud on the data centers
- Security and Disaster recovery
  - Should I put my money in a bank or under my bed?
- Environment

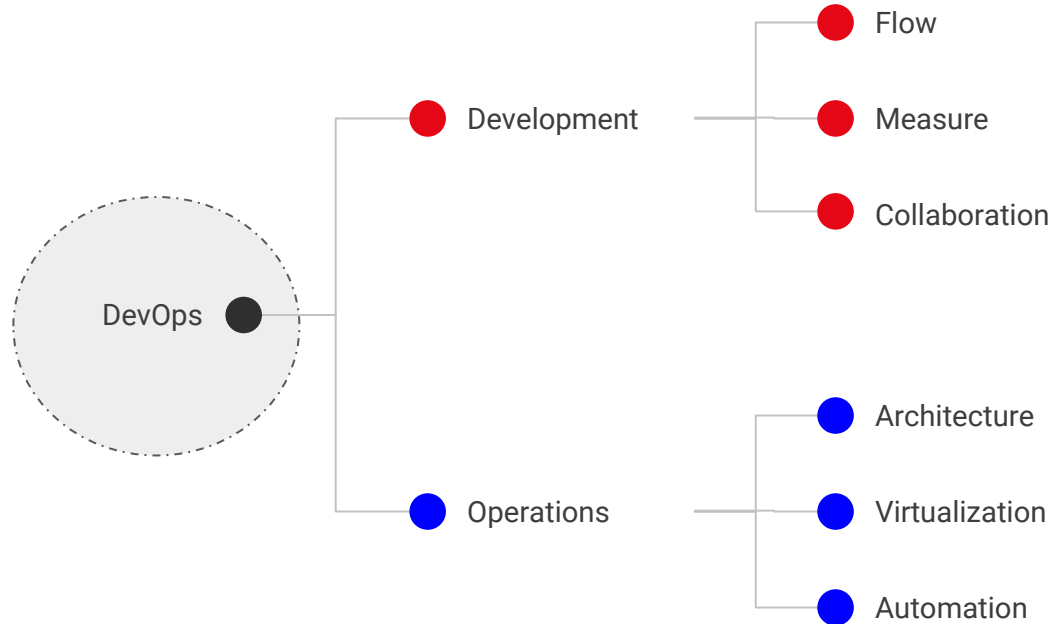
# What is Devops?

- Develop to automate, automate to develop.
- Develop to automate resources; provisioning and management.
- Automate to enable software development pipeline: develop -> test -> stage and QA -> release
- We develop systems and deploy systems through automation of things we traditionally did manually throughout the SDLC.

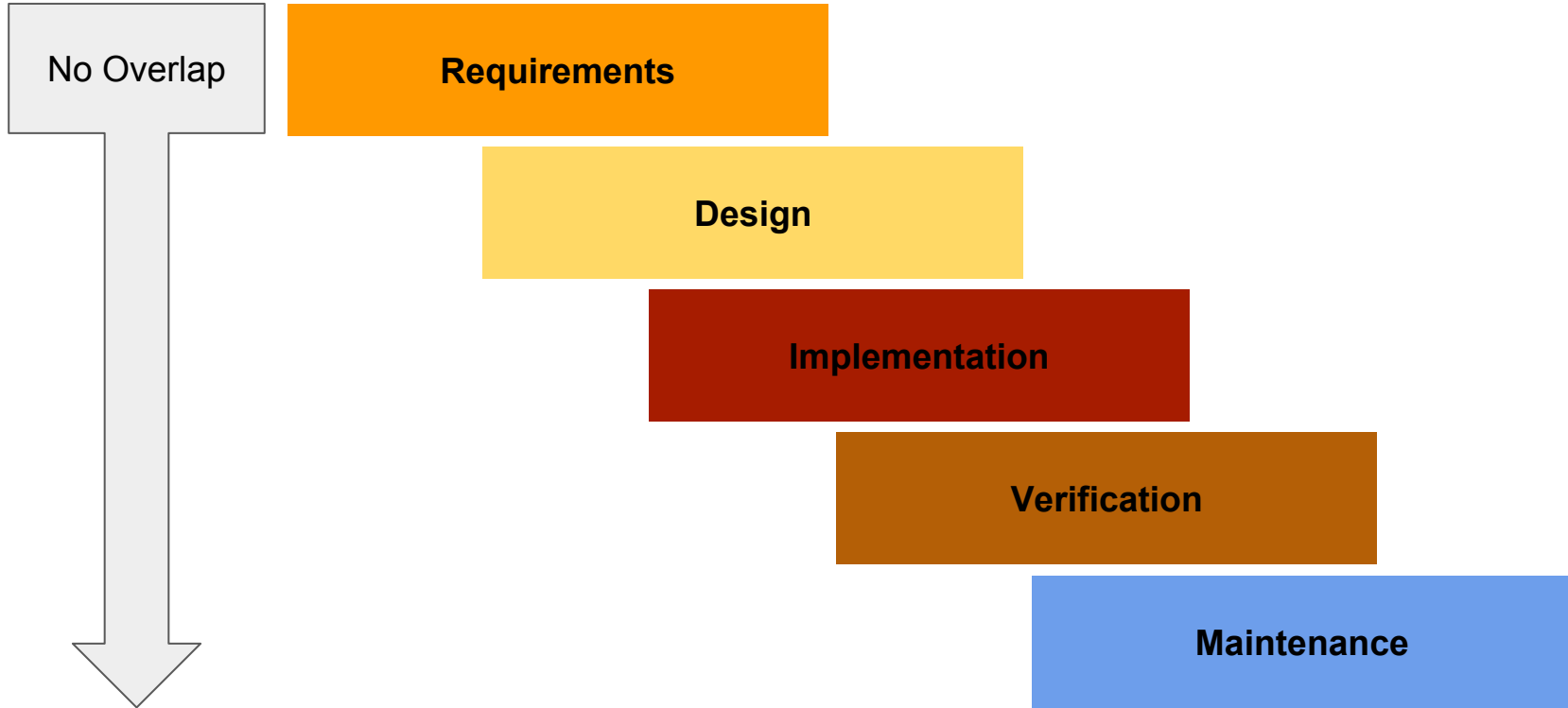




# Combination of the word DevOps



# Waterfall (Plan-Driven) : 1956



# Manifesto Agile Software Development: 2001

- Waterfall stands until 2001 when a group of engineer met in Utah and put the manifesto of Agile Software development manifesto.
- Agile Values
  - Individuals and interactions over processes and tools
  - Working software over comprehensive documentation
  - Customer collaboration over contract negotiation
  - Responding to change over following a plan
- <http://agilemanifesto.org>

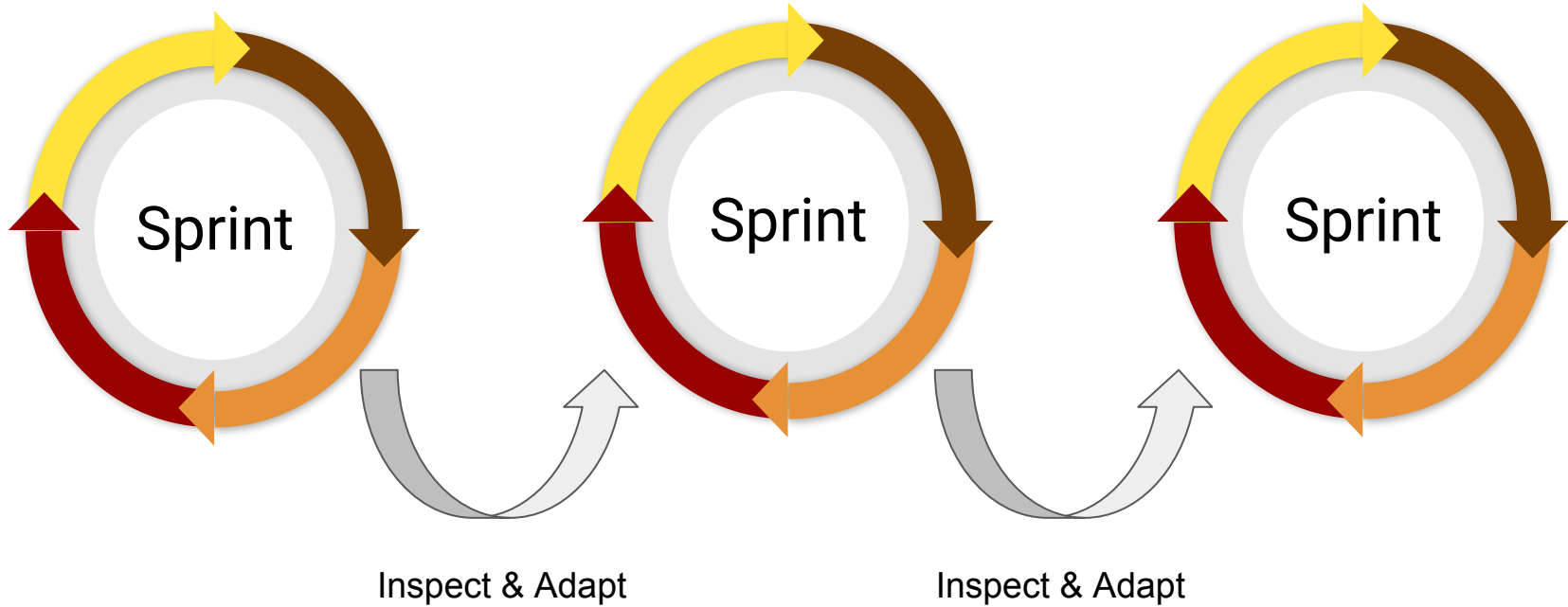
# Agile Development methodology

- Scrum - project management methodology
  - Product Owner – Represents Stakeholders
  - Scrum Master – The one responsible for maintaining the processes
  - Team – A cross functional group of about 6-8 people who do actual design, testing, implementation, etc.
  - Sprints (2 to 4 weeks)
  - No change during the sprint period
- Extreme Programming- XP
  - Software development methodology
  - XP does prescribe some engineering practices: Unitest, Pair review, simple clear code, frequent communication with the costumer

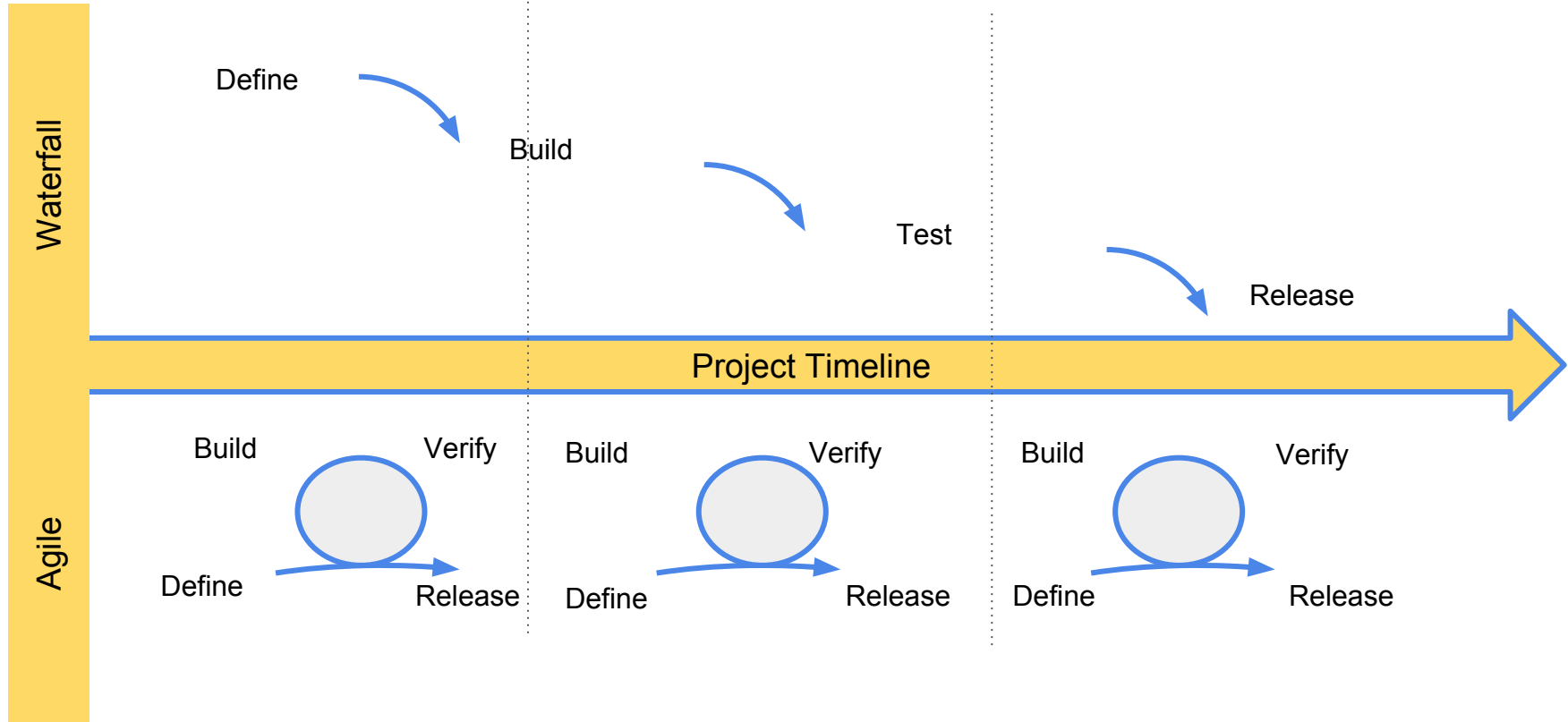
# Why agile

- The number one key difference is the **ability to respond to the evolving business needs immediately.**
- Transparency and customer satisfaction - continuous communication with the customer, the customer decide the priority of the features
- Early release - beta and test version in weeks rather than months or years
- Continues delivery - continue to add features
- Adaptation to change
- Rapid sprint from development and testing
- Software agility and Operations
  - Agility for the operations!
  - Automate the operation!
  - Automate the infrastructure!
  - DevOps!

# Agile



# Waterfall vs Agile



# What DevOps Engineers do?

- ★ Write code.
- ★ System Admin skills.
- ★ Infrastructure design.
- ★ Quality assurance (is it testing ? No)
- ★ Automation.
- ★ Building tools.
- ★ Optimization, tuning.
- ★ Cost and scaling.
- ★ Monitoring.
- ★ Virtualization.
- ★ Agile development methodology.
- ★ Security (DevSecOps/SecDevOps).

- ★ Software release cycles and management.
- ★ Designing a branch/release strategy for the provided SCM (git, Mercurial, svn, etc).
- ★ Configuration management. (You've surely heard of Puppet, Chef, Ansible, etc. Yes?)
- ★ Package Management.
- ★ Load balancing / proxying. (Of services, systems, components and processes.)
- ★ Authentication services.
- ★ Continuous Integration, Continuous Delivery(CI/CD) and Continuous Deployment.



# Cloud and DevOps

- Cloud Computing self-services empower the DevOps concept
- Developer can take operations and infrastructure management on their hand.
- The scalability, availability, mobility of cloud computing lead to the flexibility of the DevOps engineer work.

# Assignment 1

- 1) Visit this page to create an AWS account <https://aws.amazon.com/>
- 2) Use your Harvard Email
- 3) Use your credit card (You will not be charged)
- 4) Send us your:
  - a) AWS Account number
  - b) Email Address
  - c) Your Full Name

For more information on how to create AWS account please visit:

<https://aws.amazon.com/premiumsupport/knowledge-center/create-and-activate-a-aws-account/>