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Master in Fundamental Principles of Data Science

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Today's Objective

- Recap basic CS
- Introduction to Cloud
- Short Introduction to AWS

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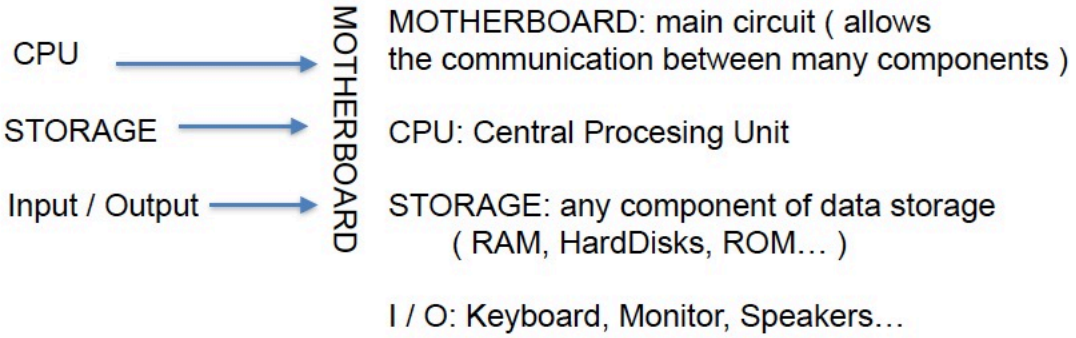
Quick recap of Basics

What is an OS?

Hardware: any physical component or parts of a computer.



Software: Collection of computer instructions.

(Drivers, apps, scripts…)

We need a system that manages all these components in a proper way and it is called Operating System

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Virtual machine

Virtual machine is an emulation of a computer system. It hold do reservations of the resources (physical computer).
Virtual machine vocabulary

– Hypervisor: Software capable of creating a virtual machine

– Host machine: Operating system running in the physical hardware

– Guest machine: Operating system in the simulated environment

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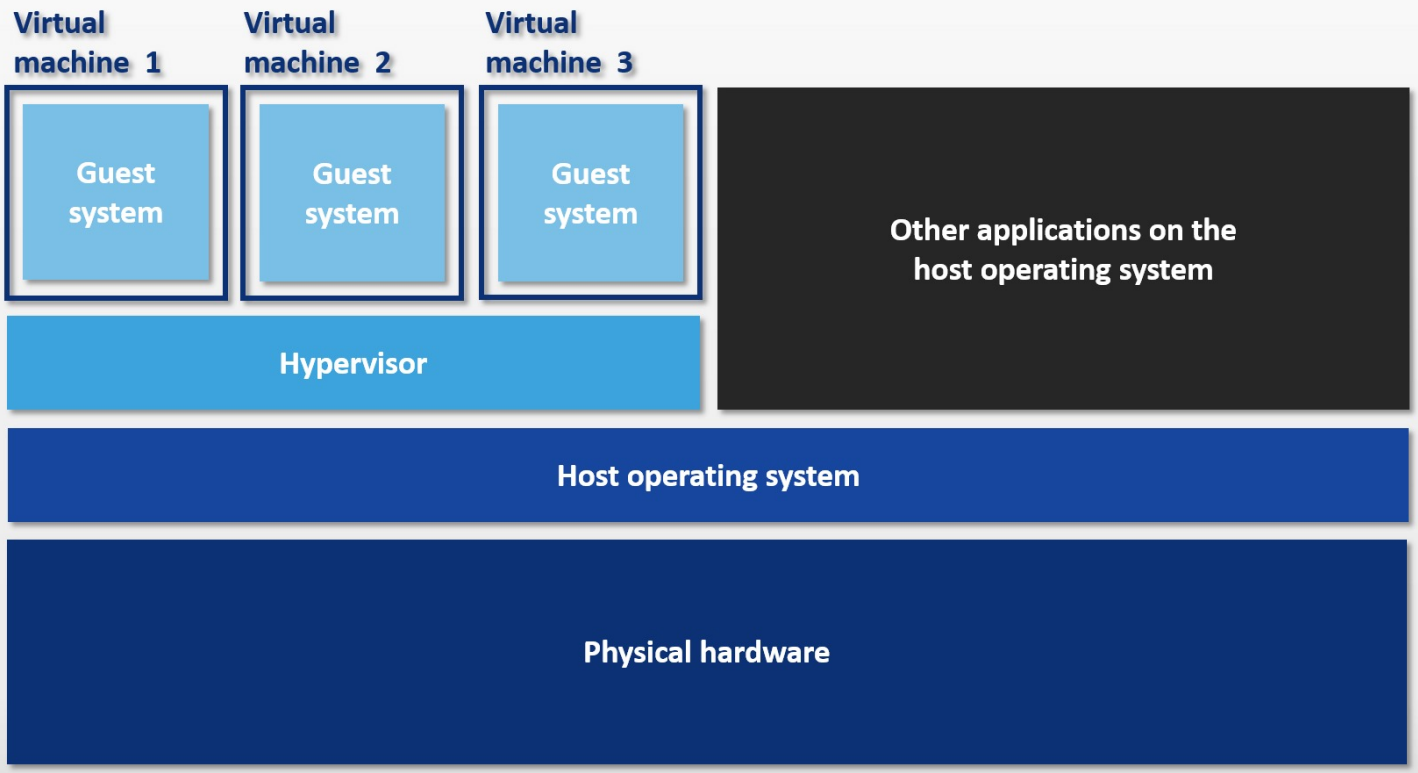
Virtual Machines



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Virtual Machines

Virtual machine characteristics

– They create an isolated environment from the host machine

– Multiple virtual machines can run simultaneously on the same physical computer.

– Ideal for testing software

– Each virtual machine has its own virtual hardware (CPU,MEM,Disk…)

– Reducing the need for physical hardware and associated maintenance

– Reduces power and cooling demand

– Hardware fail tolerance

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What is a network

A **computer network** is any set of computers or devices connected to each other with the ability to exchange data.

History Fact:

The first-ever computer-to-computer link was established on ARPANET (Advanced Research Projects Agency Network) on October 29, 1969.

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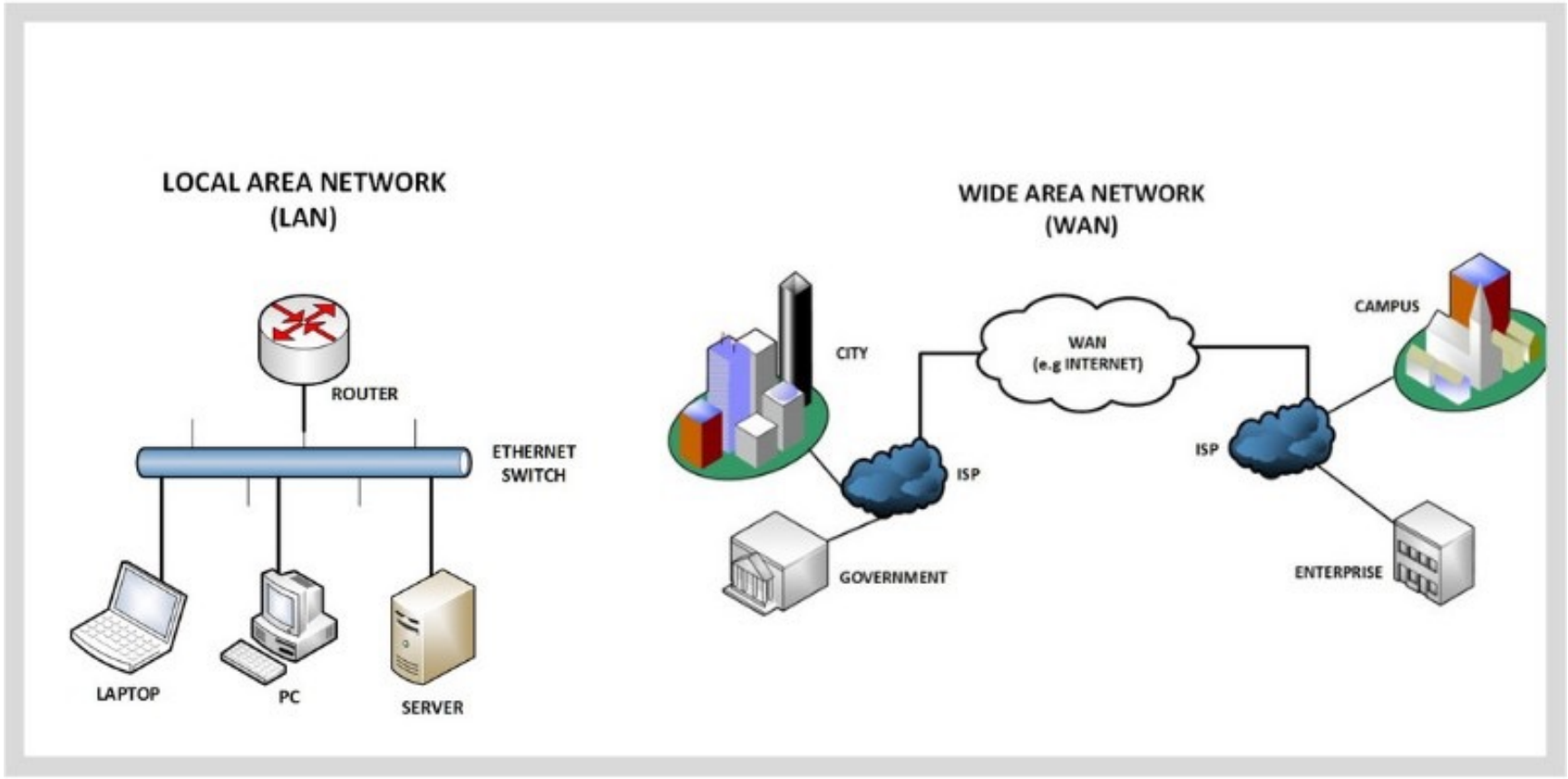
Network



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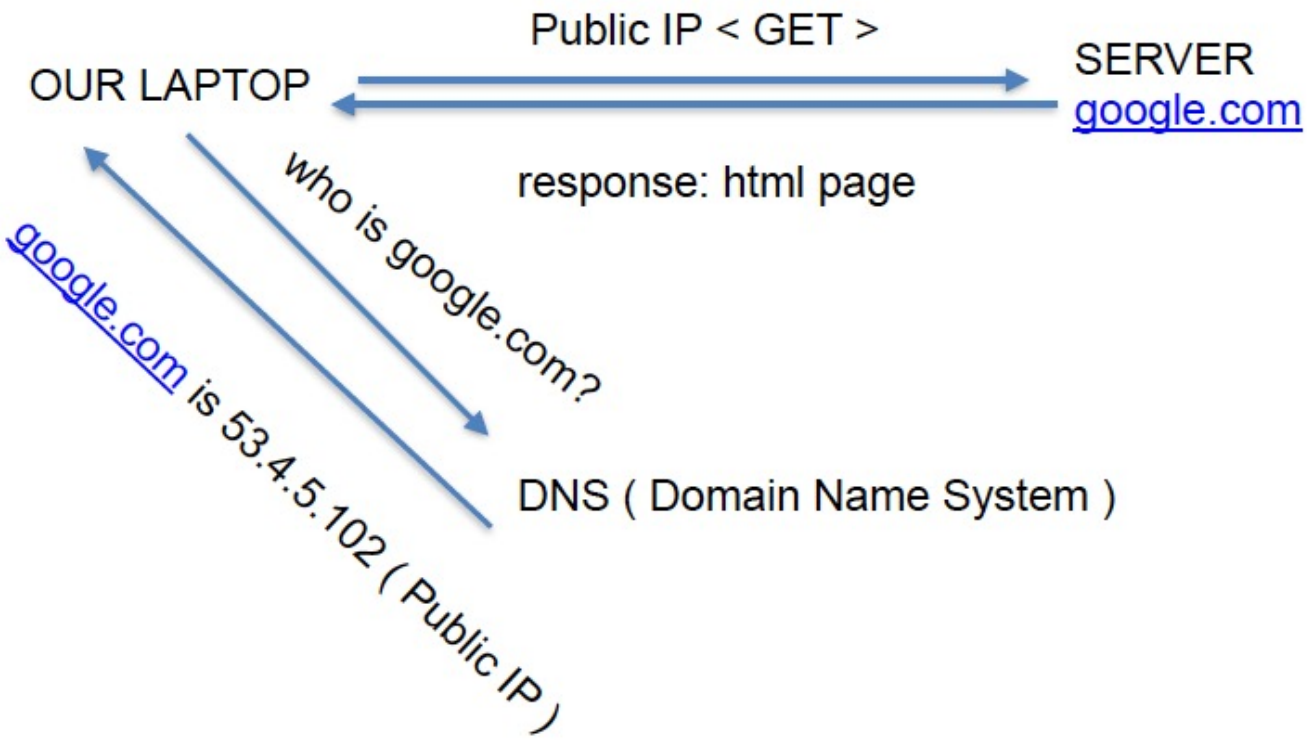
A brief explanation of Internet



Note: Google.com is a domain name and not an IP address

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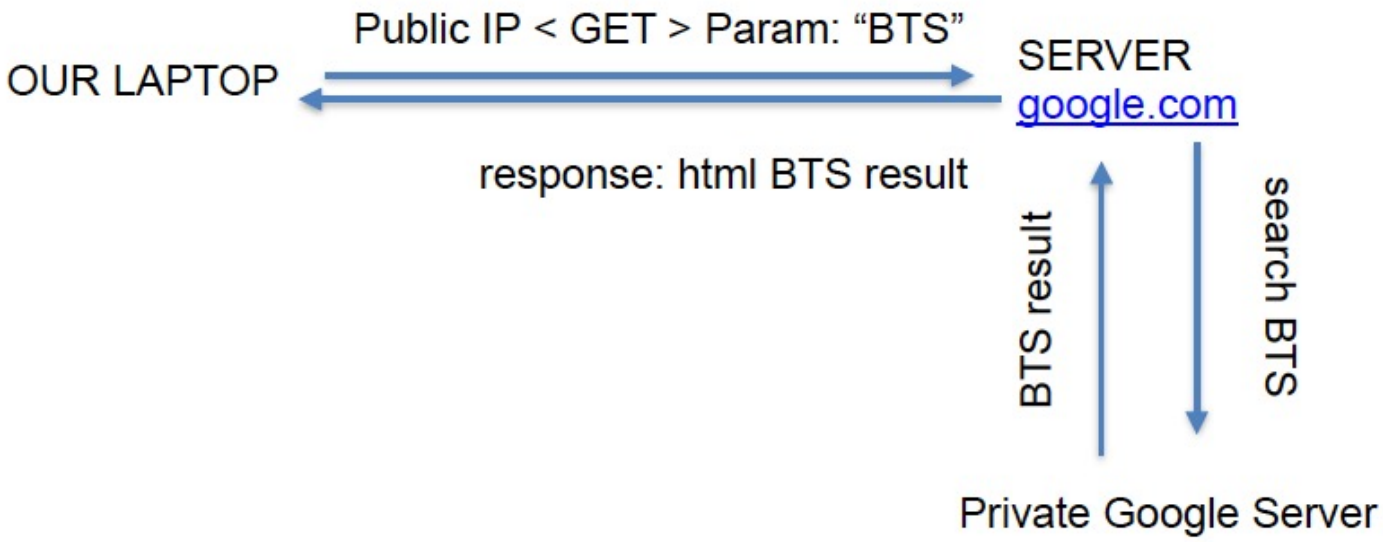
A brief explanation of Internet



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Private IP vs Public IP

A **public IP** address is the address that is assigned to a computing device to allow direct access over the Internet. A web server, email server and any server device directly accessible from the Internet are candidate for a public IP address. A public IP address is globally unique, and can only be assigned to a unique device.

A **private IP** address is the address space allocated by InterNIC to allow organizations to create their own private network. When a computer is assigned a private IP address, the local devices see this computer via it's private IP address. However, the devices residing outside of your local network cannot directly communicate via the private IP address, but uses your router's public IP address to communicate.

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Before we move on

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Cloud Computing

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Life before cloud computing

One big server with many virtual OS for different use cases

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Life before cloud computing

Rack of servers put together to serve your organization needs.

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Life before cloud computing

Do you feel there is some problem in this scenario??

- How you decide how big servers you need?
- If your business grows how you scale up?
- If your business do not grow as you expected how you scale down?
- You need IT skill set to maintain your servers.

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Business Drivers

- **Capacity Planning**
  - Lead Strategy - adding capacity to an IT resource in anticipation of demand
  - Lag Strategy - adding capacity when the IT resource reaches its full capacity
  - Match Strategy - adding IT resource capacity in small increments, as demand increases

- **Cost Reduction**

  Common forms of infrastructure-related operating overhead include the following:
  - technical personnel required to keep the environment operational
  - upgrades and patches that introduce additional testing and deployment cycles
  - utility bills and capital expense investments for power and cooling
  - security and access control measures that need to be maintained and enforced to protect infrastructure resources
  - administrative and accounts staff that may be required to keep track of licenses and support arrangements

- **Organizational Agility:** Organizational agility is the measure of an organization's responsiveness to change.

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Cloud Computing

The definition that received industry-wide acceptance was composed by the National Institute of Standards and Technology (NIST). NIST published its original definition back in 2009, followed by a revised version after further review and industry input that was published in September of 2011:

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models."

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Cloud Computing

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. 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**.

- AWS

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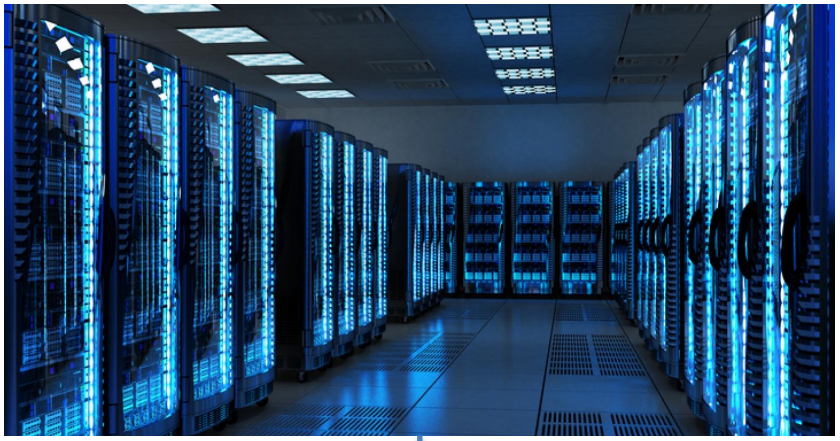
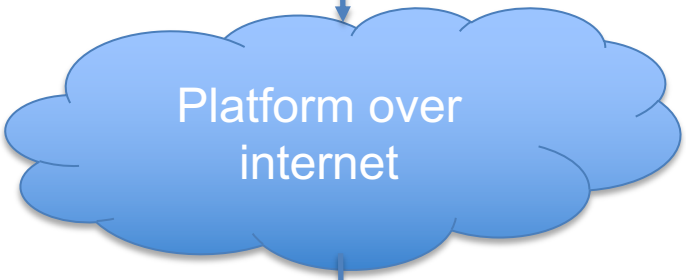
Cloud Computing





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Cloud Computing

Benefits:

- Trade capital expense for variable expense – Instead of having to invest heavily in data centers and servers before you know how you're going to use them, you can pay only when you consume computing resources, and pay only for how much you consume.
- Benefit from massive economies of scale – By using cloud computing, you can achieve a lower variable cost than you can get on your own. Because usage from hundreds of thousands of customers is aggregated in the cloud, providers such as AWS can achieve higher economies of scale, which translates into lower pay as-you-go prices.

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Cloud Computing

- **Stop guessing about capacity** – Eliminate guessing on your infrastructure capacity needs. When you make a capacity decision prior to deploying an application, you often end up either sitting on expensive idle resources or dealing with limited capacity. With cloud computing, these problems go away. You can access as much or as little capacity as you need, and scale up and down as required with only a few minutes' notice.
- **Increase speed and agility** – In a cloud computing environment, new IT resources are only a click away, which means that you reduce the time to make those resources available to your developers from weeks to just minutes. This results in a dramatic increase in agility for the organization, since the cost and time it takes to experiment and develop is significantly lower.

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Cloud Computing

- **Stop spending money running and maintaining data centers** – Focus on projects that differentiate your business, not the infrastructure. Cloud computing lets you focus on your own customers, rather than on the heavy lifting of racking, stacking, and powering servers.
- **Go global in minutes** – Easily deploy your application in multiple regions around the world with just a few clicks. This means you can provide lower latency and a better experience for your customers at minimal cost.

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Cloud Computing

Cloud computing promotes cloud based services

- SaaS - Software as a service
- PaaS – Platform as a service
- IaaS – Infrastructure as a service

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Infrastructure As A Service

- Infrastructure as a service (IaaS) is an instant computing infrastructure, provisioned and managed over the Internet. Quickly scale up and down with demand, and pay only for what you use.
- IaaS helps you avoid the expense and complexity of buying and managing your own physical servers and other datacenter infrastructure. Each resource is offered as a separate service component, and you only need to rent a particular one for as long as you need it.
  The cloud computing service provider manages the infrastructure, while you purchase, install, configure, and manage your own software—operating systems, middleware, and applications.

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Infrastructure As A Service

Typical things businesses do with IaaS include:

- **Test and development.**
- **Website hosting.**
- **Storage, backup, and recovery.**
- **High-performance computing.**
- **Big data analysis.**

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Platform As A Service

- Platform as a service (PaaS) is a complete development and deployment environment in the cloud, with resources that enable you to deliver everything from simple cloud-based apps to sophisticated, cloud-enabled enterprise applications. You purchase the resources you need from a cloud service provider on a pay-as-you-go basis and access them over a secure Internet connection.
- Like IaaS, PaaS includes infrastructure—servers, storage, and networking—but also middleware, development tools, business intelligence (BI) services, database management systems, and more. PaaS is designed to support the complete web application lifecycle: building, testing, deploying, managing, and updating.

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Platform As A Service

Organizations typically use PaaS for these scenarios:

- **Development framework.**
- **Analytics or business intelligence.** Tools provided as a service with PaaS allow organizations to analyze and mine their data, finding insights and patterns and predicting outcomes to improve forecasting, product design decisions, investment returns, and other business decisions.
- **Additional services.** PaaS providers may offer other services that enhance applications, such as workflow, directory, security, and scheduling.

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Advantages of PaaS

By delivering infrastructure as a service, PaaS offers the same advantages as IaaS. But its additional features—middleware, development tools, and other business tools—give you more advantages:

- **Cut coding time.**
- **Add development capabilities without adding staff.**
- **Develop for multiple platforms—including mobile—more easily.**
- **Use sophisticated tools affordably.**
- **Support geographically distributed development teams.**
- **Efficiently manage the application lifecycle.**

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Software As A Service

Software as a service (SaaS) allows users to connect to and use cloud-based apps over the Internet. Common examples are email, calendaring, and office tools (such as Microsoft Office 365).

SaaS provides a complete software solution that you purchase on a pay-as-you-go basis from a cloud service provider. You rent the use of an app for your organization, and your users connect to it over the Internet, usually with a web browser. All of the underlying infrastructure, middleware, app software, and app data are located in the service provider's data center. The service provider manages the hardware and software, and with the appropriate service agreement, will ensure the availability and the security of the app and your data as well. SaaS allows your organization to get quickly up and running with an app at minimal upfront cost.

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Advantages of SaaS

- Gain access to sophisticated applications.
- Pay only for what you use.
- Use free client software.
- Mobilize your workforce easily.
- Access app data from anywhere.

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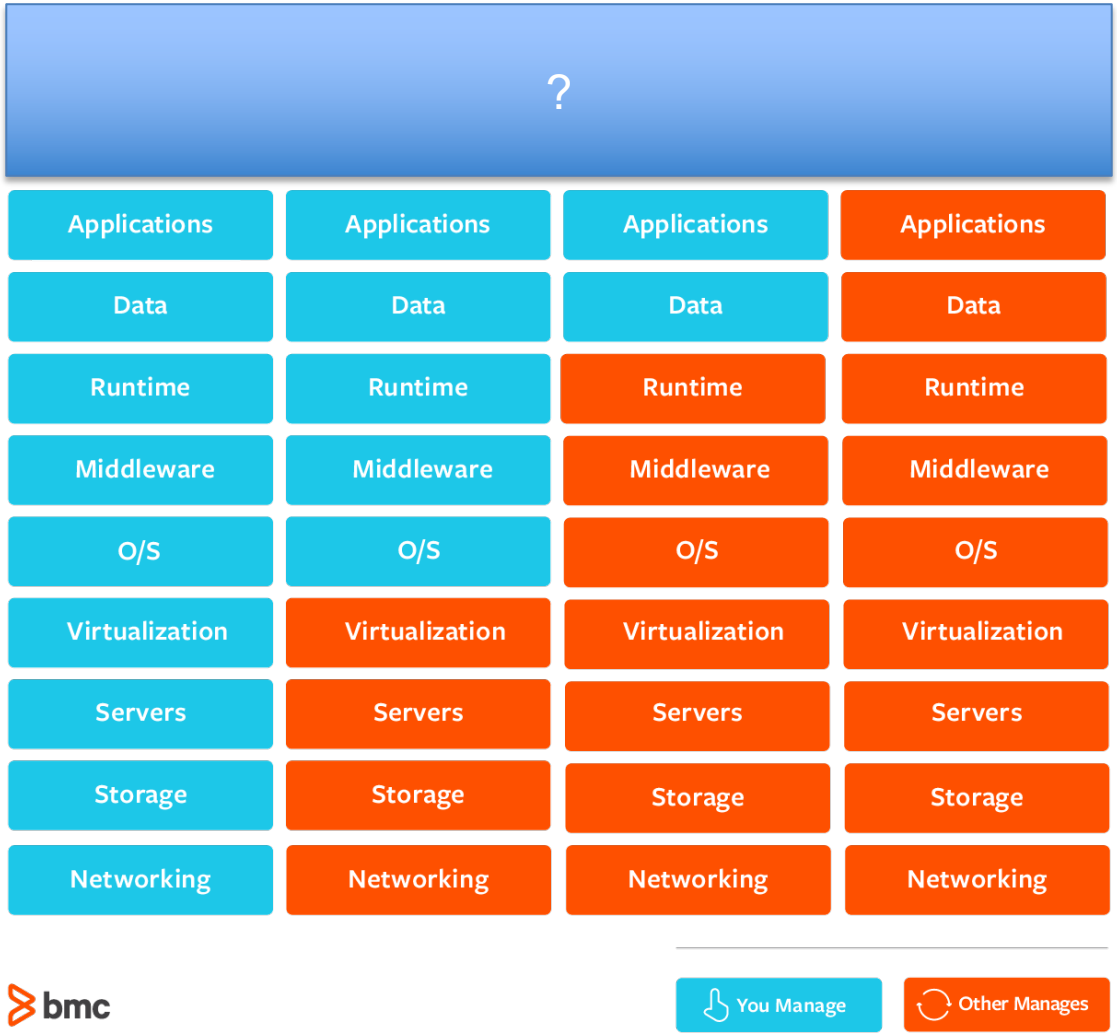
Cloud Computing



https://www.bmc.com/blogs/saas-vs-paas-vs-iaas-whats-the-difference-and-how-to-choose/

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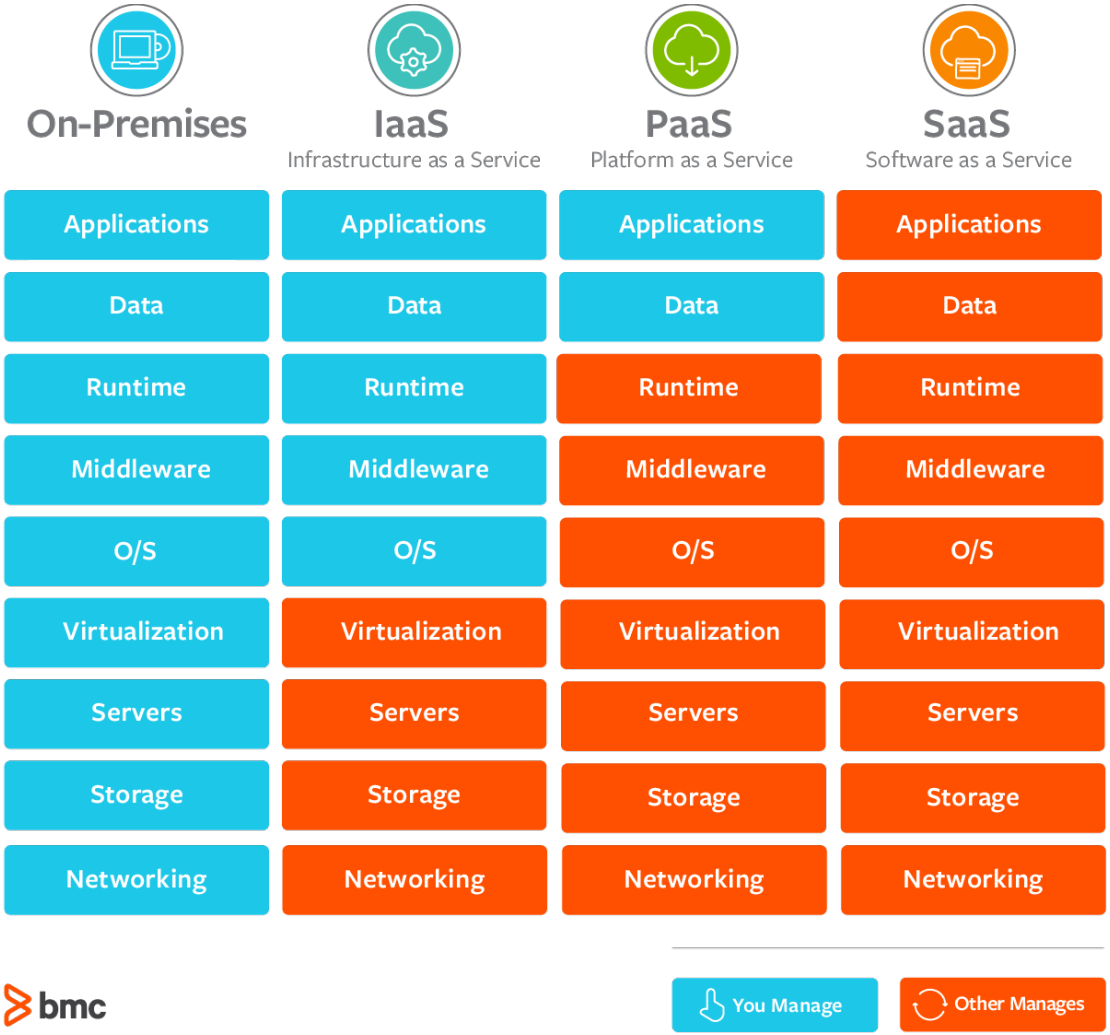
Cloud Computing



https://www.bmc.com/blogs/saas-vs-paas-vs-iaas-whats-the-difference-and-how-to-choose/

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Cloud Computing

Platform Type	Common Examples
SaaS	Google Apps, Dropbox, Salesforce, Cisco WebEx, Concur, GoToMeeting
PaaS	AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, OpenShift
IaaS	DigitalOcean, Linode, Rackspace, Amazon Web Services (AWS), Cisco Metapod, Microsoft Azure, Google Compute Engine (GCE)

https://www.bmc.com/blogs/saas-vs-paas-vs-iaas-whats-the-difference-and-how-to-choose/

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Infrastructure Deployment models

On-premises

The deployment of resources on-premises, using virtualization and resource management tools, is sometimes called the “private cloud.” On-premises deployment doesn’t provide many of the benefits of cloud computing but is sometimes sought for its ability to provide dedicated resources. In most cases this deployment model is the same as legacy IT infrastructure while using application management and virtualization technologies to try and increase resource utilization.

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Infrastructure Deployment models

Cloud

A cloud-based application is fully deployed in the cloud and all parts of the application run in the cloud. Applications in the cloud have either been created in the cloud or have been migrated from an existing infrastructure to take advantage of the benefits of cloud computing. Cloud-based applications can be built on low-level infrastructure pieces or can use higher level services that provide abstraction from the management, architecting, and scaling requirements of core infrastructure.

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Infrastructure Deployment models

Hybrid

A hybrid deployment is a way to connect infrastructure and applications between cloud-based resources and existing resources that are not located in the cloud. The most common method of hybrid deployment is between the cloud and existing on-premises infrastructure to extend, and grow, an organization's infrastructure into the cloud while connecting cloud resources to the internal system. For more information on how AWS can help you with your hybrid deployment, please visit our hybrid page.

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QUIZ

A hybrid deployment uses virtualization and resource management tools, and is sometimes called the “private cloud.”

- TRUE
- FALSE

ANS: FALSE

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Quiz

Which of the following is NOT a cloud service model?

- Platform as a Service(PaaS) Model
- Infrastructure as a Service(IaaS) Model
- Storage as a Service (SaaS) Model
- Software as a Service(SaaS) Model

ANS: Storage as a Service (SaaS) Model

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Quiz

Software as a Service (SaaS) is defined as:

1. a completed product that is run and managed by the service provider, and is often referred to as end-user applications.
2. the underlying infrastructure (usually hardware and operating systems) and allow you to focus on the deployment and management of your applications.
3. the basic building blocks for cloud IT providing access to networking features, computers, and data storage space.

ANS: 1

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Some pics for you

A Data Center located in Oregon

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Some pics for you

Data Center Racks

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Some pics for you

Data Center Networking

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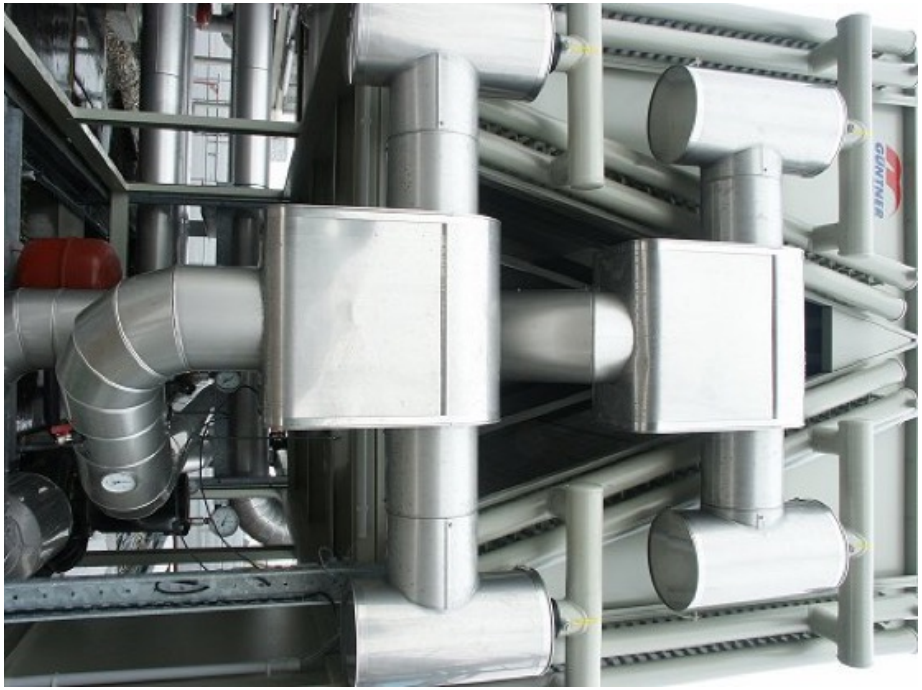
Some pics for you



Data Center Cooling

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Some pics for you

Data Center Emergency Power

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AWS

Amazon web services

- EC2
- S3
- Lambda functions
- RDS
- ELB
- SageMaker
- API gateway
- Cloud9
- Glue

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Some basic concepts

Amazon EC2 is hosted in multiple locations world-wide. These locations are composed of **Regions**, **Availability Zones**, and **Local Zones**.

Each *Region* is a separate geographic area. Each Region has multiple, isolated locations known as ***Availability Zones***. Local Zones provide you the ability to place resources, such as compute and storage, in multiple locations closer to your end users. Resources aren't replicated across Regions unless you specifically choose to do so.

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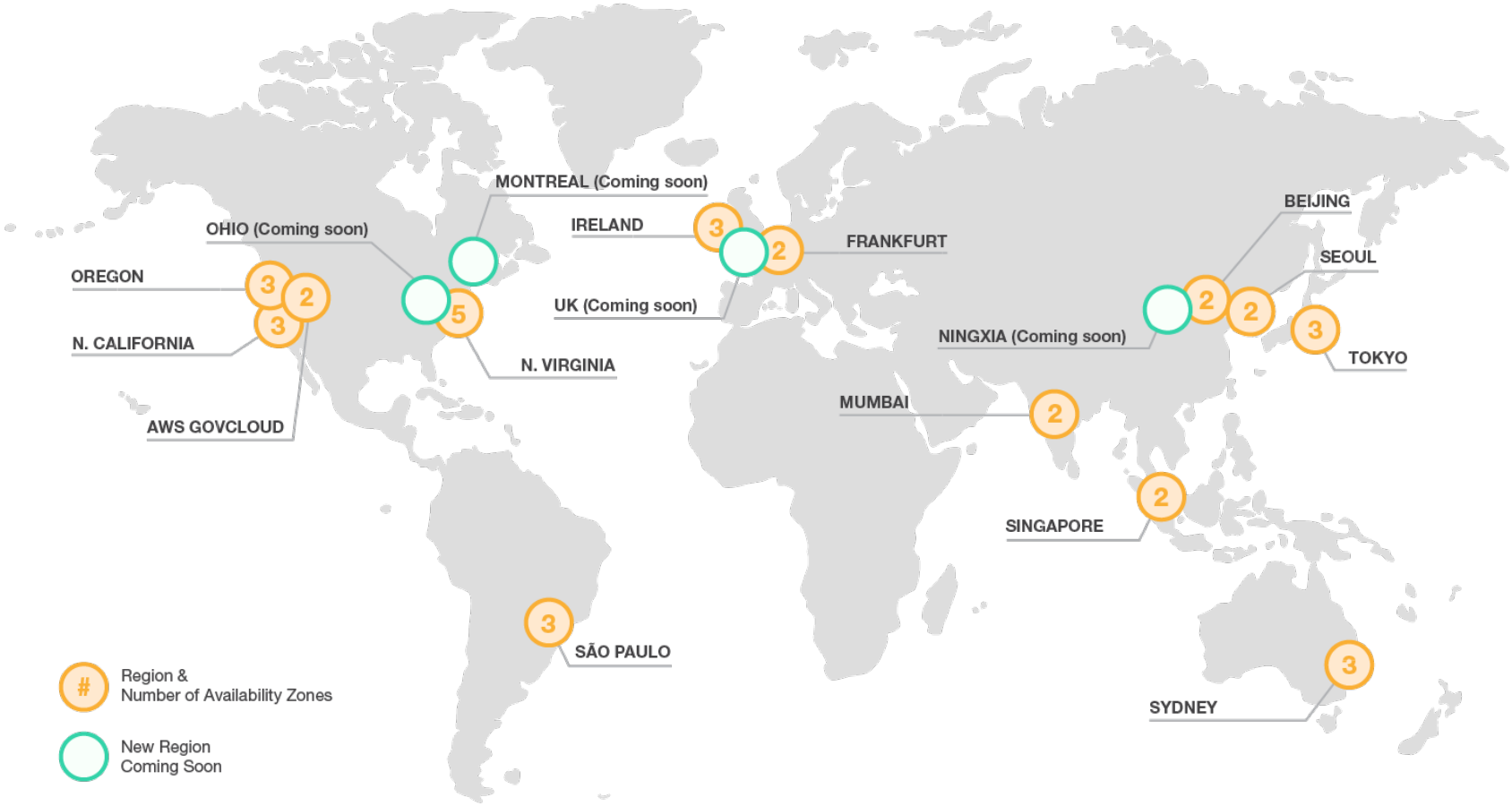
AWS regions



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AWS Regions

- Each Amazon EC2 Region is designed to be isolated from the other Amazon EC2 Regions. This achieves the greatest possible fault tolerance and stability.
- When you view your resources, you see only the resources that are tied to the Region that you specified. This is because Regions are isolated from each other, and AWS don't automatically replicate resources across Regions.

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AWS Availability Zones

When you launch an instance, you can select an Availability Zone or let us choose one for you. If you distribute your instances across multiple Availability Zones and one instance fails, you can design your application so that an instance in another Availability Zone can handle requests.

An Availability Zone is represented by a Region code followed by a letter identifier; for example, us-east-1a.

To ensure that resources are distributed across the Availability Zones for a Region, AWS independently map Availability Zones to names for each AWS account. For example, the Availability Zone us-east-1a for your AWS account might not be the same location as us-east-1a for another AWS account.

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Class Assisgnment

- Create account to AWS Educate.

- Login to AWS Educate
- Open Course **Introduction to Cloud 101 (Labs)**
- Work on Lab 1 - Introduction to Amazon S3 (follow the instruction given)

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Before next class

Please install docker in your laptops you can follow following links.

- https://docs.docker.com/docker-for-mac/install/
- https://docs.docker.com/install/linux/docker-ce/ubuntu/#install-using-the-repository
- https://docs.docker.com/desktop/windows/install/

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References

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  - https://docs.aws.amazon.com/aws-technical-content/latest/aws-overview/what-is-cloud-computing.html
  - https://docs.aws.amazon.com/aws-technical-content/latest/aws-overview/introduction.html
  - https://commons.wikimedia.org/wiki/File:Cloud_computing_layers.png
  - https://docs.aws.amazon.com/aws-technical-content/latest/aws-overview/six-advantages-of-cloud-computing.html
  - https://docs.aws.amazon.com/aws-technical-content/latest/aws-overview/types-of-cloud-computing.html
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  - https://youtu.be/97Wi7V1wLYA
  - https://www.youtube.com/watch?v=WbHw14hF7IU&feature=youtu.be

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Thank you!