Cloud Introduction

Cloud Concepts, IaaS, PaaS, CaaS, SaaS,
Public Cloud Platforms

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#Dev-Ops

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What is Cloud Computing?

On-demand Delivery of IT Resources over The Internet with Pay-as-you-go Pricing
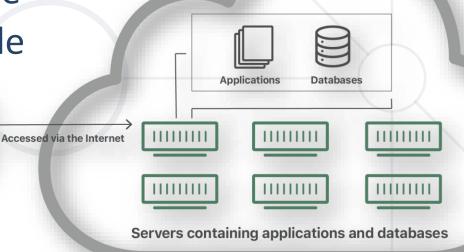
What is Cloud?

- **Cloud** == **virtual space** (software and services) that runs on the **Internet**, instead of locally on your computer

- **Clouds** combine computing power and resources of multiple hardware machines

  - Share cloud resources more efficiently between multiple users and apps

  - Save costs

  - Better service

Applications   Databases

Accessed via the Internet

User device

Servers containing applications and databases

The Cloud

What is Cloud Computing?

- **Cloud computing** == the delivery of IT resources over the Internet
  - Instead of buying, owning, and maintaining physical data centers and servers, you can **access technology from a cloud**
  - Includes servers, storage, databases, software, networking, analytics, and intelligence
- **Cloud computing environment**
  - Suppose we have 20-30 powerful machines
  - We can run 100-200 virtual machines (VMs)
  - We can deploy hundreds of applications
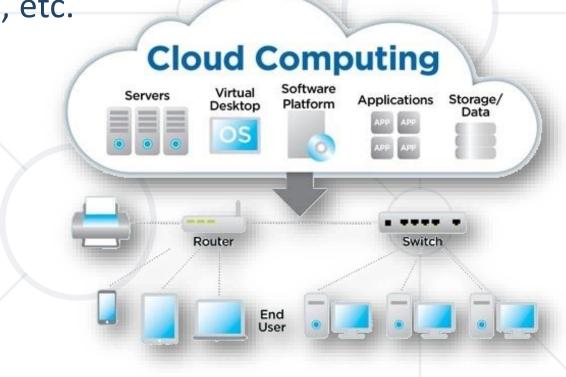 - We can serve millions of users

How the Cloud Works?

- In the **cloud** everyone consumes a portion of the **shared computing resources**

  - CPU, memory, storage, IO, networking, etc.

- If your business is small, you consume less cloud resources

  - If your business is growing, you consume more resources

- **Pay-as-you-go**

  - Start for free, pay when you grow and need more resources

Cloud Computing – Example

- Suppose we have a **mail server software**

  - It needs **computing resources** (CPU, disk operations, networking, etc.) only when sending or receiving emails

  - It the rest of the time it does nothing (**waits**)

- The mail server on **dedicated machine** will use less than 1% of its power and resources

  - You can run 100 mail servers in the **cloud** on the same hardware

  - Less hardware, reduced costs, increased quality

Cloud Benefits

- Cloud provides **computing resources on demand**

  - Rent a hosting + CPU power + RAM + storage + IO operations + networking + other services (e.g. databases, CDN, analytics, …)

  - Pay-as-you-go

- Cloud has better **support** and **reliability**

  - Your data lives in a **professional data center**

  - Has 24 x 7 **monitoring** + **backup** + **support**

  - **Reduces costs**: rent a piece of a data center instead of building your own IT infrastructure / data center

Virtualization vs Cloud

- **Virtualization** is a technology that transforms physical hardware into virtual resources

- Easy server maintenance

- Effective server utilization

- Separated physical infrastructure

- Infrastructure cost savings

- The **cloud** is an environment that delivers virtualized resources through the Internet

- Scalability

- Automated management

- Self-serving

- Pay-as-you-go

- **Cloud computing** uses **virtualization technology** to deliver services for user access to virtualized servers, apps, etc.

Types of Clouds

- **Public** cloud
  - IT infrastructure, service or platform **publicly accessible from the Internet** (free or paid)
  - Amazon AWS, Windows Azure
- **Private** cloud
  - Cloud infrastructure (hardware + software) for **internal use only**
  - **Two types**
    - Managed == deployed, configured and managed by third-party
    - Dedicated == cloud within another cloud
  - Banking / Government

Types of Clouds

- **Hybrid cloud**

    - Mix of private and public cloud infrastructure and services

    - At least 1 private cloud + at least 1 public cloud

    - Two or more private or public clouds

- **Multicloud**

    - Cloud approach made up of more than 1 cloud service from more than 1 cloud vendor

    - All hybrid clouds are multiclouds, but not all multiclouds are hybrid clouds

    - They become hybrid when multiple clouds are connected by orchestration
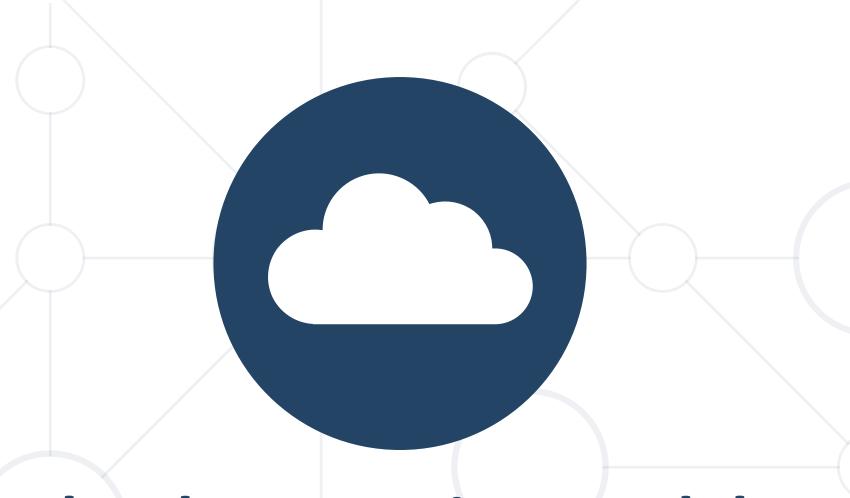
What is Cloud Development?

- **Cloud software development**

  - Design and develop an **app for the cloud**

    - e.g., for **public PaaS or CaaS platforms**

- Steps in cloud software development

  - Choose a **development stack** of technologies

  - Choose a **public cloud platform** + **services**

  - Design the app for to run in **containers** or in a **cloud**

  - Develop the app using **containers** / **microservices** / **cloud APIs**

  - Deploy, run and monitor the application in the **cloud**

What is a Cloud-First Strategy?

- **Cloud-first strategy** == adoption of **cloud technologies** for all new apps, platforms and infrastructure

  - Opting for **cloud-based solutions** before considering on-premises

  - Puts the cloud at the center

- May also include moving all or most of your **current infrastructure** onto a **cloud-computing platform**

Cloud Computing Models

IaaS, PaaS, SaaS, CaaS, BaaS

Infrastructure as a Service (IaaS)

- **Infrastructure as a Service** (**IaaS**)
  - VMs in the cloud on demand
  - Users install the OS and software they need
- Usage Scenarios
  - Web Hosting
  - Virtual Data Centers
- Examples
  - Amazon Web Services, Google Cloud, Microsoft Azure, Digital Ocean

Platform as a Service (PaaS)

- **Platform as a Service** (**PaaS**)
  - Platform, environment and services and APIs for developers
    - Develop, run and manage applications
    - Includes dev tools, DBs, operating systems, networking, storage, etc.
- Usage Scenarios
  - Web application hosting
  - Database and/or business process management
  - Development frameworks and middleware
- Examples
  - Google App Engine, Heroku, MS Azure, AWS

Typical PaaS Platform

Front-End: HTML5, JavaScript / Mobile Front-Ends

Middle-Tier Languages and Frameworks:
PHP, Java, C#, Python, Ruby, JavaScript, Symfony, Laravel, Zend Framework, JSF, ADF, Sprint MVC, Django, Rails, Sinatra, Play, ASP.NET, ASP.NET MVC, Node.js, Express, ...

Computing Nodes (VMs):
Amazon EC2, Azure Compute, App Engine Backends, ...
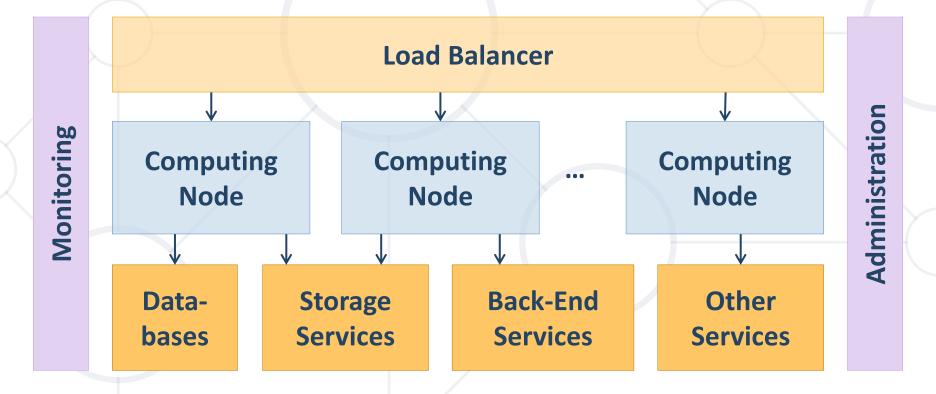
Back-End Technologies:
Relational DBs, NoSQL DBs, Blob Storage, Message Queues, Notifications, CDN, Search, Email, ...

Operating Systems: Linux / Windows / other

Typical PaaS Architecture

- The **typical cloud architecture** is multi-tier, SOA, highly-scalable and highly-available

- Each **tier** hosts different managed services and technologies

Software as a Service (SaaS)

- **Software as a Service** (**SaaS**)
  - Hosted application on demand
    - Typically accessed by a web browser, eliminating the need for installation
- Usage Scenarios
  - CRM systems
  - Accounting software
  - Project management tools
- Examples
  - GMail, Jira, Office 365, Wix, Dropbox, DocuSign, HubSpot

Containers as a Service (CaaS)

- **Containers as a Service** (**SaaS**)
  - Container engines, orchestration and the compute resources are delivered to users as a service from a cloud provider
- Usage Scenarios
  - CI/CD Pipelines
  - Microservices architecture
- Examples
  - Docker Datacenter, Azure Kubernetes, Amazon Elastic Kubernetes Service

Kubernetes as a Service (KaaS)

- **Kubernetes as a Service** (**KaaS**)
  - Managed Kubernetes cluster to deploy your containerized apps
- Usage Scenarios
  - CI/CD Pipelines
  - Microservices deployment
- Examples
  - Google Kubernetes Engine, Azure Kubernetes, Amazon Elastic Kubernetes Service

Database as a Service (DBaaS)

- **Database as a Service** (**DBaaS**)
  - Managed database service in the cloud
  - No need for setting up and maintaining physical hardware
- Usage Scenarios
  - E-commerce platforms storing product and user data
  - Data backup and archiving solutions
  - Analytics and reporting platforms processing large data sets
- Examples
  - Azure SQL Database, Amazon RDS, Amazon DynamoDB, Google Cloud SQL, Firebase

Function as a Service (FaaS)

- **Function as a Service** (**FaaS**)
  - Hosting of serverless apps in the cloud
  - Enable execution of individual functions or pieces of code in stateless compute containers that are event-triggered
- Usage Scenarios
  - Web APIs
  - Serverless applications
  - Automation and integrations
- Examples
  - Azure Functions, AWS Lambda, Google Cloud Functions

Backend As a Service (BaaS)

- **Backend as a Service** (**BaaS**)

  - Ready-to-use backend stack that can be integrated with applications

- Usage Scenarios

  - Mobile applications

  - Web applications

  - Rapid prototyping

- Examples

  - Firebase, AWS Amplify, Kinvey, Parse

IaaS vs CaaS vs PaaS vs BaaS vs SaaS

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IaaS	CaaS	PaaS	BaaS	SaaS
Applications	Applications	Applications	Applications	**Applications**
Data	Data	Data	**Data**	**Data**
Runtime	Runtime	**Runtime**	**Runtime**	**Runtime**
Containers	**Containers**	**Containers**	**Containers**	**Containers**
O/S	**O/S**	**O/S**	**O/S**	**O/S**
Virtualization	**Virtualization**	**Virtualization**	**Virtualization**	**Virtualization**
Servers	**Servers**	**Servers**	**Servers**	**Servers**
Storage	**Storage**	**Storage**	**Storage**	**Storage**
Networking	**Networking**	**Networking**	**Networking**	**Networking**

CUSTOM

AS SERVICE

Cloud Service Providers

Amazon Web Services, Azure, Google Cloud, etc.

- Amazon Web Services (AWS)
  - The pioneer of the public clouds
  - Provides cloud platform and services from 2002
  - Provides IaaS and PaaS on demand
- Microsoft Azure
  - Management and development of applications and servers
  - On focus during the course

Top Cloud Service Providers for 2023

- Google Cloud Platform (GCP)
  - Suite of cloud services by Google
  - Google App Engine (GAE) – PaaS public cloud for Java, Python, JavaScript, C#, PHP, Go, Ruby
- Alibaba Cloud
- Oracle Cloud
- IBM Cloud (Kyndryl)
- Tencent Cloud

Microsoft Azure

Microsoft's Public Cloud Platform

Microsoft Azure

- Fast-growing **public cloud** from Microsoft

- Provides **rich PaaS platform**

  - Mainly for .NET developers

  - Provides also Java, PHP, Python, and Node.js APIs
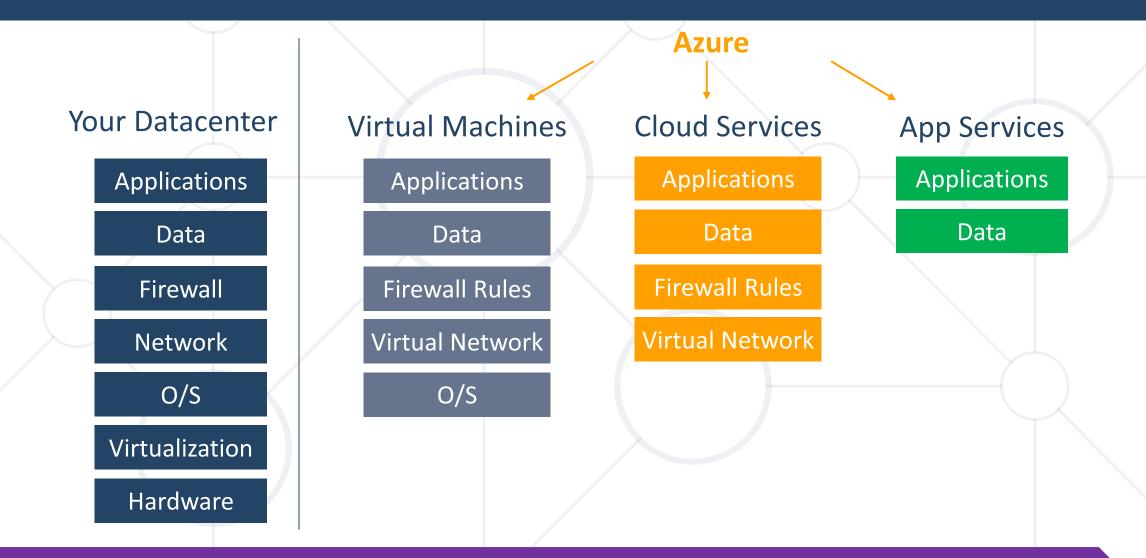
  - Databases, storage, mobile back-ends, CDN, …

- Provides **IaaS cloud** (Windows and Linux VMs)

Azure – Focus on the Application

Azure

Your Datacenter

- Applications
- Data
- Firewall
- Network
- O/S
- Virtualization
- Hardware

Virtual Machines

- Applications
- Data
- Firewall Rules
- Virtual Network
- O/S

Cloud Services

- Applications
- Data
- Firewall Rules
- Virtual Network

App Services

- Applications
- Data

Focus on the Application

Azure Services – Examples
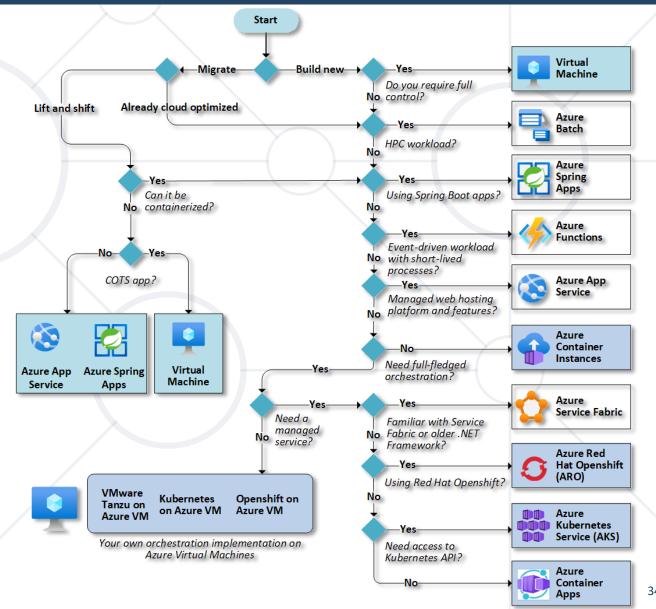
- **Azure DevOps**
  - DevOps toolchain for app development and deploy
- **Azure Virtual Machines**
  - VMs in cloud
- **Azure Backup**
  - Allows secure and cost-effective data backup and recovery
- **Azure Active Directory**
  - Cloud-based identity and access management
- **Azure Logic Apps**
  - Helps in creating automated workflows

Choosing an Azure Compute Service

- **Compute** refers to the **hosting model** for the resources that your app runs on

- You can read more about comparing Azure container options [here](#)

Azure File Share

- **Azure File Share** is a fully managed, cloud-based **file storage service** for files, documents and data

- You can use Azure File Share as **Docker volumes** for **Azure Container Instances containers**

- Azure File Share needs an **Azure storage account** that provides a centralized location to store and access data
  - Such as blobs, files, queues, tables, and disks
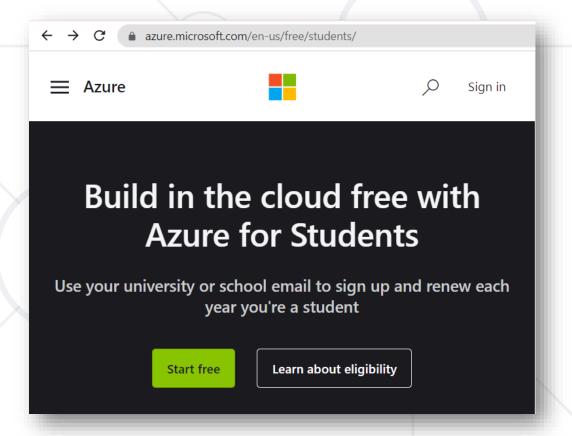
Azure for Students

Free Azure Access for University / School Students

Azure for Students

- **Azure for Students** provides free Azure access for students
  - Use your **university email** to sign up for free
  - Use the provided instruction on how to activate your free account

Azure Portal

Single Portal to Access and Manage All Your Apps

Azure Portal

- **Azure Portal** is a web-based, unified console
  - It provides an alternative to command-line tools

- With the Azure Portal, you can access **Azure resources** and manage your **Azure subscription** with a **GUI**

- You can **build**, **manage**, and **monitor** everything from simple web apps to complex cloud deployments

Azure Dashboard

- **Azure dashboard** is a customizable **view of the resources** in your subscription

- You can

  - Create **custom dashboards** for an organized view of resources

  - Configure **accessibility options** for an optimal experience

  - Customize the **user interface** so that you are more productive

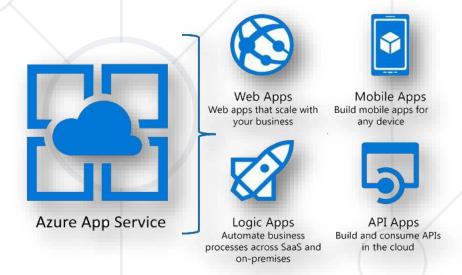- Learn how to customize your dashboard by following [this tutorial](#)
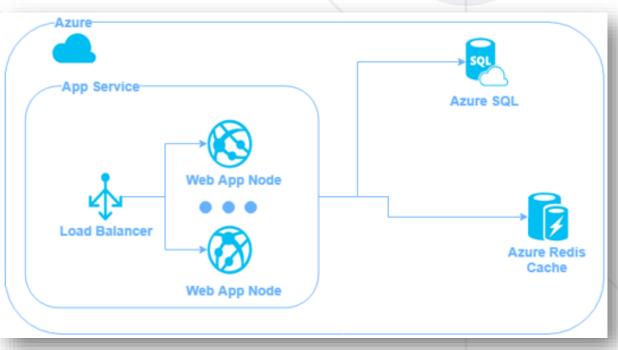
Azure App Service

Cloud-based Platform for Hosting Web Apps

What is Azure App Service?

- **Azure App Service** (or **Web Apps**) is a Platform-as-a-Service
- Cloud computing based platform for **hosting websites**
- Allows publishing web apps written in different platforms
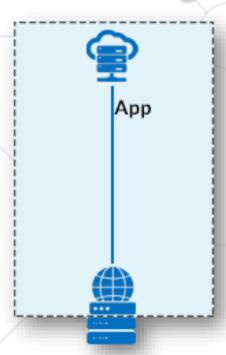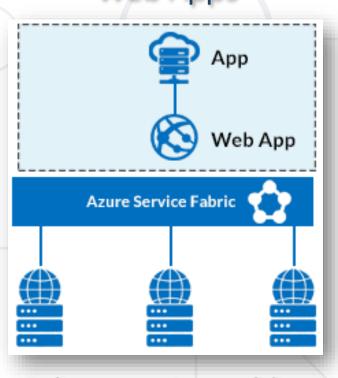 - .NET, Python, PHP, Java, Node.js, etc.

Web Apps
Web apps that scale with your business

Mobile Apps
Build mobile apps for any device

Azure App Service

Logic Apps
Automate business processes across SaaS and on-premises

API Apps
Build and consume APIs in the cloud

Azure

App Service

Load Balancer

Web App Node

Web App Node

Azure SQL

Azure Redis Cache

Azure Web Apps Benefits

- Easily create, **manage** and **scale** Web apps

- Automatic **load balancing** and **shared storage** across instances

- Use ASP.NET, PHP, Node.js, etc.

- Supports any **Web development tool** on any **platform**
  - Windows, OSX, Linux

- **Azure SQL** or **MySQL databases**

- Hosted on **virtual machines**

Traditional Webhosting

Hosting with Web Apps

App

App

Web App
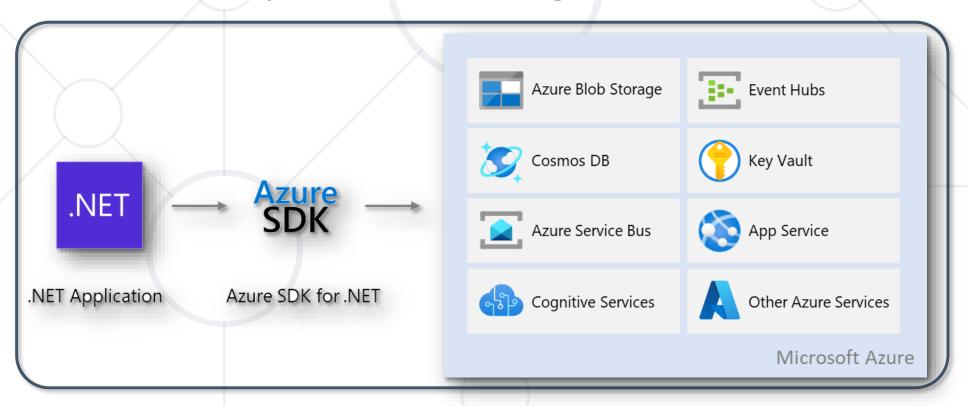
Azure Service Fabric

Server + OS + Web Server (IIS)

Server + Azure OS + Web Server (IIS)

Azure SDK

- The **Azure SDKs** are **collections of libraries** built to make it easier to use Azure services from your language of choice

- Azure SDK components are integrated into **Visual Studio**

Summary

- **Cloud computing** == the on-demand delivery of IT resources over the Internet with pay-as-you-go pricing

- Cloud **benefits**: cost savings, security, flexibility, scalability, etc.

- **Types of cloud**: public, private, hybrid, multicloud

- Types of **cloud computing models**: IaaS, CaaS, PaaS, BaaS, SaaS, KaaS, DBaaS, FaaS

- **Cloud service providers** include AWS, Azure, Google Cloud, etc.

- **Azure** is a public cloud computing platform with services for analytics, databases, migration, networking, storage, etc.

- You can easily manage apps in **Azure Portal**, deploy apps with **Azure App Service**, deploy a containerized apps with **ACI** and many more

Questions?

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