Benefits of Cloud Computing

- **Benefits**
  - Cost savings (real and accounting)
    - Economies of scale
    - TCO (Electricity, cooling, maintenance)
    - Use the pricing calculator
  - Agility
    - Ability to scale up/down
    - No need to overprovision
    - Disaster recovery
      - Duplicate copy in another region
      - Able to recover from failure
    - Capital expenditure (CapEx)
      - Its (upfront) money invested in assets ... Buildings, computers, ...
      - Reduces over time
    - Operational expenditure (OpEx)
      - Predictable expense for tax optimization
      - Cloud services fall under this category
      - Consumption based model
      - Money spent every day on operation expenses ... Electricity, cooling, ...
  - Availability
    - See SLA
  - Security
  - Innovation
  - Global reach
    - Servers all over the world
      - Faster apps (lower latency)
  - Range of ready on-demand services
  - Range of tools
  - Scaleability
    - The ability to add capacity
      - Vertically: Increase computer capacity (RAM, CPU,...) of a VM
      - Horizontally: Adding more VM's
  - Elasticity
    - The ability to automatically grow/shrink (= autoscaling)
- **Categories**
  - "Something"-as-a-service
    - You don't own it
    - Someone else owns it and you benefit from it
    - Not in control how it is delivered
    - Pas as you go; no upfront costs
    - ? IaaS can be seen as the basic layer in cloud computing
    - Infrastructure-as-a-Service (IaaS)
      - Most flexible
      - The closest to managing physical services
      - VM (where you can do what you want with hardware)
      - ! Completely dumb unless you control it
      - 3 categories
        - Compute
        - Storage
        - Networking
    - ? The platform that can be accessed through the internet provides developers with a framework and tools to build apps and software that are tailored to the organization's individual needs.
    - Platform-as-a-Service (PaaS)
      - More agile than IaaS (no need to configure servers)
      - No choise of hardware
        - Choise in tiers
      - ! It's a platform that you need to build upon to be useful
      - ! eg: App Services, Azure SQL Database, CosmosDB, Azure functions
    - ? These entire cloud application services are the most common form of cloud computing. They are ready-to-use and often run directly through the client's web browser
    - Software-as-a-Service (SaaS)
      - Anything where you use a web browser to access a service
      - Not running the software on your own machine
      - Software running in the cloud
      - ! It stands alone as a useful product
      - ! Does not require something else to be useful
      - eg: Outlook 365, DevOps
  - Serverless
    - There are still servers
    - Servers are added as needed (not your responsibility)
    - Autoscaling
- **Types**
  - Public cloud
    - You don't own the hardware
    - Easy to scale
    - Only pay for what you use
    - Can be on premise
  - Private cloud
    - It's your hardware
      - You are responsible.
    - Resources only for one company or organisation
  - Hybrid cloud
    - Combination of private & public cloud
- **Core Azure Archtictural Components**
  - Regions
    - ? A region is a geographical area on the planet
    - Broken up the world into 60+ regions
    - Not every region available to everyone
      - Because of (local) restrictions
    - All regions are paired
      - ? Each Azure region is always paired with another region within the same geography (such as US, EU, or Asia) at least 300 miles away.
        - High speed
        - Reduces the likelihood of interruption
      - ? Multiple regions go down, one region of each pair is treated as a priority
      - Have "availability zones"
        - ? Physically separate locations that are tolerant to local failures.
        - Availability zones with a Region
          - Running on it own electricity, cooling, network
          - Physically separated
  - Management Groups
    - A hierarchy of subscriptions
    - Can group other management groups
    - Can be nested
    - Easy to set rules/governance
  - Subscriptions
    - A billing unit
    - All resources get charged under that subscription
    - Users can have access to multiple subscriptions
    - ! Three types
      - Free trial
        - 12 months popular free services.
        - A credit (200 USD) to explore services for 30 days.
        - Using up the free credits causes all your resources to be stopped until you decide to get a paid account.
      - Pay-as-you-go
        - Pay for what you use by attaching a credit or debit card to your account.
      - Member offers
        - Certain Microsoft products and services might provide you with credits for your Azure account and reduced rates on Azure service
  - Resource Groups
    - ? A resource group is a logical container for resources deployed on Azure
      - Helps to manage and organize your Azure resources.
    - ? Resource groups are also a scope for applying Role-Based Access Control (RBAC) permissions
      - Like a folder structure for resources.
  - Resources
    - An instance of an Azure Service
      - Eg. VM, AD, Storage, ChatBots
    - ? Resources go into Resource Groups.
    - Resources go into Resource Groups
      - Resource Groups go into Subscriptions
      - Subscriptions go into Management Groups.
- **Core resources**
  - Compute
    - Azure compute is an on-demand computing service for running cloud-based applications.
    - ? A category of services in Azure that provides CPU cycles for rent
    - ? Executing code in the cloud
    - Virtual Machines
      - Full control
      - Windows/Linux
      - A 'slice' of a physical machine
      - Cloud-scale job computing parallel and High-Performance Computing (HPC) batch jobs with the ability to scale to tens, hundreds, or thousands of VMs.
        - Starts a pool of VM's
        - Autoscaling
        - Load balancing
      - ? Virtual machine scale sets let you create and manage a group of identical, load-balanced VMs
      - View a Resource Health blade
      - Running code in the cloud
    - App Services
      - Promise of performance but no access to hardware
    - Azure Container Instances
      - ACI
      - Single instance
      - Deploy a Docker image
    - Azure Kubernetes Services
      - AKS
      - Run apps on a cluster of servers.
      - ? A desktop and application virtualization service
    - Windows Virtual Desktop
      - Desktop version of windows that runs in the cloud
  - Networking
    - Azure virtual networks enable Azure resources to communicate with each other, with users on the internet, and with your on-premises client computers.
      - Isolation & segmentation.
      - Internet communication.
      - Communication between AZ resources & on-premise resources
      - Route & filter network traffic
      - Connect virtual networks.
    - Connectivity
      - Virtual Network
        - Emulating a physical network
      - Virtual Private Network (VPN)
        - Connecting two networks as if they were on the same network
        - Policy-based
        - Route-based
      - Virtual Network Peering
        - Allows you to connect two or more virtual networks in Azure.
      - ExpressRoute lets you extend your on-premises networks into the Microsoft cloud over a private connection with the help of a connectivity provider.
        - High-speed private connection to Azure cloud services
        - Redundant connectivity
        - Consistent network throughput
        - ⚠ Not encrypted
    - Protection
      - See Security.
    - Delivery
      - Load Balancer, distribute traffic evenly between multiple backend servers.
      - Application Gateway, a higher-level of load balancer with an optional firewall
        - Can make load balancing decisions based on the URL path.
        - Contains a Web Application Firewall (WAF).
      - Content Delivery Network (CDN)
        - Any static file that doesn't change
      - Front Door Service, combines the above 3.
    - Monitoring
      - Network Watcher
      - Experienced Monitor.
      - Azure Monitor.
  - Storages
    - Disk Storage provides disks for Azure virtual machines. Applications and other services can access and use these disks as needed, similar to how they would in on-premises scenarios.
    - Disk
      - Manages disks (use it or not, you pay).
      - Reserve capacity in advance.
    - Container (blob)
      - ? Azure Blob Storage is an object storage solution for the cloud
        - It can store massive amounts of data, such as text or binary data. Azure Blob Storage is unstructured.
      - ! Best option for storing disaster recovery files and archives
      - ! You pay per gigabyte.
      - General Purpose V2 (gpv2) is the most common.
        - Blobs
        - Tables
        - Queues
        - Files
      - Access tiers
        - Hot
          - Optimized for storing data that is accessed frequently.
        - Cool
          - Optimized for data that is infrequently accessed and stored for at least 30 days.
        - Archive
          - Appropriate for data that is rarely accessed and stored for at least 180 days.
      - Many options
        - Performance tiers
          - Standard
          - Premium
            - Faster but costs more.
        - Redundancy & replication.
        - Failover options.
    - Files
      - Azure Files offers fully managed file shares in the cloud that are accessible via the industry standard Server Message Block and Network File System.
      - Use a URL that points to file.
    - Data Lake Storage
      - For huge data (petabytes).
  - Database
    - Cosmos Db
      - ? Globally distributed, multi-model database service
      - NoSql storage.
      - Fast
      - Good for small data.
      - Easy to replicate.
    - Azure SQL database
      - ? Relational database based on the latest stable version of the Microsoft SQL Server database engine.
      - Easy to replicate and scale.
    - Azure SQL manages Instance
      - ! Provides several extra options that might not be available to Azure SQL Database
      - Most compatible with existing SQL server
    - Azure database for MySql
      - Open-source database
    - Azure database for PostGreSql
      - ? Relational database service in the cloud. Based on the community version of the open-source PostgreSQL database engine.
      - Better support for clusters
  - Marketplace
    - A place where MS and partners can place 'images'
- **Core Azure Solutions**
  - Internet of Things (IoT)
    - IoT enables devices to gather and relay information for data analysis. These devices can connect to the internet and send their sensor readings to a specific endpoint in Azure via a message
      - Environmental sensors that capture temperature and humidity levels.
      - Light, color, and infrared sensors.
      - Motion and touch sensors.
    - Iot Hub
      - Acts as a central message hub for bi-directional communication between an IoT application and the devices it manages.
      - Allow businesses to communicate with high speed and low latency.
      - Can handle million of devices.
    - IoT Central
      - Builds on top of IoT Hub by adding a dashboard that allows you to connect, monitor, and manage your IoT devices.
      - Collects data via sensors only (read-only).
    - Azure Sphere
      - Piece of hardware
        - For scenarios where security is critical
      - Cloud-based security service.
  - Big data
    - HDInsight
      - Makes it easier, faster, and more cost-effective to process massive amounts of data.
    - Data Lake Storage
      - Write queries to transform your data and extract valuable insights.
    - Databricks
      - Unlock insights from all your data and build artificial intelligence (AI) solutions
      - Real time reporting.
      - Derive insights in big data.
    - Azure Synapse Analytics
      - Brings together enterprise data warehousing and big data analytics
      - Designed to pull in big quantities of data.
      - Good for reporting
      - Data can come from multiple sources
  - AI
    - Machine learning
      - It's a platform for making predictions
    - Cognitive services
      - Prebuilt machine learning models that enable applications to see, hear, speak, understand, and even begin to reason.
        - Language
        - Speech
        - Vision
        - Decision
    - Bot service
      - ? For creating virtual agents that understand and reply to questions just like a human.
        - Chatbot
  - Serverless
    - Azure functions
      - ? Execute code in the cloud but doesn't require managing underlying server or have any control over its performance
        - ! Functions can execute code in almost any modern language...
        - HTTP-enabled
        - Change in blob storage.
      - Small pieces of code that can run after a trigger
        - Hosted directly on Azure.
        - Can execute logic triggered by Azure services without writing any code (GUI).
    - Azure Logic App
      - ? Helps automate and orchestrate tasks, business processes, and workflows when integrating apps, data, systems, and services across enterprises / organizations
      - Event driven.
      - ⚠ Not the same as HTTP
    - Event grid
      - Message communication between the outside world
      - Configurable not programmable.
  - Azure DevOps
    - Azure DevOps
      - It's a suite of services that address every stage of the software development lifecycle.
        - Repositories
        - Boards
        - Pipelines
        - Artifacts
        - Test plans.
    - GitHub
      - ? Decentralized source-code management tool. GitHub is a hosted version of Git that serves as the primary remote.
      - More code to repositories.
      - Private or public
    - GitHub actions
      - Automate software workflows
      - Continuous integration.
    - DevTest labs
      - ! Manages the process of building, setting up, and tearing down VMs that contain builds of your software projects.
- **Management Tools**
  - Azure Portal
    - ? The Azure portal provides a friendly, graphical UI to view all the services you're using, create new services, configure your services, and view reports
  - Web-based user interface
    - Access virtually every feature of Azure
  - PowerShell
    - ? A shell which developers and DevOps and IT professionals can use to execute commands called cmdlets
      - The routine setup, teardown, and maintenance of a single resource or multiple connected resources.
      - Deployment of an entire infrastructure from imperative code.
  - Azure CLI
    - ? Command-line interface is an executable program with which you can execute commands in Bash
    - Almost identical to Azure PowerShell
      - Difference in syntax, not compatible with eachother.
  - Azure Resource Manager (ARM) templates
    - ? Describe the resources you want to use in a declarative JSON format
      - Verified before code is executed
    - ! Created in JSON.
    - This is how Azure deals with resources behind the scenes
    - Management layer that allows you to create, update and delete resources called "deployments"
  - Azure Cloud Shell
  - Azure Mobile App
    - Manage Azure on the go
      - Trimmed down version of the Portal.
  - Azure Advisor
    - ? Evaluates resources and makes recommendations to help improve reliability, security performance, reduce costs and achieve operational excellence
    - ? Provides recommendations based on your deployed Azure services configuration
    - Analyzes your usages of Azure
      - High availability.
      - Security.
      - Performance.
      - Operational-excellence
      - Cost.
  - Azure Monitor
    - ? A platform for collecting, analyzing, visualizing, and potentially taking action based on the metric and logging data from your entire Azure and on-premises environment.
    - ! Helps you understand how your applications are performing and proactively identifies issues affecting them and the resources they depend on
    - ! Ability to sent alerts when resources are created
    - Keep tracks of your resources
  - Azure Service Health
    - ? Provides a personalized view of the health of the Azure services, regions, and resources you rely on
    - Monitors the status of Azure itself

- **Security features**
  - Azure security center
    - ? Provides visibility (dashboard) of your security posture on Azure and on-premises
    - Strengthen security
    - Protect against threads
    - Get secure faster
  - Azure Sentinel
    - ? Security Information and Event Management (SIEM)
    - ! See and stop threads before they cause harm. It's a birds-eye view across the enterprise
    - SIEM system. It uses intelligent security analytics and threat analysis
      - Collect cloud data at scale
      - Detect previously undetected threats.
      - Investigate threats with artificial intelligence ...
      - Respond to incidents rapidly
    - Automatically checks for misconfigurations in the cloud set-up
      - Analyzes cloud data to detect threats
      - Investigate incidents
      - Orchestration and automation to fix the issues.
    - Centralize log files
  - Key Vault
    - ! For storing an application's secrets in a single, central location.
    - Store secrets, certificates and keys
    - Generate keys
    - Grant apps to the keys in real time
  - Azure dedicated hosts
    - ! Azure assigns you a physical server in Microsoft's cloud datacenter
    - Hardware dedicated solely to you
- **Defence in Depth**
  - ! Security Layers
    - Protect hardware in the datacenter
      - Physical, door locks and key cards.
    - Control access to infrastructure and change control
      - Identity & access, Azure AD.
    - Filter large-scale attacks before they can cause a denial of service for users (DDoS)
      - Perimeter
    - Limits communication between resources through segmentation and access controls
      - Network, Subnets.
    - Secures access to virtual machines
      - Compute
    - Ensure that applications are secure and free of security vulnerabilities
      - Application
    - Controls access to business and customer data that you need to protect
      - Data
- **Network security**
  - Azure Firewall
    - Built-in high availability.
    - Unrestricted cloud availability.
    - Inbound and outbound filtering rules.
    - Inbound Destination Network Address Translation (DNAT) support.
    - Azure Monitor logging.
    - ! Protect resources in your Azure virtual networks
  - DDoS protection
    - Standard level has extra protection, but costs
    - Blocks malicious address...
      - Analyzes incoming trafic
    - ! Every property in Azure is protected by Azure's infrastructure DDoS (Basic) Protection at no additional cost
  - Network security group (NSG)
    - ! Like an internal firewall
    - ! Basic way of protecting an Azure virtual network
    - Checks all traffic travelling over a subnet against a set of rules before allowing it in or out
      - ? You can divide a virtual network into multiple subnets for organization and security.
    - A static set of rules for backend and frontend (separation)
      - A list of IP address and ports.
      - The source and destination that are allowed
  - Application Security Group (ASG)
    - A way of grouping related resources together to simplify the way NSG rules are created
  - User Defined Routes (UDR)
    - A way of forcing traffic travelling over a virtual network over a specific path
- **Identity services**
  - Identity
    - Authentication
      - A user proving who they are (user id & password)
      - Establishing the identity of a person or service that wants to access a resource.
    - Authorization
      - Ensuring that a user is permitted to perform an action
      - The process of establishing what level of access an authenticated person or service has.
    - Azure active directory (AAD)
      - ! Can control the access of both the apps and the app resources.
      - Azure Tenant is a dedicated and trusted instance of AAD that's automatically created when your organization signs up for a Microsoft cloud service subscription.
      - Not active directy
        - Identity as a service
      - Handles users, password, password reset,...
      - Free
        - Two types of licenses
      - Pay as you go
    - Benefits of AAD
      - ! Single sign-on (SSO).
      - Security.
      - Reduced development time.
      - Centralized administration.
      - Integration with other Azure services
    - AD Connect
      - ! Synchronizes your corporate AD with Azure AD.
      - Multifactor authentication
        - Privileges (roles)
        - Extra features
      - Conditional access
      - ! A process where a user is prompted during the sign-in process for an additional form of identification
    - Multi-factor authentication (MFA).
      - Something you know.
      - Something you have (phone).
      - Something you are (fingerprint).
      - Requires 2 or more pieces of evidence to login.
    - Conditional access
      - ! A tool that AAD uses to allow/deny access to resources based on identity signals
      - Based on time (login in the weekend).
      - Geographic (user from other side of the world).
      - Inactivity (user that was inactive for long times tries to login).
- **Governance features**
  - Role-based access control (RBAC)
    - ! Helps you manage who has access to resources, what they can do with those resources, and what areas they have access to
    - ! Assigning permissions by role instead of to individuals one by one
    - Roles present the common tasks of the job
      - Eg. accountant, developer, business lead
      - Assign granular permissions.
      - Assign user to roles
      - Reader, contributor, owner
        - Azure has predefined roles.
  - Locks (lock resources)
    - ! Prevents resources from being accidentally deleted/ changed.
    - ! Lock must be removed before continuing
      - Limit who has the ability to delete locks ...
        - Locks Access Control
  - Azure policy
    - ! Enables you to create, assign, and manage policies that control or audit your resources.
    - ! With a policy initiative you can group policies together
      - eg. specific SQL version, allowed regions,...
        - Build-in policies
        - Custom policies
      - Use JSON definition.
  - Blueprints
    - Azure subscription templates with Roles and Policies predefined
  - Cloud adoption framework (CAF)
    - Best practices for the cloud ...
      - Set of documentation, guidance and tools
- **Azure Trusted Cloud**
  - Security
    - ! The list of standards that Azure has been certified to meet is in the Trust Center
    - Azure is build with security in mind
    - Azure delivers tools and technologies to protect apps and data.
      - Azure uses encryption.
    - Azure offers advanced tools to detect and defend against threats.
  - Privacy
    - You own all your data.
    - Azure will not mine your data.
    - Control is where your data is located
    - Azure follows specific policies for government or law enforcement requests.
    - Azure removes data if you discontinue using their service
    - Azure follows more than 50 regional standards.
    - Azure has more than 90 compliance certifications.
  - Compliance
    - Azure follows internal standards.
    - Azure can help with standards ...
  - Resiliency
    - High availability.
    - Disaster recovery.
    - Backup of data.
  - Intellectual property (IP) protection
    - You can build your solutions on top of Azure's products and services.
    - Azure offers protections against frivolous infringement claims ...
- **Policy and compliance features**
  - Microsoft Privacy Statement
    - ! Explains what personal data Microsoft collects, how Microsoft uses it, and for what purposes
    - Microsoft privacy statement
      - privacy.microsoft.com
  - Online Services Terms (OST)
    - ! Details the obligations by both parties (Microsoft and the user) with respect to the processing and security of customer data and personal data
  - Data protection addendum (DPA).
    - ! Further defines the data processing and security terms for online services
  - Trust center
    - ! The portal for everything about GDRP, ISO and NIST
    - ! Showcases Microsoft's principles for maintaining data integrity in the cloud and how Microsoft implements and supports security, privacy, compliance, and transparency in all Microsoft cloud products and services
    - General data protection regulation (GDPR)
      - A set of rules designed to give EU citizens more control over their personal data.
      - Affects companies that handle with EU citizen's data.
      - Data must be collected under strict conditions
      - Data must be protected from misuse
      - Report obligation if data is mishandled
    - International organization for standardization (ISO)
    - National institute of standards and technology (NIST)
  - Sovereign regions
    - Some government region have their own isolated data centers
- **Managing azure costs**
  - Total costs of ownership (TCO) calculator
    - ! Compares the cost of running workload in the datacenter versus on Azure (over time)
  - Pricing calculator
    - Estimate costs upfront
  - Factors affecting costs
    - Different services are billed based on different factors
      - Free services.
      - Time.
      - Size (GB).
      - CPU usage.
      - Pay per usage
    - Stability in pricing
    - Bandwidth
      - Inbound is free
      - Outbound if not
  - Azure Advisor - Costs
    - Reserved instances
      - Cost reduction when reserving items for +1 year ...
    - Billing alerts
      - Receive notification when thresholds are passed
    - Policies
      - Restrict access to certain expensive resources
    - Autoscaling
    - Spot pricing
      - Use services when nobody is using it.
  - Cost management
    - Historical costs
      - Old invoices ...
      - Actual costs
    - Analyze spending over time
    - Track actual costs
    - Schedule reports
    - Azure making certain commitments
      - ! There are service credits ...
        - If not met you can get refunds
- **Service level agreement (SLA)**
  - Preview features
    - No support
    - Not recommended for production
      - No SLA
      - May not go live
  - General availability (GA)
    - Two types
      - Can be used by everyone
      - Supported
        - Private
        - Public
  - Percentages of downtime
    - 99.00
      - 7 hours per month ...
    - 99.90
      - 43 minutes per month ...
    - 99.95
      - 21.6 minutes per month ...
    - 99.99
      - 4 minutes per month ...