**Module 1: Cloud Concepts**

* What is cloud commuting?
  1. Cloud computing is renting of resources, like
     1. **Compute power** - such as Linux servers or web applications, containers and serverless computing
     2. **Storage** - such as files and databases
     3. **Networking** - such as secure connections between the cloud provider and your company
     4. **Analytics** - such as visualizing telemetry and performance data
* What are containers?
  1. **Containers** provide a consistent, isolated execution environment for applications. They're similar to VMs except they don't require a guest operating system. Instead, the application and all its dependencies is packaged into a "container" and then a standard runtime environment is used to execute the app
* What is serverless computing?
  1. **Serverless computing** lets you run application code without creating, configuring, or maintaining a server. The core idea is that your application is broken into separate functions that run when triggered by some action.
* Benefits of cloud computing
  1. Flexible
     1. **pay-as-you-go** or **consumption-based** pricing model
     2. No upfront costs
     3. Better cost prediction
  2. Cost-effective
     1. Increase or decrease the resources and services used based on the demand or workload at any given time
     2. **Vertical scaling**, also known as "scaling up", is the process of adding resources to increase the power of an existing server, adding more CPUs, or adding more memory.
     3. **Horizontal scaling**, also known as "scaling out", is the process of adding more servers that function together as one unit, adding more than one server processing incoming requests.
     4. Scaling can be done manually or automatically based on specific triggers such as CPU utilization or the number of requests and resources can be allocated or de-allocated in minutes
  3. Elastic
     1. Automatically adding or removing resources by a cloud computing system when  your workload changes due to a spike or drop in demand
  4. Current
     1. Cloud Computing eliminates the burdens of maintaining software patches, hardware setup, upgrades, and other IT management tasks
  5. Reliable
     1. Cloud computing providers offer data backup, disaster recovery, fault tolerance , redundancy and data replication services to make sure your data is always safe
  6. Global
     1. Replicate your services into multiple regions for redundancy and locality, or select a specific region to ensure you meet data-residency and compliance laws for your customers.
     2. Cloud providers have fully redundant datacenters located in various regions all over the globe.
  7. Secure
     1. Protect data, apps, and infrastructure from potential threats by offering a broad set of policies, technologies, controls, and expert technical skills that can provide better security
     2. Cloud providers offer tools that help you mitigate digital security threats and you must use these tools to protect the resources you use.
  8. Agile
     1. Cloud agility is the ability to rapidly change an IT infrastructure to adapt to the evolving needs of the business.
* list of some of the compliance & terms offered
  1. Criminal Justice Information Services (CJIS)
  2. Cloud Security Alliance (CSA) STAR Certification
  3. General Data Protection Regulation (GDPR)
  4. EU Model Clauses
  5. Health Insurance Portability and Accountability Act (HIPAA)
  6. International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) 27018
  7. Multi-Tier Cloud Security (MTCS) Singapore
  8. Service Organization Controls (SOC) 1, 2, and 3
  9. National Institute of Standards and Technology (NIST) Cybersecurity Framework (CSF)
  10. UK Government G-Cloud
* Principles of economies of scale
  1. **Economies of scale** is the ability to do things more efficiently or at a lower-cost per unit when operating at a larger scale
  2. This cost advantage is an important benefit in cloud computing
* Capital Expenditure (**CapEx**)
  1. CapEx is the spending of money on physical infrastructure up front, and then deducting that expense from your tax bill over time.
  2. CapEx is an upfront cost, which has a value that reduces over time
  3. CapEx computing costs includes
     1. Server costs
     2. Storage costs
     3. Network costs
     4. Backup & archive costs
     5. Organization continuity and disaster recovery costs
     6. Datacenter infrastructure costs
     7. Technical personnel & workforce

* Operational Expenditure (**OpEx**)
  1. OpEx is spending money on services or products now and being billed for them now.
  2. You can deduct this expense from your tax bill in the same year.
  3. There's no upfront cost. You pay for a service or product as you use it.
  4. OpEx computing costs includes
     1. Leasing software and customized features
     2. Scaling charges based on usage/demand instead of fixed hardware or capacity
     3. Billing at the user or organization level
* Cloud deployment models
  1. **Public cloud** (MS Azure , AWS, GCP)
     1. This is the most common deployment model.
     2. You have no local hardware to manage or keep up-to-date – everything runs on your cloud provider’s hardware.
     3. You can also save additional costs by sharing computing resources with other cloud users.
     4. Advantages
        + High scalability/agility – you don’t have to buy a new server in order to scale
        + Pay-as-you-go pricing – you pay only for what you use, no CapEx costs
        + You’re not responsible for maintenance or updates of the hardware
        + Minimal technical knowledge to set up and use - you can leverage the skills and expertise of the cloud provider to ensure workloads are secure, safe, and highly available
     5. Disadvantages
        + There may be specific security requirements
        + There may be government policies, industry standards, or legal requirements
        + You don't own the hardware or services and cannot manage them
        + Unique business requirements, such as having to maintain a legacy application
  2. **Private cloud** (Azure Stack)
     1. You create a cloud environment in your own datacenter and provide self-service access to compute resources to users in your organization.
     2. Your  responsible for the purchase and maintenance of the hardware and software services you provide
     3. Advantages
        + You can ensure the configuration can support any scenario or legacy application
        + you have control (and responsibility) over security
        + Private clouds can meet strict security, compliance, or legal requirements
        + Economies at scale and integration with Azure Security Center
     4. Disadvantages
        + Initial CapEx costs and must purchase the hardware for startup and maintenance
        + Limits the agility - to scale you must buy, install, and setup new hardware
        + Require IT skills and expertise that's hard to come by
  3. **Hybrid cloud**
     1. A hybrid cloud combines public and private clouds, allowing you to run your applications in the most appropriate location
     2. Advantages
        + Gradual migration approach (Lift & Shift model)
        + It can be used for segmenting
        + Cloud bursting when demand increases
        + Systems running and accessible that use out-of-date hardware or an out-of-date operating system
        + Flexibility with what you run locally versus in the cloud
        + Take advantage of economies of scale from public cloud
        + Use your own equipment to meet security, compliance, or legacy scenarios
     3. Disadvantages
        + It involves some CapEx cost up front
        + It can be more complicated to set up and manage
* Types of cloud services
  1. Infrastructure as a service (IaaS)
     1. Instead of buying hardware, with IaaS, you rent it
     2. It's an instant computing infrastructure, provisioned and managed over the internet
     3. It gives you complete control over the hardware that runs your application (IT infrastructure servers and virtual machines (VMs), storage, networks, and operating systems)
     4. This is referred to as the **shared responsibility model**
     5. There are no upfront costs. Users pay only for what they consume.
     6. Use-case
        + Migrating workloads
        + Test and development
        + Storage, backup, and recovery
  2. Platform as a service (PaaS)
     1. PaaS helps you create an application quickly without managing the underlying infrastructure
     2. PaaS is a complete development and deployment environment in the cloud
     3. PaaS provides an environment for building, testing, and deploying software applications
     4. There are no upfront costs. Users pay only for what they consume.
     5. Use-case
        + Development framework
        + Analytics or business intelligence
  3. Software as a service (SaaS)
     1. SaaS is software that is centrally hosted and managed for the end customer
     2. Users have no upfront costs; they pay a subscription, typically on a monthly or annual basis