ISDM (INDEPENDENT SKILL DEVELOPMENT MISSION)

WHAT IS CLOUD COMPUTING? BENEFITS, DEPLOYMENT MODELS (PUBLIC, PRIVATE, HYBRID)

CHAPTER 1: INTRODUCTION TO CLOUD COMPUTING

1.1 What is Cloud Computing?

Cloud computing is a technology that enables users to access computing resources—such as servers, storage, databases, networking, software, and analytics—over the internet. Instead of managing physical hardware and software on-premises, cloud computing allows businesses and individuals to use resources on demand from cloud service providers like **Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP).**

1.2 Key Characteristics of Cloud Computing

- **On-Demand Self-Service** – Users can provision computing resources without human intervention.
- **Broad Network Access** – Resources are accessible from anywhere via the internet.

- **Resource Pooling** – Providers serve multiple users by dynamically allocating resources.
- **Rapid Elasticity** – Resources can scale up or down based on demand.
- **Measured Service** – Users pay only for the resources they consume.

📌 **Example:** A startup hosting an application on AWS uses cloud computing to scale its infrastructure as its user base grows.

CHAPTER 2: BENEFITS OF CLOUD COMPUTING

Cloud computing has revolutionized the IT industry by offering several key advantages:

2.1 Cost Efficiency

- No need for expensive hardware purchases or maintenance.
- Pay-as-you-go model reduces operational costs.
- Eliminates the need for in-house IT infrastructure.

📌 **Example:** A small business uses Microsoft Azure Virtual Machines, paying only for the hours used instead of investing in physical servers.

2.2 Scalability & Flexibility

- Easily scale resources up or down based on demand.
- Supports both horizontal (adding more instances) and vertical (upgrading existing instances) scaling.

📌 **Example:** An e-commerce website scales up during the holiday season and scales down afterward to save costs.

2.3 Performance & Reliability

- Cloud providers ensure high availability and low latency.
- Redundant data storage prevents data loss.
- Global distribution of resources ensures minimal downtime.

📌 **Example:** Netflix uses AWS to deliver high-performance streaming services worldwide.

2.4 Security & Compliance

- Built-in security features like encryption, firewalls, and identity management.
- Compliance with industry standards like GDPR, HIPAA, and ISO 27001.

📌 **Example:** A healthcare company stores patient records on Google Cloud while meeting HIPAA compliance.

2.5 Disaster Recovery & Backup

- Automated backups and failover solutions minimize data loss.
- Quick recovery in case of system failure.

📌 **Example:** A financial institution backs up transaction data in multiple AWS regions for disaster recovery.

CHAPTER 3: DEPLOYMENT MODELS OF CLOUD COMPUTING

Cloud computing deployment models define how and where cloud resources are managed and stored.

3.1 Public Cloud

A **public cloud** is owned and operated by third-party cloud providers, offering computing resources over the internet.

🔹 **Features:**

- Available to the general public.
- Cost-effective with a pay-as-you-go model.
- No maintenance required by the user.

🔹 **Advantages:**

✓ Lower operational costs.
✓ High scalability and reliability.
✓ Wide range of services and global accessibility.

🔹 **Disadvantages:**

✗ Limited control over security.
✗ Potential compliance issues for sensitive data.

📌 **Example:** A SaaS startup uses AWS EC2 instances to host its customer-facing web application.

3.2 Private Cloud

A **private cloud** is dedicated to a single organization, either hosted on-premises or by a third-party provider.

🔹 **Features:**

- Exclusively used by one organization.

- Higher control over security and compliance.
- Can be managed internally or externally.

🔹 **Advantages:**

✓ Enhanced security and data privacy.

✓ Greater customization and control.

✓ Better compliance with industry regulations.

🔹 **Disadvantages:**

✗ Higher initial costs.

✗ Requires in-house IT expertise.

📌 **Example:** A bank sets up a private cloud to store and process sensitive financial transactions securely.

3.3 Hybrid Cloud

A **hybrid cloud** combines both public and private clouds, allowing data and applications to be shared between them.

🔹 **Features:**

- Allows organizations to use both public and private cloud resources.
- Offers flexibility in workload management.
- Can integrate on-premises infrastructure with cloud services.

🔹 **Advantages:**

✓ Cost-effective with better resource utilization.

✓ Balances security with scalability.

✓ Supports compliance and disaster recovery strategies.

🔹 **Disadvantages:**

❌ Complex management and integration.

❌ Security challenges in data transfer.

📌 **Example:** A retail company stores customer data in a private cloud while hosting its website on AWS for scalability.

Chapter 4: Case Study – Cloud Deployment in Action

Company: TechStartup Inc.

Problem: The company needed a scalable infrastructure to support its growing SaaS platform but lacked the resources for on-premise servers.

Solution:

1. **Adopted a Hybrid Cloud Model:**
    - Public cloud (AWS) for hosting customer applications.
    - Private cloud for storing sensitive customer data.
2. **Utilized Cloud Benefits:**
    - **Cost Savings:** Reduced IT expenses by 50%.
    - **Scalability:** Handled a 200% traffic increase seamlessly.
    - **Security:** Used IAM policies and encryption for data protection.

Outcome:

🚀 **Achieved a 99.9% uptime guarantee, ensuring customer satisfaction and business growth.**

Chapter 5: Exercise & Review Questions

- **Exercise:**

1. Set up a **free-tier account** with any cloud provider (AWS, Azure, or Google Cloud).
2. Deploy a **basic virtual machine (VM)** and access it remotely.
3. Compare the pricing for a **public cloud VM** vs. an **on-premises server setup**.

- **Review Questions:**

1. Define **cloud computing** in simple terms.
2. What are the **five key benefits** of cloud computing?
3. Explain the differences between **public, private, and hybrid clouds**.
4. Why would a company **choose a private cloud over a public cloud**?
5. What is **an example of a hybrid cloud application**?

Conclusion: The Future of Cloud Computing

Cloud computing continues to **evolve** with innovations like **AI-driven cloud services, edge computing, and multi-cloud strategies**. As businesses increasingly migrate to the cloud, **understanding cloud models and their benefits is essential** for IT professionals, developers, and enterprises. 🚀

Overview of Microsoft Azure – Features, Services, and Use Cases

Chapter 1: Introduction to Microsoft Azure

1.1 What is Microsoft Azure?

Microsoft Azure is a **cloud computing platform and service** provided by **Microsoft**. It offers **infrastructure, platform, and software services** over the internet, enabling businesses and developers to build, deploy, and manage applications efficiently.

Azure provides **on-demand computing resources**, helping organizations scale applications dynamically while maintaining cost efficiency. It supports multiple programming languages, frameworks, and tools, making it a preferred choice for enterprises and startups alike.

1.2 Key Characteristics of Microsoft Azure

- **Scalability:** Allows automatic scaling of resources based on workload demand.
- **Flexibility:** Supports various operating systems, databases, and programming languages.
- **Global Reach:** Azure operates in **60+ regions** worldwide, ensuring high availability.
- **Security & Compliance:** Offers built-in **encryption, firewalls, and security monitoring** for data protection.
- **Hybrid Cloud Capability:** Seamlessly integrates on-premises infrastructure with cloud solutions.

📌 **Example:** A retail company uses Azure to manage its inventory and customer data across multiple global locations.

CHAPTER 2: FEATURES OF MICROSOFT AZURE

2.1 Security & Compliance

- **Azure Security Center:** Monitors security threats and provides threat protection.
- **Azure Key Vault:** Manages encryption keys, passwords, and secrets securely.
- **Azure Active Directory (AD):** Controls identity and access management (IAM).
- **Compliance Certifications:** Meets **GDPR, HIPAA, ISO 27001, and SOC 2** standards.

📌 **Example:** A healthcare provider uses Azure Security Center to ensure patient data is secure and meets HIPAA compliance.

2.2 Scalability & High Availability

- **Auto-Scaling:** Automatically adjusts resources based on application load.
- **Azure Load Balancer:** Distributes network traffic across multiple instances.
- **Azure Traffic Manager:** Routes traffic based on geographic locations for better performance.
- **High Availability Zones:** Ensures **99.99% uptime** by replicating data across regions.

📌 **Example:** A media streaming platform scales up its Azure Virtual Machines during peak hours and scales down to reduce costs when traffic decreases.

2.3 Cost Management & Optimization

- **Azure Cost Management:** Monitors cloud spending and provides optimization recommendations.
- **Azure Reserved Instances:** Allows users to save up to **72%** on VM costs by committing to long-term use.
- **Pay-As-You-Go Model:** Users only pay for what they use, reducing unnecessary expenses.

📌 **Example:** A small business uses **Azure Reserved Instances** to reduce monthly cloud costs by pre-paying for computing power.

CHAPTER 3: CORE MICROSOFT AZURE SERVICES

3.1 Compute Services

Azure provides powerful computing resources to run applications, virtual machines, and containers.

Service	Description
Azure Virtual Machines (VMs)	Deploy and run Windows or Linux-based virtual servers.
Azure Kubernetes Service (AKS)	Manage and deploy Kubernetes-based containerized applications.
Azure Functions	Serverless computing to execute code in response to events.
Azure App Services	Host and manage web applications without managing infrastructure.

📌 **Example:** A software company runs **machine learning models on Azure Virtual Machines with GPU acceleration**.

3.2 Networking Services

Azure provides networking capabilities for **secure communication** between cloud resources.

Service	Description
Azure Virtual Network (VNet)	Connects Azure resources securely within a private network.
Azure Load Balancer	Distributes traffic across multiple servers for availability.
Azure VPN Gateway	Securely connects on-premises networks to Azure.
Azure ExpressRoute	Provides dedicated, high-speed connections between Azure and on-premises infrastructure.

📌 **Example:** A financial institution connects its **on-premises data center with Azure** using **ExpressRoute** to ensure fast, secure transactions.

3.3 Storage Services

Azure provides **scalable and highly available** storage solutions.

Service	Description
Azure Blob Storage	Object storage for large-scale unstructured data like images, videos, and logs.
Azure Files	Cloud-based file shares that can be accessed across devices.
Azure Disk Storage	Managed SSD and HDD disks for virtual machines.

Azure Backup	Automatic data backup and recovery solutions.

📌 **Example:** A video production company stores **high-definition videos in Azure Blob Storage** for easy access and sharing.

3.4 Database Services

Azure provides **managed database services** for both SQL and NoSQL workloads.

Service	Description
Azure SQL Database	Fully managed relational database service.
Cosmos DB	Globally distributed NoSQL database for scalable applications.
Azure Database for MySQL/PostgreSQL	Managed open-source databases with built-in security.

📌 **Example:** A travel website uses **Azure Cosmos DB** to store and process millions of user searches across the globe.

CHAPTER 4: USE CASES OF MICROSOFT AZURE

4.1 Enterprise Application Hosting

- Companies host their **web applications, enterprise software, and databases** in Azure.
- Use Azure **App Services, VMs, and SQL Databases** for high availability.

📌 **Example: Airbus** uses Azure to manage its global aviation operations.

4.2 Artificial Intelligence & Machine Learning

- Azure provides **AI/ML services** like Azure Machine Learning, Cognitive Services, and AI-powered analytics.
- Businesses use AI for **customer insights, fraud detection, and automation**.

📌 **Example: BMW** uses **Azure AI to develop self-driving car technologies**.

4.3 Internet of Things (IoT)

- Azure IoT Hub allows devices to securely send and receive data.
- Azure Stream Analytics processes **real-time sensor data**.

📌 **Example: Schneider Electric** uses Azure IoT to **optimize energy consumption in smart buildings**.

4.4 Hybrid Cloud Solutions

- Azure Arc allows businesses to **extend Azure services to on-premise infrastructure**.
- Companies can create a **hybrid cloud environment** by integrating Azure with existing IT infrastructure.

📌 **Example: HSBC** uses Azure Arc to **securely manage its banking systems**.

4.5 Data Analytics & Business Intelligence

- Azure Synapse Analytics helps process **big data workloads**.
- Power BI integrates with Azure to **visualize business insights**.

📌 **Example: PepsiCo** uses **Azure AI and analytics to optimize its supply chain**.

CHAPTER 5: EXERCISE & REVIEW QUESTIONS

- **Exercise:**

1. **Set up a Microsoft Azure Free Tier account** and explore the Azure portal.
2. **Deploy a basic Azure Virtual Machine (Windows/Linux)** and access it remotely.
3. **Store and retrieve files using Azure Blob Storage**.

- **Review Questions:**

1. What are the **key features of Microsoft Azure**?
2. Name at least **three Azure Compute Services** and their use cases.
3. How does Azure provide **security and compliance** for enterprises?
4. What is the difference between **Azure Blob Storage and Azure Files**?
5. Explain how **Azure AI and Machine Learning** can be used in real-world applications.

Conclusion: Why Learn Microsoft Azure?

As businesses shift to the cloud, **Azure is one of the leading platforms** for cloud computing. Learning Azure opens **job opportunities in cloud computing, AI, IoT, and DevOps**, making it an essential skill for IT professionals and developers. 🚀

AZURE PORTAL, CLI, AND POWERSHELL – BASICS OF NAVIGATION

CHAPTER 1: INTRODUCTION TO AZURE NAVIGATION TOOLS

1.1 Overview of Azure Management Tools

Microsoft Azure provides multiple ways to **interact, configure, and manage cloud resources**:

1. **Azure Portal** – A **graphical user interface (GUI)** for managing Azure services via a web browser.
2. **Azure Command-Line Interface (Azure CLI)** – A **command-line tool** for executing commands and automating tasks.
3. **Azure PowerShell** – A **scripting environment** for managing Azure services with automation capabilities.

Each of these tools is used **based on user preferences and automation needs**.

📌 **Example:** A system administrator might use **Azure CLI or PowerShell** for automation, while a beginner may prefer the **Azure Portal** for an easier GUI-based experience.

CHAPTER 2: AZURE PORTAL – WEB-BASED INTERFACE

2.1 What is Azure Portal?

Azure Portal is a **web-based interface** that allows users to manage Azure resources visually.

- Accessible at: https://portal.azure.com
- Requires an **Azure account and subscription** to log in.

2.2 Key Features of Azure Portal

✓ **Dashboard Customization** – Personalize with widgets and pinned resources.
✓ **Resource Management** – Create, configure, and monitor Azure services.
✓ **Access Control** – Manage **identity and role-based access control (RBAC)**.
✓ **Billing & Cost Management** – View spending details and optimize costs.
✓ **Monitoring & Alerts** – Set up **real-time alerts and performance metrics**.

2.3 Navigating the Azure Portal

1. **Sign In** – Log in at **portal.azure.com** with your Microsoft credentials.
2. **Home Page** – Displays **recent activities, resources, and subscription details**.
3. **Search Bar** – Quickly find services (e.g., Virtual Machines, Storage Accounts).
4. **Left Menu Panel** – Access **Compute, Networking, Databases, AI, and Security**.
5. **Dashboard Customization** – Click **"Edit Dashboard"** to personalize the view.
6. **Create a Resource** – Click **"+ Create a Resource"** to deploy a new service.

📌 **Example:** A developer launches an **Azure Virtual Machine (VM)** via the Azure Portal by selecting **Compute → Virtual Machines → Create VM**.

2.4 Pros & Cons of Azure Portal

✅ **Easy-to-use visual interface**
✅ **No need for additional installation**
✅ **Real-time monitoring & security features**
❌ **Manual, time-consuming for bulk operations**
❌ **Limited automation compared to CLI/PowerShell**

CHAPTER 3: AZURE COMMAND-LINE INTERFACE (CLI)

3.1 What is Azure CLI?

Azure CLI is a **cross-platform command-line tool** that allows users to interact with Azure services **via text-based commands**.

- Available on **Windows, macOS, and Linux**
- Used in **Command Prompt, Terminal, and Cloud Shell**

3.2 Installing Azure CLI

Windows: Download from https://aka.ms/installazurecli
macOS/Linux: Install via package managers (e.g., brew install azure-cli for macOS)

3.3 Azure CLI Basics

1. **Login to Azure**
2. az login

(Opens a browser for authentication)

3. **Check Azure Account Details**
4. az account show
5. **List Available Azure Subscriptions**
6. az account list --output table
7. **Create a Virtual Machine (VM)**
8. az vm create --resource-group MyResourceGroup --name MyVM --image UbuntuLTS --admin-username azureuser --generate-ssh-keys
9. **Delete a Virtual Machine**
10. az vm delete --name MyVM --resource-group MyResourceGroup --yes

3.4 Pros & Cons of Azure CLI

✅ **Faster than GUI for repetitive tasks**
✅ **Supports automation & scripting**
✅ **Works across different operating systems**
❌ **Requires knowledge of CLI commands**
❌ **Steeper learning curve for beginners**

📌 **Example:** A DevOps engineer provisions **100 Virtual Machines** using **Azure CLI in seconds,** rather than creating them one by one in Azure Portal.

CHAPTER 4: AZURE POWERSHELL – SCRIPTING FOR AUTOMATION

4.1 What is Azure PowerShell?

Azure PowerShell is a **PowerShell module** that allows users to automate Azure resource management **using scripts**.

- Works in **Windows PowerShell & PowerShell Core (cross-platform)**
- Uses **cmdlets** (Get-AzVM, New-AzStorageAccount) to interact with Azure

4.2 Installing Azure PowerShell

Install via **PowerShell** command:

Install-Module -Name Az -AllowClobber -Scope CurrentUser

4.3 Azure PowerShell Basics

1. **Login to Azure**
2. Connect-AzAccount
3. **List All Resource Groups**
4. Get-AzResourceGroup
5. **Create a Virtual Machine (VM)**
6. New-AzVM -ResourceGroupName "MyResourceGroup" -Name "MyVM" -Location "East US"
7. **Start a Virtual Machine**
8. Start-AzVM -ResourceGroupName "MyResourceGroup" -Name "MyVM"
9. **Delete a Virtual Machine**
10. Remove-AzVM -Name "MyVM" -ResourceGroupName "MyResourceGroup"

4.4 Pros & Cons of Azure PowerShell

✅ **Ideal for automation & infrastructure as code (IaC)**
✅ **Deep integration with Azure Services**
✅ **Efficient for bulk operations**
❌ **Not as user-friendly as Azure Portal**
❌ **Requires PowerShell scripting knowledge**

📌 **Example:** A system administrator **creates and manages multiple VMs and storage accounts using PowerShell scripts,** reducing manual effort.

Chapter 5: Comparison of Azure Portal, CLI, and PowerShell

Feature	Azure Portal	Azure CLI	Azure PowerShell
Ease of Use	✅ Easy GUI	⚠️ Moderate (commands-based)	⚠️ Moderate (PowerShell scripting)
Automation	❌ Manual process	✅ Supports scripting	✅ Supports automation
Speed	❌ Slower for bulk tasks	✅ Faster than GUI	✅ Best for automation
Cross-Platform	✅ Web-based	✅ Works on Windows, macOS, Linux	✅ Works on Windows, macOS, Linux
Best Use Case	Beginners, small-scale setups	Developers, DevOps engineers	Sysadmins, Infrastructure as Code (IaC)

📌 **Example:** A cloud engineer sets up **Azure Kubernetes Service (AKS)** using Azure CLI, while an IT admin configures **Role-Based Access Control (RBAC)** using PowerShell.

CHAPTER 6: EXERCISE & REVIEW QUESTIONS

- **Exercise:**
  1. **Log in to Azure Portal** and create a new **Resource Group**.
  2. **Install Azure CLI and PowerShell,** then authenticate using az login and Connect-AzAccount.
  3. **Use CLI or PowerShell to deploy a Virtual Machine**.
  4. **List all running VMs** using both **CLI and PowerShell**.
- **Review Questions:**
  1. What are the **main differences** between Azure Portal, CLI, and PowerShell?
  2. What is the command to **list all Azure resource groups** in CLI and PowerShell?
  3. How can you automate VM creation using **Azure PowerShell**?
  4. Why might a **DevOps engineer prefer Azure CLI over Azure Portal**?
  5. Explain the role of **Azure PowerShell in cloud automation**.

CONCLUSION: CHOOSING THE RIGHT TOOL FOR AZURE MANAGEMENT

- **Beginners** → Use **Azure Portal** for an easy visual interface.
- **Developers & DevOps Engineers** → Use **Azure CLI** for automation.
- **System Administrators** → Use **Azure PowerShell** for scripting and infrastructure automation.

SETTING UP AN AZURE FREE TIER ACCOUNT & SUBSCRIPTION MANAGEMENT

CHAPTER 1: INTRODUCTION TO AZURE FREE TIER & SUBSCRIPTION MANAGEMENT

1.1 What is Microsoft Azure Free Tier?

Microsoft Azure offers a **Free Tier account** that allows new users to explore cloud services **without upfront costs**. This account includes:

- **12 months** of free access to popular Azure services.
- **$200 credit** valid for **30 days** to test additional Azure features.
- **Always free** services (with usage limits).

1.2 Why Use the Azure Free Tier?

✅ **Test & Learn** – Explore cloud services **risk-free** before committing.
✅ **Develop & Deploy** – Build **small-scale applications** at no cost.
✅ **Experiment with AI, IoT & DevOps** – Gain **hands-on experience** with Azure's advanced tools.

📌 **Example:** A student learning cloud computing uses **Azure Free Tier** to deploy a basic virtual machine (VM) and experiment with cloud storage.

CHAPTER 2: SETTING UP AN AZURE FREE TIER ACCOUNT

2.1 Prerequisites

Before signing up, ensure you have:

✓ **A valid email address** (preferably Outlook or Gmail).

✓ **A credit or debit card** (for identity verification, no charges applied).

✓ **A phone number** (for authentication).

2.2 Step-by-Step Guide to Creating an Azure Free Account

Step 1: Visit the Azure Free Account Page

1. Open your browser and go to https://azure.microsoft.com/en-us/free/.
2. Click **"Start free"** to begin registration.

Step 2: Sign in with a Microsoft Account

- If you have a **Microsoft account**, sign in.
- If not, click **"Create one"** and follow the instructions.

Step 3: Enter Personal Details

Fill in required details:

- **Name, country, and region**
- **Phone number** (receive a verification code)

Step 4: Verify Identity

- Provide a valid **credit or debit card** (Azure won't charge anything, only verification).
- Phone number verification via **SMS or call**.

Step 5: Accept Terms & Create Account

- Read and accept **Microsoft Azure's terms & conditions**.
- Click **"Sign up"** to activate your account.

🎉 **Congratulations! Your Azure Free Tier account is ready to use.**

📌 **Example:** A developer signs up for **Azure Free Tier** and deploys a free **SQL database** to practice cloud-based queries.

CHAPTER 3: UNDERSTANDING AZURE SUBSCRIPTION MANAGEMENT

3.1 What is an Azure Subscription?

An **Azure Subscription** links your Azure account to **billing, resources, and permissions**. It defines:

- **Billing & Costs** – Tracks cloud usage.
- **Resource Limits** – Determines access to services.
- **Access Control** – Assigns user permissions.

📌 **Example:** A company may have **multiple Azure subscriptions** for development, testing, and production environments.

3.2 Types of Azure Subscriptions

- 🔹 **Free Tier Subscription** – Includes free credits and services.
- 🔹 **Pay-As-You-Go** – Charges based on actual usage.
- 🔹 **Enterprise Agreements (EA)** – For large businesses with **bulk Azure purchases**.
- 🔹 **Student Subscription** – Provides free Azure access for students.

📌 **Example:** A startup migrates from **Free Tier** to **Pay-As-You-Go** after exceeding free limits.

Chapter 4: Managing Azure Subscriptions

4.1 Checking Subscription Details

You can manage subscriptions via **Azure Portal, CLI, or PowerShell**.

Using Azure Portal

1. Log in to https://portal.azure.com.
2. Click **"Subscriptions"** in the search bar.
3. View **subscription name, ID, and billing details**.

Using Azure CLI

```
az account list --output table
```

Using Azure PowerShell

```
Get-AzSubscription
```

📌 **Example:** A cloud engineer uses **Azure CLI** to check active subscriptions before deploying a virtual machine.

Chapter 5: Azure Free Tier Limits & Upgrade Options

5.1 Free Tier Service Limits

Azure Service	Free Usage Limit	Duration

Azure Virtual Machines	750 hours (B1s VM)	12 months
Azure Blob Storage	5 GB	12 months
Azure SQL Database	250 GB	12 months
Azure Functions	1 million requests	Always free
Azure AI Services	Limited free credits	Always free

5.2 Upgrading to a Paid Plan

Once **free credits expire**, you can:

✅ **Upgrade to Pay-As-You-Go** – Continue using services with on-demand pricing.

✅ **Purchase Reserved Instances** – Save costs on long-term commitments.

✅ **Switch to an Enterprise Agreement** – Suitable for businesses.

📌 **Example:** A company develops a cloud app using **Azure Free Tier**, then upgrades to **Pay-As-You-Go** to handle increased user traffic.

CHAPTER 6: BEST PRACTICES FOR FREE TIER USAGE

✅ Optimize Resource Usage

- **Shut down unused VMs** to avoid exceeding free limits.

- **Use cost management tools** to track expenses.

✅ **Leverage Always-Free Services**

- Use **Azure Functions** for serverless workloads.
- Store files in **Azure Blob Storage** within the 5 GB free limit.

✅ **Monitor Billing & Subscription**

- Set up **spending alerts** to avoid unexpected charges.
- Review **Azure Cost Management Dashboard** regularly.

📌 **Example:** A developer enables **Azure Cost Alerts** to receive email notifications if usage approaches free limits.

CHAPTER 7: EXERCISE & REVIEW QUESTIONS

🔹 **Exercise:**

1. **Create an Azure Free Tier account** and activate a **new subscription**.
2. **Deploy a Virtual Machine** and check its free-tier limits.
3. **List all active Azure Subscriptions** using **Azure CLI & PowerShell**.

🔹 **Review Questions:**

1. What are the benefits of using the **Azure Free Tier**?
2. What is an **Azure Subscription**, and why is it important?
3. How do you check subscription details using **Azure Portal, CLI, and PowerShell**?

4. What are the key **Azure Free Tier service limits**?
5. What steps should be taken **before upgrading** from Free Tier to Pay-As-You-Go?

CONCLUSION: GETTING STARTED WITH AZURE THE RIGHT WAY

Microsoft Azure Free Tier is a **great entry point** for beginners to explore cloud computing. By managing **subscriptions, monitoring costs, and leveraging free-tier services wisely**, users can **maximize their Azure experience** while avoiding unnecessary expenses. 🚀

CORE AZURE ARCHITECTURE – REGIONS, AVAILABILITY ZONES, RESOURCE GROUPS

CHAPTER 1: INTRODUCTION TO AZURE ARCHITECTURE

What is Azure Architecture?

Microsoft Azure follows a **globally distributed cloud infrastructure model**, ensuring:

- **High availability**
- **Scalability**
- **Fault tolerance**
- **Security and compliance**

To achieve these, Azure's **core architecture** consists of **Regions, Availability Zones, and Resource Groups**, which form the foundation for managing and deploying cloud services efficiently.

📌 **Example:** A multinational company deploys its **critical applications in multiple Azure regions** to ensure continuous service even if a data center fails.

CHAPTER 2: AZURE REGIONS

What is an Azure Region?

An **Azure Region** is a **geographically distinct area** where Microsoft has **one or more data centers** to provide cloud services.

Key Characteristics of Azure Regions

- **Each region consists of multiple data centers** to improve redundancy.
- **Supports high availability and disaster recovery** by allowing deployment across different locations.
- **Regions are connected by Microsoft's high-speed global network** for optimal performance.

Types of Azure Regions

Azure regions are classified based on their **functionality and access**:

Region Type	Description	Examples
General Availability (GA) Regions	Standard regions for public use	East US, West Europe, Southeast Asia
Geopolitical & Government Regions	Compliant with government regulations	Azure Government (US), China East
Specialized Regions	Built for high security or special use cases	US DoD, Germany Central

Edge Zones	Close to end-users for low latency	Azure Edge Zones in major cities

List of Popular Azure Regions

- **East US, West US, Central US**
- **North Europe, West Europe**
- **Southeast Asia, Australia East**
- **Japan East, South India**

📌 **Example:** A gaming company chooses **Azure West Europe** to provide low-latency services to its European customers.

CHAPTER 3: AZURE AVAILABILITY ZONES

What are Availability Zones?

Availability Zones (AZs) are **physically separate data centers** within a single **Azure Region**, designed to protect against **data center failures**.

Key Features of Availability Zones

- **Each zone has independent power, networking, and cooling.**
- **Provides protection from localized failures.**
- **Enables high availability architectures (99.99% uptime SLA).**

How Availability Zones Work?

- Azure divides regions into **at least three Availability Zones**.
- Resources can be **replicated across zones** for **fault tolerance**.
- Commonly used for **Virtual Machines, Databases, and Kubernetes Clusters**.

Services that Support Availability Zones

- **Azure Virtual Machines (VMs)**
- **Azure SQL Database (Zone-redundant)**
- **Azure Kubernetes Service (AKS)**
- **Azure Load Balancer & VPN Gateway**

📌 **Example:** A financial company deploys its database in **three Availability Zones in East US** to ensure data remains accessible even if one zone goes down.

CHAPTER 4: AZURE RESOURCE GROUPS

What is a Resource Group?

A **Resource Group (RG)** is a **logical container** that holds Azure resources (VMs, storage, databases, networking).

Key Features of Resource Groups

- **Organizes related Azure services** together for easy management.
- **Simplifies access control, monitoring, and cost management.**

- **Resources inside a group share common permissions and policies.**

Best Practices for Resource Groups

- **Use a clear naming convention** (e.g., RG-Production-WebApps).
- **Group resources by application or environment** (Dev/Test/Prod).
- **Apply Role-Based Access Control (RBAC)** to control permissions.

📌 **Example:** A development team creates **separate Resource Groups** for **Testing (RG-Test)** and **Production (RG-Prod)** environments to ensure better management.

CHAPTER 5: HOW REGIONS, AVAILABILITY ZONES & RESOURCE GROUPS WORK TOGETHER

Scenario: Deploying a Scalable Web Application

- **Choose a Region:**
  - Select **East US** to host the web application.
- **Use Availability Zones for Redundancy:**
  - Deploy **three Virtual Machines (VMs)** across different Availability Zones.
- **Create a Resource Group:**
  - Group all components (VMs, Load Balancer, Database) inside **RG-WebApp**.

- **Implement Load Balancing:**
    - Use **Azure Load Balancer** to distribute traffic between the VMs.
- **Enable Auto-Scaling & Monitoring:**
    - Configure **Azure Monitor** and **Auto-Scaling** policies.

📌 **Example:** A multinational retailer deploys a **global e-commerce application** across multiple Azure regions, ensuring fast and uninterrupted service.

CHAPTER 6: EXERCISE & REVIEW QUESTIONS

Exercise:

- **Check available Azure regions** using CLI or PowerShell:
- az account list-locations --output table
- Get-AzLocation
- **Create a new Resource Group using Azure CLI:**
- az group create --name MyResourceGroup --location EastUS
- **Deploy a Virtual Machine inside a Resource Group:**
- az vm create --resource-group MyResourceGroup --name MyVM --image UbuntuLTS --admin-username azureuser --generate-ssh-keys

Review Questions:

- What is the difference between an **Azure Region and an Availability Zone**?

- Why is it important to **deploy applications across multiple Availability Zones**?
- How do **Resource Groups** help in managing cloud resources efficiently?
- Which Azure services support **Availability Zones** for high availability?
- How do you create a **Resource Group using Azure CLI and PowerShell**?

Conclusion: The Role of Azure Core Architecture in Cloud Success

Understanding **Regions, Availability Zones, and Resource Groups** helps businesses achieve:

- **Better performance and resilience**
- **Improved resource organization**
- **High availability and disaster recovery**

Cost Management & Pricing Calculator in Azure

Chapter 1: Introduction to Azure Cost Management

What is Azure Cost Management?

Azure Cost Management is a set of tools provided by Microsoft Azure to **track, optimize, and reduce cloud spending**. It helps businesses monitor **real-time usage, control budgets, and forecast expenses** based on resource consumption.

Why is Cost Management Important?

- **Optimizes cloud spending** and prevents budget overruns.
- **Identifies unused or underutilized resources** to minimize waste.
- **Helps organizations forecast and plan cloud expenses** efficiently.

📌 **Example:** A startup using **Azure Virtual Machines (VMs)** realizes through Cost Management that they are over-provisioning resources. By resizing VMs, they save **30% on costs**.

Chapter 2: Key Components of Azure Cost Management

Azure Cost Analysis

✓ Provides **detailed cost reports** and usage breakdowns.
✓ Identifies which **services, departments, and users** are driving costs.

Azure Budgets

✓ Enables organizations to **set spending limits** for Azure subscriptions.
✓ Sends **alerts** when spending approaches the defined budget.

Azure Advisor – Cost Optimization

✓ Recommends **cost-saving opportunities**, such as:

- **Right-sizing VMs**
- **Deleting unused resources**
- **Moving workloads to reserved instances**

Azure Reservations & Savings Plans

✓ Allows customers to **pre-pay for Azure resources** at a discount (up to 72% savings).
✓ Suitable for **long-term workloads** (e.g., databases, compute resources).

📌 **Example:** A company reserves **Azure SQL Database instances** for 3 years, reducing monthly expenses by **40%**.

CHAPTER 3: AZURE PRICING CALCULATOR

What is the Azure Pricing Calculator?

The **Azure Pricing Calculator** is a web-based tool that helps estimate **cloud costs before deployment**. It allows users to:

- **Select Azure services** (e.g., Virtual Machines, Storage, Databases).
- **Adjust configurations** (e.g., region, instance type, hours of usage).
- **Compare cost estimates** across different scenarios.

📌 **Access the Pricing Calculator:**
https://azure.microsoft.com/en-us/pricing/calculator/

CHAPTER 4: HOW TO USE THE AZURE PRICING CALCULATOR

Step 1: Choose an Azure Service

- Go to the **Azure Pricing Calculator** page.
- Click **"+ Add Product"** and select a service (e.g., Virtual Machines).

Step 2: Configure the Service

For Virtual Machines, configure:
✓ **Region** (e.g., East US, West Europe).
✓ **Operating System** (Windows/Linux).
✓ **Instance Size** (CPU, RAM).
✓ **Usage Hours per Month** (Pay-As-You-Go or Reserved).

Step 3: Estimate the Cost

- The calculator displays the **monthly and annual estimated cost**.

- Compare different pricing models (Pay-As-You-Go vs. Reserved Instances).

Step 4: Export & Share Cost Estimates

- Download the estimate as a **CSV file**.
- Share with team members for budget planning.

📌 **Example:** A cloud architect estimates the **total monthly cost of running an e-commerce website** before deployment.

CHAPTER 5: COST OPTIMIZATION STRATEGIES IN AZURE

Right-Sizing Resources

- Choose the **correct VM size** based on actual usage.
- Use **Auto-Scaling** to adjust resources dynamically.

Use Reserved Instances (RI) & Savings Plans

- Prepay for compute resources to **reduce long-term costs**.
- Compare **RI pricing vs. on-demand pricing** before committing.

Implement Azure Budgets & Alerts

- Set **spending limits** and receive notifications when nearing the threshold.
- Avoid unexpected charges.

Turn Off Idle Resources

- **Deallocate VMs** when not in use (e.g., during weekends).

- **Use Azure Automation** to shut down resources at specific times.

Use Azure Spot VMs

- Save up to **90% on compute costs** by running non-critical workloads on **Spot Instances**.

📌 **Example:** A data analytics company reduces its **Azure bill by 50%** by switching to **Spot VMs** for processing large datasets.

CHAPTER 6: EXERCISE & REVIEW QUESTIONS

Exercise:

1. **Access the Azure Pricing Calculator** and estimate the cost of a **Standard B2s Virtual Machine** in **East US**.
2. **Set up a Budget in Azure Cost Management** and create an alert for when spending exceeds **$100/month**.
3. **List all current costs using Azure CLI:**
4. az consumption usage list --output table

Review Questions:

- What are the **main components of Azure Cost Management**?
- How does the **Azure Pricing Calculator** help businesses?
- What is the difference between **Pay-As-You-Go and Reserved Instances**?
- Name three **strategies to reduce Azure costs**.

- How can **Azure Budgets** help organizations **avoid unexpected expenses**?

Conclusion: Managing Costs Effectively in Azure

By using **Azure Cost Management & the Pricing Calculator,** organizations can:

- **Optimize spending.**
- **Prevent budget overruns.**
- **Make informed cloud investment decisions.**

ASSIGNMENT

CREATE AN AZURE FREE TIER ACCOUNT AND DEPLOY A BASIC VIRTUAL MACHINE

SOLUTION: CREATE AN AZURE FREE TIER ACCOUNT AND DEPLOY A BASIC VIRTUAL MACHINE (VM)

Step-by-Step Guide

Step 1: Create an Azure Free Tier Account

To deploy a Virtual Machine (VM) on Azure, you first need to create an **Azure Free Tier account**.

1.1 Go to the Azure Free Tier Website

- Open your web browser and visit Azure Free Account.
- Click on **"Start free"** to begin the registration process.

1.2 Sign in or Create a Microsoft Account

- If you already have a **Microsoft account,** sign in with your credentials.
- If not, click **"Create one!"** and follow the prompts to set up a new account.

1.3 Enter Personal & Payment Details

- Fill in your **Name, Country, and Contact Information**.
- Provide a **valid phone number** for verification.
- Enter a **credit or debit card** (for identity verification only, no charges will be made).
- Accept the **terms and conditions,** then click **"Create"**.

✅ **Your Azure Free Tier account is now active!**
Now, you can proceed to deploy a Virtual Machine.

Step 2: Deploy a Virtual Machine (VM) in Azure

Once your Azure account is set up, follow these steps to create and deploy a basic Virtual Machine (VM).

2.1 Log in to Azure Portal

- Open your browser and go to Azure Portal.
- Sign in with your **Azure Free Tier** credentials.

2.2 Navigate to the Virtual Machines Service

- In the Azure Portal, click on **"Create a resource"** (from the left panel).
- Search for **"Virtual Machine"** and select **"Create"**.

2.3 Configure the Virtual Machine

Now, configure the necessary settings:

Basics Tab

1. **Subscription:** Select **Azure Free Trial**.
2. **Resource Group:** Click **"Create new"** and name it **MyResourceGroup**.
3. **Virtual Machine Name:** Enter a unique name like **MyVM**.
4. **Region:** Choose a region close to you (e.g., **East US**).
5. **Availability Options:** Choose **No infrastructure redundancy required**.
6. **Image:** Select **Ubuntu Server 20.04 LTS** (or Windows Server if needed).
7. **Size:** Choose **B1s (Free Tier eligible)**.

8. **Authentication Type:** Select **Password**.
9. **Username & Password:** Create a secure admin username and password.

Disks Tab

- **OS disk type:** Choose **Standard SSD (Recommended for Free Tier)**.

Networking Tab

- **Virtual network (VNet):** Keep the default setting.
- **Subnet:** Keep default.
- **Public IP:** Select **Enable** (to access your VM remotely).
- **Allow inbound ports:** Select **RDP (for Windows)** or **SSH (for Linux)**.

2.4 Review and Deploy

- Click **"Review + Create"** to validate the settings.
- If everything is correct, click **"Create"** to deploy the VM.

🚀 **Azure will now create and deploy your Virtual Machine.**
The process takes a few minutes. Once deployed, you can access your VM.

Step 3: Connect to the Virtual Machine

After deployment, you need to connect to your VM.

3.1 Connect to a Linux VM (Ubuntu) via SSH

1. Go to **Azure Portal** → **Virtual Machines**.
2. Select **MyVM**.

3. Copy the **Public IP Address** from the overview page.
4. Open your terminal (Mac/Linux) or PowerShell (Windows) and type:
5. ssh azureuser@<public-ip-address>

Replace <public-ip-address> with your VM's IP.

6. Enter your **password** when prompted.

3.2 Connect to a Windows VM via RDP

1. Open **Remote Desktop Connection** on your PC.
2. Enter the **Public IP Address** of your VM.
3. Log in using the **Username and Password** you created.
4. You should now have access to your Windows VM.

Step 4: Verify and Manage Your VM

4.1 Verify VM Performance

- Go to **Azure Portal → Virtual Machines**.
- Click on **MyVM** to view resource usage.

4.2 Stop or Delete the VM (To Save Free Tier Credits)

To avoid charges, stop or delete your VM when not in use.

Stop VM (No Cost)

az vm stop --resource-group MyResourceGroup --name MyVM

Delete VM (Removes Resources)

az vm delete --resource-group MyResourceGroup --name MyVM --yes

✅ **Congratulations! You have successfully created and deployed a Virtual Machine using the Azure Free Tier.** 🎉

Recap of Steps

✓ **Step 1:** Create an Azure Free Tier Account
✓ **Step 2:** Deploy a Virtual Machine using Azure Portal
✓ **Step 3:** Connect to the VM via SSH (Linux) or RDP (Windows)
✓ **Step 4:** Monitor and manage the VM to optimize free-tier usage

DOCUMENT COST ESTIMATION USING THE AZURE PRICING CALCULATOR

SOLUTION: DOCUMENT COST ESTIMATION USING THE AZURE PRICING CALCULATOR

Step-by-Step Guide

Step 1: Access the Azure Pricing Calculator

Azure provides a web-based tool called the **Azure Pricing Calculator** that allows users to estimate the cost of cloud resources before deployment.

1.1 Open the Azure Pricing Calculator

- Go to Azure Pricing Calculator.
- The pricing calculator homepage will open with options to add different Azure services.

Step 2: Add a Service for Cost Estimation

To estimate the cost, you need to select the Azure services you plan to use.

2.1 Choose a Service

- Click **"+ Add Products"**.
- Select the service you want to estimate (e.g., **Virtual Machines, Storage, Databases**).
- The selected service will appear in the pricing calculator panel.

Step 3: Configure the Service Settings

Each Azure service has multiple configuration options that affect pricing. Below is an example of estimating the cost of an **Azure Virtual Machine**.

3.1 Configure Virtual Machine (VM) Pricing

- **Region:** Select the Azure region (e.g., **East US**).
- **Operating System:** Choose **Linux** or **Windows**.
- **Type:** Choose **General Purpose** or other categories.
- **Instance Size:** Select **B2s (Free Tier eligible)** for cost savings.
- **Billing Option:** Choose **Pay-As-You-Go** or **Reserved Instance**.
- **Hours Per Month:** Default is **730 hours** (Full month).
- **Quantity:** Choose the number of VMs you need.

📌 **Example Cost for B2s VM (Pay-As-You-Go, East US):** ~$13 per month

3.2 Configure Additional Services (Optional)

- **Azure Storage**: Estimate storage costs based on **Blob Storage, File Storage, or Disk Storage**.
- **Azure Database**: Choose **Azure SQL Database, Cosmos DB, or MySQL**.
- **Networking**: Add **Load Balancer, Virtual Network (VNet), or VPN Gateway**.

📌 **Example:** A business running a **web app on a Virtual Machine with 100 GB of Blob Storage and an SQL Database** estimates a monthly cost of **$60**.

Step 4: Review and Export Cost Estimation

4.1 Check the Total Estimated Cost

- The pricing calculator will display a **summary of estimated costs** for all selected services.
- The total **monthly cost** and **annual cost projection** will be displayed.

4.2 Export the Estimate for Documentation

- Click **"Export"** to download the estimate in **Excel (CSV) or PDF** format.
- Save the file and share it with **stakeholders, finance teams, or project managers**.

📌 **Example:** A cloud architect exports an Azure cost estimate for a **development team** to ensure the project stays within budget.

Step 5: Optimize Cost Using Azure Cost Management

5.1 Use Azure Cost Saving Features

- **Reserved Instances (RI):** Get up to **72% discount** for long-term VM use.
- **Spot VMs:** Save up to **90%** by running non-critical workloads.
- **Auto-Scaling:** Reduce costs by scaling resources up/down based on demand.
- **Azure Budgets & Alerts:** Set spending limits and get notified before exceeding budget.

📌 **Example:** A DevOps team switches to **Reserved Instances** and reduces Azure costs by **40%** for their production environment.

Step 6: Monitor and Adjust Costs

- **Set up Cost Alerts** in **Azure Cost Management** to track usage.
- **Review your estimate regularly** as pricing may change based on usage.

✅ **Congratulations! You have successfully estimated and documented Azure costs using the Pricing Calculator.** 🎉