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Amazon Web Services with AI

Module 1: Foundations of Cloud Computing and Virtualization

- **Learning Objectives**:
  - Define and differentiate the various types of computing, such as traditional, cloud, and hybrid models.
  - Grasp the basics of virtualization, its types, and the key advantages it brings to cloud computing.
  - Understand AWS global infrastructure, regions, availability zones, and edge locations.
  - Explore methods of accessing AWS, including AWS Management Console, CLI, and SDKs, and learn about different AWS account plans.
- **Topics Covered**:
  - **Types of Computing**: Traditional IT, Cloud Computing, Hybrid Computing.
  - **Virtualization**: Server, Network, Storage Virtualization.
  - **Cloud Computing Models**: Public, Private, Hybrid Clouds.
  - **Advantages of Cloud Computing**: Cost savings, scalability, global reach, agility, elasticity.
  - **AWS Infrastructure**: Regions, Availability Zones, Edge Locations.
  - **Accessing AWS**: AWS Console, CLI, SDK, AWS Organizations, and Free Tier.
- **Hands-on Lab**:
  - Create a new AWS account, explore the AWS Console, and configure CLI access with credentials.
  - Explore AWS Free Tier services.

Module 2: Introduction to EC2 and Launching Windows Instances

- **Learning Objectives**:
  - Understand the core concepts of Amazon EC2, including AMIs, security groups, key pairs, and how to launch an EC2 instance.

    - Learn to deploy a Windows EC2 instance and configure the IIS Web Server for hosting simple websites.
- **Topics Covered**:
    - **EC2 Concepts**: Instances, Amazon Machine Images (AMIs), Instance Types.
    - **Security Groups**: Configuring security groups for inbound and outbound traffic.
    - **Key Pairs**: Understanding key pair creation for secure SSH access.
    - **Windows EC2 Launch**: Step-by-step instance launch with Windows Server.
    - **Configuring IIS Web Server**: Introduction to IIS setup on Windows.
- **Hands-on Lab**:
    - Launch a Windows EC2 instance, configure security groups, and access the instance using RDP.
    - Set up IIS on the Windows instance to host a simple HTML webpage.

Module 3: Cloud Service and Deployment Models

- **Learning Objectives**:
    - Understand the core cloud service models (IaaS, PaaS, SaaS) and deployment models (Public, Private, Hybrid).
    - Explore the differences and use cases for each model to choose the right strategy for different scenarios.
- **Topics Covered**:
    - **Service Models**:
        - **IaaS**: Infrastructure as a Service.
        - **PaaS**: Platform as a Service.
        - **SaaS**: Software as a Service.
    - **Deployment Models**:
        - Public Cloud.
        - Private Cloud.
        - Hybrid Cloud.

Module 4: EC2 and Linux Instances – Configuration and Vertical Scaling

- **Learning Objectives**:
  - Launch a Linux EC2 instance and connect using SSH.
  - Learn to configure Apache Web Server on a Linux instance and automate setup via user data.
  - Explore vertical scaling of EC2 instances and understand different pricing models.
- **Topics Covered**:
  - **Linux EC2 Launch**: Launching a Linux instance and connecting via SSH.
  - **Apache Web Server Configuration**: Installing and configuring Apache on EC2 Linux.
  - **Automating via User Data**: Configuring Apache and other software during EC2 launch using user data.
  - **Vertical Scaling**: Scaling instance size (upgrading from t2.micro to larger instances).
  - **EC2 Pricing Models**:
    - **On-Demand**: Pay-as-you-go pricing.
    - **Reserved Instances**: Commitment for cost savings.
    - **Spot Instances**: Low cost with potential interruptions.
    - **Dedicated Hosts and Instances**: Single-tenant hardware.
- **Hands-on Lab**:
  - Launch and connect to a Linux EC2 instance, configure Apache Web Server, and scale the instance vertically.
  - Automate the Apache installation using EC2 user data during instance launch.

Module 5: Amazon Elastic Block Store (EBS) – Managing and Scaling Storage

- **Learning Objectives**:
  - Understand the various EBS volume types and their use cases.
  - Learn how to create, attach, detach, and extend EBS volumes.
  - Learn how to create EBS snapshots and manage cross-region snapshots and AMIs.

- **Topics Covered**:
  - **EBS Overview**: EBS Volume types (General Purpose SSD, Provisioned IOPS SSD, Cold HDD, Throughput Optimized HDD).
  - **Volume Management**: Creating, attaching, detaching, extending EBS volumes.
  - **Snapshots**: Creating snapshots for backup and disaster recovery.
  - **AMIs and Snapshots**: Source and management of AMIs.
  - **Cross-Region Snapshot Copy**: Managing snapshot copies across AWS regions.
- **Hands-on Lab**:
  - Create, attach, and extend an EBS volume to an EC2 instance.
  - Create an EBS snapshot and copy it across regions.

Module 6: Elastic File System (EFS) and Amazon S3 Storage Solutions

- **Learning Objectives**:
  - Understand Amazon EFS and its use cases.
  - Learn how to set up and manage Amazon S3 buckets, storage classes, versioning, and static website hosting.
  - Explore S3's transfer acceleration feature for faster data transfers.
- **Topics Covered**:
  - **EFS Overview**: Setting up and managing Elastic File System.
  - **Amazon S3**: Buckets, Objects, and Object URLs.
  - **Storage Classes**: Standard, Standard-IA, Glacier, and Intelligent-Tiering.
  - **Versioning and Lifecycle Policies**: Managing versions and configuring lifecycle policies.
  - **Static Website Hosting**: Configuring S3 as a static website host.
  - **Transfer Acceleration**: Speeding up global file uploads to S3.
- **Hands-on Lab**:
  - Create an EFS file system and attach it to an EC2 instance.
  - Set up an S3 bucket, enable versioning, and host a static website.

Module 7: Virtual Private Cloud (VPC) – Networking in AWS

- **Learning Objectives**:
    - Understand the fundamentals of VPC, subnets, route tables, internet gateways, and NAT gateways.
    - Learn how to create a custom VPC and configure private, public, and elastic IP addresses.
    - Explore VPC peering and Site-to-Site VPN for cross-region and cross-account communication.
- **Topics Covered**:
    - **Introduction to Subnetting**: FLSM (Fixed Length Subnet Masking) and CIDR notation.
    - **VPC Fundamentals**: Subnets, Route Tables, Internet Gateways, NAT Instances vs Gateways.
    - **Elastic IPs**: Managing public and private IP addresses.
    - **VPC Peering**: Cross-region and cross-account peering.
    - **Site-to-Site VPN**: Virtual Private Gateway (VPG), Customer Gateway (CG), and Direct Connect.
- **Hands-on Lab**:
    - Create and configure a custom VPC with private and public subnets.
    - Set up VPC peering and Site-to-Site VPN.

Module 8: Load Balancers, Auto Scaling, and High Availability

- **Learning Objectives**:
    - Learn how to implement load balancing using Elastic Load Balancers (ELB), including ALB, NLB, and path-based routing.
    - Understand Auto Scaling Groups (ASG), scaling policies, and termination policies to ensure high availability and fault tolerance.
- **Topics Covered**:
    - **Load Balancers**: Introduction to ELB, ALB, NLB.
    - **Path-based Routing**: Configuring ALB with path-based routing rules.
    - **Auto Scaling Groups (ASG)**: Configuring basic ASG, scaling policies, and termination policies.

    - **High Availability**: Ensuring fault tolerance using ASG and load balancers.
- **Hands-on Lab**:
    - Configure an Auto Scaling Group and set up ELB with path-based routing.

Module 9: Cloud Monitoring and Security – CloudWatch, SNS, and AWS CLI

- **Learning Objectives**:
    - Gain a comprehensive understanding of AWS CloudWatch for monitoring AWS resources and applications.
    - Explore AWS Simple Notification Service (SNS) for setting up notifications, and learn how to automate AWS tasks using the AWS CLI.
    - Understand key security practices with AWS Identity and Access Management (IAM), focusing on user, group, and policy management.
- **Topics Covered**:
    - **CloudWatch**: Setting up metrics, alarms, dashboards, and logs to monitor AWS services.
    - **SNS**: Creating SNS topics, setting up subscribers, and configuring notifications for CloudWatch alarms.
    - **AWS CLI**: Introduction to the CLI, setting up profiles, and performing basic operations on AWS resources using CLI commands.
    - **IAM Basics**: Users, groups, and policies. Understanding permissions and how to create and assign policies.
- **Hands-on Lab**:
    - Set up CloudWatch alarms for EC2 instances, create SNS topics, and configure email notifications.
    - Use the AWS CLI to perform basic tasks such as launching an EC2 instance, attaching an EBS volume, and creating S3 buckets.
    - Set up IAM users and groups with custom policies.

Module 10: VPC Endpoints, Lambda, API Gateway, and SQS

- **Learning Objectives**:
    - Explore VPC Endpoints for securely connecting VPCs to AWS services without using public IPs.
    - Understand AWS Lambda and API Gateway for building and deploying serverless applications.
    - Learn how to implement decoupled architectures using Amazon Simple Queue Service (SQS).
- **Topics Covered**:
    - **VPC Endpoints**: Types of VPC endpoints (Gateway, Interface), and creating VPC endpoints for S3, DynamoDB, and other services.
    - **Lambda Functions**: Overview of AWS Lambda, event-driven compute services, and integrating Lambda with CloudWatch for automated tasks.
    - **API Gateway**: Setting up APIs to trigger Lambda functions and managing API lifecycle.
    - **SQS**: Introduction to message queuing services, creating standard and FIFO queues, and handling message visibility.
- **Hands-on Lab**:
    - Create a VPC Endpoint for S3 and explore its usage.
    - Develop and deploy a Lambda function triggered by an API Gateway request.
    - Set up an SQS queue and simulate decoupling by using Lambda to process messages from the queue.

Module 11: Databases in AWS – RDS, Aurora, DynamoDB, and Elasticache

- **Learning Objectives**:
    - Dive into managed relational databases (RDS) and explore high availability options such as Multi-AZ and Read Replicas.
    - Learn about Amazon Aurora, a high-performance database, and in-memory databases using ElastiCache.
    - Understand DynamoDB, a fully managed NoSQL database, and DAX clusters for caching DynamoDB queries.
- **Topics Covered**:

- **RDS Overview**: Database types, Multi-AZ deployments, Read Replicas, RDS backups, and restoring RDS instances.
- **Amazon Aurora**: Understanding Aurora clusters, read scaling, and fault tolerance.
- **DynamoDB**: Key-value store concepts, tables, partition keys, indexes, and capacity planning.
- **Elasticache**: In-memory caching with Redis and Memcached.
- **DAX**: Setting up DAX clusters for DynamoDB query acceleration.

- **Hands-on Lab**:
  - Create an RDS instance, configure Multi-AZ, and set up a Read Replica.
  - Launch a DynamoDB table and use DAX to accelerate queries.
  - Set up an ElastiCache Redis cluster and integrate it with an application.

Module 12: Data Migration, CloudFormation, and Elastic Beanstalk

- **Learning Objectives**:
  - Learn how to migrate databases using AWS Database Migration Service (DMS) and manage server migrations with Server Migration Service (SMS).
  - Dive into AWS CloudFormation for infrastructure as code, and learn to deploy applications using Elastic Beanstalk.
  - Explore how to automate infrastructure deployment with reusable CloudFormation templates.
- **Topics Covered**:
  - **DMS Overview**: Migrating databases from on-premises to AWS with minimal downtime.
  - **CloudFormation**: Infrastructure as code, template structure, stacks, and change sets.
  - **Elastic Beanstalk**: Platform-as-a-service (PaaS) for quick application deployment with EC2, RDS, S3, and more.
  - **SMS**: Server migration to AWS cloud, planning and execution.
- **Hands-on Lab**:

- Set up a CloudFormation template to create a VPC, EC2 instance, and S3 bucket.
- Deploy a web application using Elastic Beanstalk with an RDS database backend.
- Migrate an on-premises database to AWS RDS using DMS.

Module 13: AWS Systems Manager, Cross-Account Access, and ECS

- **Learning Objectives**:
  - Gain hands-on experience with AWS Systems Manager for automating operational tasks across AWS resources.
  - Understand AWS Organizations and Cross-Account Access for managing multiple AWS accounts.
  - Learn about container orchestration with Amazon Elastic Container Service (ECS).
- **Topics Covered**:
  - **AWS Systems Manager**: Managing EC2 instances, creating Run Command, and automating patching.
  - **AWS Organizations**: Managing multiple AWS accounts, service control policies, and consolidated billing.
  - **Cross-Account Access**: Setting up IAM roles for cross-account resource access.
  - **ECS Overview**: ECS launch types, Fargate vs EC2, task definitions, and service scheduling.
- **Hands-on Lab**:
  - Set up and manage an EC2 fleet using AWS Systems Manager.
  - Configure cross-account access using IAM roles.
  - Launch a containerized application using ECS with the Fargate launch type.

Module 14: Introduction to AI Ecosystem

- **Understanding Cloud Computing & AWS**

  1. AWS Global Infrastructure & Cloud Computing Models (IaaS, PaaS, SaaS)
  2. AWS Core Services Overview (EC2, S3, RDS, IAM, Lambda)
  3. AWS CLI, SDKs & Boto3 for AI integration

- **Introduction to AI & Machine Learning in AWS**

  1. What is AI? Machine Learning vs. Deep Learning vs. Generative AI
  2. AWS AI/ML Service Overview: SageMaker, Bedrock, Rekognition, Lex, Polly
  3. Business Use Cases: AI-driven analytics, automation & personalization

Module 15: AI & Machine Learning on AWS

- **AWS SageMaker – Machine Learning at Scale**

  1. Building & Training ML Models in SageMaker
  2. Hyperparameter Tuning & Model Optimization
  3. SageMaker AutoPilot – No-Code Machine Learning

- **AWS AI Services for Business Applications**

  1. Amazon Rekognition – Image & Video Analysis
  2. Amazon Comprehend – NLP & Sentiment Analysis
  3. Amazon Transcribe & Translate – Speech-to-Text & Multilingual AI
  4. Amazon Lex & Polly – AI Chatbots & Speech Synthesis

Module 16: Generative AI & LLMs with AWS Bedrock

- **Introduction to Generative AI & Large Language Models (LLMs)**

  1. How LLMs Work: Transformers, Attention Mechanism & GPT Models
  2. AWS Bedrock – Deploying Pre-Trained AI Models
  3. Fine-Tuning & Customizing LLMs on AWS

- **Hands-On Labs & Use Cases**
  1. Building AI Chatbots with AWS Lex & Bedrock
  2. Text Summarization & Content Generation

3. Image & Video AI with Stable Diffusion & AWS Rekognition

Module 17: Serverless AI & Real-Time AI Applications

- **Deploying AI Models in a Serverless Environment**

1. AWS Lambda for AI Inference
2. AWS Step Functions for AI Automation
3. AWS Fargate & Kubernetes (EKS) for Scalable AI Deployments

- **Edge AI & IoT Integrations**

1. AWS IoT Greengrass – AI on Edge Devices
2. Real-Time AI Inference with AWS Kinesis & Sagemaker Edge

Module 18: Deploying & Managing AI Models at Scale

- **AI Model Deployment Strategies**

1. CI/CD for ML (MLOps) with AWS CodePipeline & SageMaker Pipelines
2. Model Monitoring & Retraining with Amazon CloudWatch & SageMaker Model Monitor

- **Security, Compliance & Governance in AI on AWS**

1. AWS Identity & Access Management (IAM) for AI Workloads
2. Data Privacy & Compliance (GDPR, HIPAA, SOC2)
3. AI Bias & Fairness Considerations

Module 18: Capstone Project – AI-Powered Cloud Solution

Real-World Project: End-to-End AI Application on AWS

Project Examples:

✅ AI-Powered Customer Support Chatbot
✅ Predictive Analytics with SageMaker & Redshift
✅ Automated Image Recognition & Classification System
✅ Real-Time Sentiment Analysis & NLP-based Chatbot