AI+ Cloud (120 Hours and 20 Days)

Duration: 120 Hrs
Days: 20
Exam Code: AT-110

Executive Summary:

This curriculum is designed to provide an integrated learning experience across networking, data science, and more focused on application of AI using cloud, beginning with foundational network architectures and AI-enhanced automation capabilities , advancing through end-to-end data science workflows from exploratory analysis and generative AI techniques , and culminating in comprehensive cloud AI proficiency that includes service models, pre-built and custom model development, MLOps pipelines, edge inference, and responsible AI practices that are all reinforced through hands-on labs and a capstone project that fuses networking, data engineering, and cloud deployment into a production-ready AI solution.

Day 1: Module 1 – Networking Foundations (6 hrs)

- **Topic 1.1: Network Types & Topologies**
  - Network and Topology concepts
  - Network Types- LAN, WAN, MAN, PAN
  - Topology Types- Star, Ring, Mesh architectures
  - **Use-cases**
  - **Case Study**
- **Topic 1.2: OSI & TCP/IP Models + Protocols**
  - OSI 7-layer vs. TCP/IP 4-layer Models
  - Understanding of Protocols and their importance
  - Common Protocols- HTTP/HTTPS, FTP, SMTP, DNS
  - **Use-cases**
  - **Case Study**
- **Topic 1.3: Network Components & Devices**
  - Understanding of Routers, Switches, Hubs
  - Firewall and its types
  - VLANs, Subnetting Basics
  - **Use-cases**
  - **Case Study**
- **Hands-on Exercises**

Day 2: Module 2 – Advanced Networking Technologies (6 hrs)

- **Topic 2.1: Software-Defined Networking (SDN) & NFV**
  - Understanding SDN and its architecture
  - Understanding Controller and its importance
  - NFV concepts and its applications
  - Virtual Network (VNets) and its functions
  - **Use-cases**
  - **Case Study**
- **Topic 2.2: Edge & 5G Networking**
  - Edge computing and its importance
  - Fog Networking and its applications
  - 5G Networking understanding
  - **Use-cases**
  - **Case Study**
- **Topic 2.3: Advanced Routing and Switching**
  - Dynamic Routing Protocols such as OSPF, BGP, EIGRP
  - Layer 3 Switching and Multicast Routing basic concepts
  - QoS and its importance
  - **Use-cases**
  - **Case Study**
- **Topic 2.4: Data Center Networking & Storage**
  - SAN
  - NAS
  - SAN Vs. NAS
  - Data Center Networking and Design
  - **Use-cases**
  - **Case Study**
- **Hands-on Exercises**

Day 3: Module 3 – AI in Networking & Security (6 hrs)

- **Topic 3.1: AI-Driven Performance Optimization**
  - AI Concepts and its Terminologies
  - Overview of Machine Learning (ML)
  - ML Algorithms- Supervised, Un-Supervised and Reinforcement and its Applications and Algorithms
  - Traffic analysis & predictive load balancing using AI
  - **Use-cases**
  - **Case Study**
- **Topic 3.2: Machine Learning for Threat Detection**
  - Understanding of Threat and Threat Intelligence, its Importance
  - Threat vs. Anomaly
  - Anomaly Detection & SIEM integration
  - **Use-cases**
  - **Case Study**
- **Topic 3.3: Network Automation & Orchestration**

  - Fundamental concepts of Network Automation
  - Root-cause analysis automation
  - AI in Network Automation
  - **Use-cases**
  - **Case Study**
- **Hands-on Exercise**

Day 4: Module 4 – Networking Labs & Hands-On Projects (6 hrs)

- **Topic 4.1: Network Lab Hands-on Exercises**
  - Lab Hands-on Exercises using GNS3, Cisco Packet Tracer setups
- **Topic 4.2.: Emulating Real-World Scenarios Projects**
  - Real-World Scenario Projects

Day 5: Module 5 – Foundations of Data Science & Statistics (6 hrs)

Topic 5.1: Introduction to Data Science

- Key concepts and methodologies of data science
- Importance of data in machine learning and AI applications
- Understanding data-driven decision-making
- **Use-cases**
- **Case Study**

Topic 5.2: Statistical Foundations for Data Science

- Descriptive statistics: Mean, Median, Mode, Standard Deviation
- Probability theory and distributions (Normal, Poisson, Binomial)
- Hypothesis testing, p-values, and confidence intervals
- Exploratory data analysis (EDA)
- **Use-cases**
- **Case Study**

Hands-on Exercise

Day 6: Module 6 – Data Wrangling & Preprocessing (6 hrs)

Topic 6.1: Introduction to Data Wrangling

- Handling missing values (imputation, removal)
- Data cleaning: Removing duplicates, filling null values
- Data type conversions (integer, float, categorical)

- **Use-cases**
- **Case Study**

Topic 6.2: Preprocessing Techniques

- Feature scaling: Normalization, Standardization
- Categorical encoding (One-Hot Encoding, Label Encoding)
- Text preprocessing (Tokenization, Stopwords removal)
- Feature extraction and selection
- **Use-cases**
- **Case Study**

Hands-on Exercise

Day 7: Module 7 – Exploratory Data Analysis & Visualization (6 hrs)

Topic 7.1: Exploratory Data Analysis (EDA)

- Understanding the data through summary statistics
- Identifying patterns and anomalies in the data
- Feature selection and correlation analysis
- Data cleaning and preparation for visualization
- **Use-cases**
- **Case Study**

Topic 7.2: Data Visualization Techniques

- Plotting with Matplotlib and Seaborn
- Visualizing distributions: Histograms, Box plots
- Visualizing relationships: Scatter plots, Pair plots
- Advanced visualizations with Seaborn and Plotly
- **Use-cases**
- **Case Study**

Hands-on Exercise

Day 8: Module 8– Generative AI Tools & Insight (6 hrs)

Topic 8.1: Introduction to Generative AI

- Basics of GANs (Generative Adversarial Networks)
- Overview of VAEs (Variational Autoencoders)
- Applications of Generative AI: Image generation, data augmentation
- **Use-cases**

- **Case Study**

Topic 8.2: Leveraging Generative AI Tools

- Implementing GANs for image creation and enhancement
- Using VAEs for generating new data points
- Overview of generative models in text generation (GPT-3)
- Application of Generative AI in cybersecurity (data privacy, data augmentation)
- **Use-cases**
- **Case Study**

Hands-on Exercise

Day 9: Module 9 – Advanced ML & Dimensionality Reduction (6 hrs)

Topic 9.1: Advanced Machine Learning Techniques

- Overview of ensemble methods: Random Forests, Gradient Boosting, XGBoost
- Understanding advanced regression techniques: Lasso, Ridge, and Elastic Net
- Hyperparameter tuning and cross-validation
- Optimizing machine learning models
- **Use-cases**
- **Case Study**

Hands-on Exercise

Day 10: Module 10 –Dimensionality Reduction (6 hrs)

Topic 10.1: Dimensionality Reduction

- PCA (Principal Component Analysis)
- t-SNE (t-distributed Stochastic Neighbor Embedding)
- Feature selection techniques for improving model performance
- Visualizing high-dimensional data
- **Use-cases**
- **Case Study**

Hands-on Exercise

Day 11: Module 11 – Cloud Fundamentals & AI–Cloud Integration (6 hrs)

Topic 11.1: Cloud Computing Models

- **IaaS (Infrastructure as a Service)**:
  - Understanding virtual machines (VMs), storage solutions (e.g., block storage, object storage)
  - Networking services: VPC (Virtual Private Cloud), VPNs (Virtual Private Networks), Load Balancers
  - Understanding about AWS EC2, Azure Virtual Machines
  - **Use-cases**
  - **Case Study**
- **PaaS (Platform as a Service)**:
  - Managed platform for building, running, and scaling applications
  - Deployment pipelines, container orchestration (e.g., Kubernetes, Docker)
  - Understanding about AWS Elastic Beanstalk, Google App Engine
  - Databases as a service (e.g., RDS, Cosmos DB)
  - **Use-cases**
  - **Case Study**
- **SaaS (Software as a Service)**:
  - Fully managed cloud applications accessible via the web
  - Examples: Office 365, Salesforce, Google Workspace
  - Key benefits: Low maintenance, scalability, and access from anywhere
  - **Use-cases**
  - **Case Study**
- **Hands-on Exercise**

Day 12: Module 12 – Cloud AI Services & Pre-built Models (6 hrs)

Topic 12.1: Leveraging Cloud AI Services

- **Amazon SageMaker (AWS)**:
  - Managed service for building, training, and deploying machine learning models
  - Model training, hyperparameter tuning, and deployment pipelines
  - **Use-cases**
  - **Case Study**
- **Azure Cognitive Services**:
  - Pre-built APIs for integrating AI capabilities like language, vision, and speech into applications
  - Vision APIs: Image recognition, object detection, facial recognition
  - Language APIs: Sentiment analysis, translation, speech-to-text, text-to-speech
  - **Use-cases**
  - **Case Study**
- **Google AI Platform**:
  - Managed services for training and deploying AI models at scale
  - Integration with TensorFlow, Keras, and other ML frameworks
  - **Use-cases**

    - **Case Study**
- **Hands-on Exercise**

Day 13: Module 13 –NLP & API using Cloud Services (6 hrs)

Topic 13.1: Vision, NLP & Speech APIs + Transfer Learning

- **Vision APIs**:
    - Pre-trained models for image recognition, object detection, and facial recognition
    - Integration with cloud-based image classification models (e.g., AWS Rekognition, Google Vision)
    - **Use-cases**
    - **Case Study**
- **Natural Language Processing (NLP) APIs**:
    - Sentiment analysis, named entity recognition (NER), language translation, text summarization
    - Understanding about Azure Text Analytics API, Google Natural Language API
    - **Use-cases**
    - **Case Study**
- **Speech APIs**:
    - Speech-to-text and text-to-speech capabilities
    - Use cases: Voice commands, transcription, chatbots
    - Understanding about Google Speech-to-Text, AWS Transcribe, Azure Speech API
    - **Use-cases**
    - **Case Study**
- **Transfer Learning**:
    - Reusing pre-trained models and fine-tuning them for domain-specific applications
    - Techniques: Fine-tuning using transfer learning (e.g., BERT for NLP, ResNet for vision)
    - **Use-cases**
    - **Case Study**
- **Hands-on Exercise**

Day 14: Module 14 – REST & SDK Integration Patterns (6 hrs)

Topic 14.1: REST & SDK Integration Patterns

- **REST API Integration**:
    - Using RESTful APIs to interact with cloud AI services
    - API authentication, managing rate limits, and handling responses
- **SDKs for Cloud AI Services**:
    - Using Software Development Kits (SDKs) to simplify integration with AI models

- Understanding about SDKs: AWS SDK for Python (Boto3), Azure SDK for Python
- **Use-cases**
- **Case Study**

Day 15: Module 15 – Cloud-Native ML Development (6 hrs)

Topic 15.1: AutoML & No-Code ML Pipelines

- **AutoML (Automated Machine Learning)**:
  - AutoML platforms for automating model selection, feature engineering, and hyperparameter tuning
  - Tools: Google AutoML, H2O.ai, Microsoft Azure AutoML
- **No-Code ML**:
  - Building machine learning models without coding, through graphical interfaces
  - Understanding about IBM Watson Studio, Alteryx, Google Cloud AutoML
  - **Use-cases**
  - **Case Study**
- **Hands-on Exercise**

Topic 15.2: Containerized & Distributed ML Training

- **Containerization**:
  - Packaging machine learning models and dependencies using containers (Docker)
  - Container orchestration with Kubernetes for scaling ML workloads
- **Distributed ML Training**:
  - Techniques for scaling machine learning models across multiple nodes and GPUs
  - Understanding Distributed Tools: Horovod (distributed training for TensorFlow, PyTorch)
  - **Use-cases**
  - **Case Study**

Topic 15.3: Managed Notebooks & Data Pipelines

- **Managed Notebooks**:
  - Cloud-based Jupyter notebooks with pre-configured environments for ML development
  - Understanding about Google Colab, AWS SageMaker Notebooks
- **Data Pipelines**:
  - Automating data ingestion, preprocessing, and training workflows
  - Tools: Apache Airflow, AWS Glue, Google Cloud Dataflow
  - **Use-cases**

    - **Case Study**
- **Hands-on Exercise**

Day 16: Module 16 – Edge AI & Hybrid Cloud Patterns (6 hrs)

Topic 16.1: IoT Edge Deployments – Greengrass, IoT Edge

- **AWS Greengrass**:
    - Extending AWS services to edge devices for local compute and storage capabilities
    - Use cases: Offline machine learning, edge data processing, real-time analytics
- **Azure IoT Edge**:
    - AI and ML model deployment on edge devices to enable local processing and decision-making
    - Key components: IoT Edge modules, Docker containers for deployment
    - **Use-cases**
    - **Case Study**

Topic 16.2: Federated Learning & On-Device AI

- **Federated Learning**:
    - Collaborative learning where models are trained across decentralized devices without sharing raw data
    - Understanding about Google Gboard, healthcare applications (e.g., federated learning on mobile devices)
- **On-Device AI**:
    - Running ML models directly on mobile devices or embedded systems to avoid latency and reduce cloud dependency
    - Understanding about TensorFlow Lite for mobile, AWS IoT Core for Edge devices.
    - **Use-cases**
    - **Case Study**
- **Hands-on Exercise**

Day 17: Module 17 – Serverless Inference (6 hrs)

Topic 17.1: Serverless Inference – Lambda, Cloud Functions

- **AWS Lambda**:
    - Serverless computing for running ML inference models on demand, without managing infrastructure
    - Event-driven ML inference (e.g., running inference upon file upload in S3)
    - **Use-cases**

    - **Case Study**
- **Google Cloud Functions**:
    - Scalable serverless functions for executing machine learning models on the cloud
    - Integration with AI models for real-time inference
    - **Use-cases**
    - **Case Study**
- **Hands-on Exercise**

Day 18: Module 18 – Responsible & Explainable AI (6 hrs)

Topic 18.1: Fairness & Bias Detection in AI

- **Bias Detection**:
    - Techniques to detect and mitigate biases in AI models based on demographic attributes (e.g., race, gender, age)
    - Fairness Indicators, AI Fairness 360 library (IBM)
    - **Use-cases**
    - **Case Study**
- **Fairness Audits**:
    - Tools and metrics for evaluating fairness in AI-driven decisions
    - Understanding about Equal Opportunity Difference, Disparate Impact metric
    - **Use-cases**
    - **Case Study**

Topic 18.2: Explainable AI (XAI) – SHAP, LIME

- **SHAP (Shapley Additive Explanations)**:
    - Explainability model for understanding feature importance in machine learning models
    - Understanding about Using SHAP for model interpretability with tree-based models
    - **Use-cases**
    - **Case Study**
- **LIME (Local Interpretable Model-Agnostic Explanations)**:
    - Approximating complex models locally to provide interpretable predictions for individual instances
    - **Use-cases**
    - **Case Study**
- **Hands-on Exercise**

Day 19: Module 19 – Privacy Frameworks in AI (6 hrs)

Topic 19.1: Privacy Frameworks in AI – GDPR, HIPAA

- **GDPR (General Data Protection Regulation)**:
  - Ensuring compliance with EU data privacy regulations when deploying AI solutions
  - Principles: Data minimization, consent management, right to explanation.
  - **Use-cases**
  - **Case Study**
- **HIPAA (Health Insurance Portability and Accountability Act)**:
  - Applying privacy safeguards to protect sensitive health information in AI-driven healthcare applications
  - **Use-cases**
  - **Case Study**

Day 20: Module 20 – Capstone Projects and Presentation (6 hrs)

Topic 20.1: Capstone Projects

Topic 20.2: Capstone Projects Presentation