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Course Title
Machine Learning (ML)

Course Level
 Intermediate (Certification + Practical Cloud Skills)

Course Overview
This course introduces students to the fundamentals of Machine Learning (ML), focusing on core algorithms, their practical applications, and hands-on implementation using Python libraries. Students will learn how machines identify patterns in data, build predictive models, and evaluate their performance. The course covers essential concepts including supervised learning, unsupervised learning, neural networks, reinforcement learning, and model evaluation techniques.
By the end of the course, students will gain a strong foundation in machine learning concepts and develop the skills required to apply ML techniques to real-world problems.

Module 1: Introduction to Machine Learning
Topics:
 • What is Machine Learning and how it works
 • Role of machine learning in Artificial Intelligence
 • Evolution and history of machine learning
 • Types of machine learning (Supervised, Unsupervised, Reinforcement Learning)
 • Machine learning workflow and model development lifecycle
 • Model representation and pattern learning
 • Training datasets vs testing datasets
 • Overfitting, underfitting, and generalization in machine learning models
 • Real-world applications of machine learning across industries

Module 2: Supervised Learning
Topics:
 • Introduction to supervised learning techniques
 • Regression vs classification problems
 • Linear Regression for predicting numerical values
 • Cost functions and optimization methods
 • Gradient descent algorithm
 • Logistic Regression for classification tasks
 • Decision Tree algorithms
 • k-Nearest Neighbors (k-NN) algorithm
 • Training supervised models using labeled datasets

Module 3: Unsupervised Learning
Topics:
 • Introduction to unsupervised learning

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- Understanding unlabeled datasets
- Clustering techniques and pattern discovery
- K-Means clustering algorithm
- Hierarchical clustering methods
- Dimensionality reduction concepts
- Principal Component Analysis (PCA)
- Feature reduction for large datasets
- Applications of clustering in business and data analysis

Module 4: Introduction to Neural Networks & Deep Learning
Topics:
- Introduction to artificial neural networks
- Structure of neural networks (input, hidden, and output layers)
- Activation functions and their role in neural networks
- Backpropagation algorithm for training networks
- Deep learning architectures
- Convolutional Neural Networks (CNNs)
- Applications of deep learning in image recognition and natural language processing
- Overview of modern deep learning frameworks

Module 5: Introduction to Reinforcement Learning
Topics:
- Fundamentals of reinforcement learning
- Agents, environments, and actions
- Markov Decision Processes (MDP)
- Reward systems and policy learning
- Value functions and decision strategies
- Q-Learning algorithm
- Applications of reinforcement learning in robotics, gaming, and automation

Module 6: Model Evaluation and Selection
Topics:
- Importance of evaluating machine learning models
- Classification and regression evaluation metrics
- Accuracy, precision, recall, and F1 score
- Confusion matrix analysis
- ROC curve and AUC evaluation methods
- Cross-validation techniques
- Avoiding overfitting and improving model generalization
- Comparing and selecting machine learning models

Module 7: Advanced Machine Learning Concepts
Topics:

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• Support Vector Machines (SVM) for classification and regression
• Natural Language Processing (NLP) fundamentals
• Feature engineering techniques
• Feature selection and transformation
• Hyperparameter tuning and optimization
• Improving model performance using advanced techniques

Module 8: Tools and Practical Implementation
Topics:
• Python programming for machine learning
• Working with NumPy for numerical computing
• Data analysis and manipulation using Pandas
• Machine learning implementation with Scikit-Learn
• Introduction to TensorFlow and deep learning frameworks
• Data preprocessing and transformation techniques
• Building machine learning pipelines
• Working with real-world datasets from platforms such as Kaggle

Capstone Project: Machine Learning Application Development
During the final phase of the course, students will work on a real-world machine learning project where they will select a dataset, perform data preprocessing and exploratory data analysis, train and evaluate machine learning models, and present their final solution. This project will allow learners to apply the concepts learned throughout the course and gain practical experience solving real data science problems.

Recommended Textbooks & Resources
Books
• Introduction to Machine Learning — Ethem Alpaydin
• Pattern Recognition and Machine Learning — Christopher M. Bishop
• Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow — Aurélien Géron