Course Name: Artificial Intelligence (AI) and Machine Learning Professional Certification Course

Course Overview

This comprehensive course covers the fundamentals, intermediate, and advanced concepts in Artificial Intelligence (AI) and Machine Learning (ML). Starting with foundational topics like definitions, history, and applications of AI, learners will explore intelligent agents, search algorithms, knowledge representation, and expert systems. The intermediate level delves into planning, uncertainty, natural language processing (NLP), computer vision, and ethical considerations in AI. Advanced topics include deep learning, reinforcement learning, and specialized applications across industries. The ML section provides a detailed understanding of supervised and unsupervised learning, deep learning techniques, ensemble methods, NLP in ML, and time-series forecasting.

Course Type

Entry-level to Advanced.

Course Objectives

- Introduce the core principles and techniques of AI and ML.

- Develop problem-solving and decision-making skills using AI algorithms.

- Equip learners with knowledge of modern AI and ML tools and applications.

- Foster an understanding of ethical considerations in AI.

- Prepare learners for practical implementation and advanced research in AI and ML.

What You'll Learn?

- Fundamentals of AI, including intelligent agents, search techniques, and knowledge representation.

- Applications of AI in fields like healthcare, finance, and autonomous systems.

- Supervised and unsupervised machine learning techniques, deep learning models, and ensemble methods.

- Advanced AI topics like reinforcement learning, adversarial search, and probabilistic reasoning.

- Practical skills in NLP, computer vision, and deploying ML models.

Duration

Approximately 120–150 hours (flexible, depending on pace and depth).

Requirements

- A computer with internet access.

- Basic programming skills (Python is preferred).

Prerequisites

- Familiarity with basic mathematics (linear algebra, calculus, and probability).

- Fundamental understanding of programming concepts.

Target Audience

- Beginners interested in learning AI and ML fundamentals.

- Aspiring data scientists, AI engineers, and ML specialists.

- IT professionals seeking to upskill in AI and ML.

- Students pursuing careers in AI, ML, or data science.

- Industry professionals aiming to integrate AI/ML solutions in their organizations.

Curriculum

Basic Level

Module 1. Introduction to Artificial Intelligence

 - Definition of AI

 - History of AI

 - Applications of AI in Various Domains

 - AI vs Machine Learning vs Deep Learning

Module 2. Intelligent Agents

 - Definition and Types of Agents

 - Rationality and Environments

 - Structure of Agents (Simple Reflex, Model-Based, Goal-Based, Utility-Based)

Module 3. Problem Solving in AI

 - Search Algorithms (Uninformed and Informed)

 - Breadth-First Search (BFS), Depth-First Search (DFS)

 - Heuristic Search (Greedy, A* Algorithm)

 - Constraint Satisfaction Problems (CSPs)

Module 4. Knowledge Representation and Reasoning

 - Knowledge Representation (Logic-Based, Frame-Based, Rule-Based Systems)

 - Propositional Logic, First-Order Logic

 - Inference in First-Order Logic

 - Semantic Networks, Ontologies

Module 5. Expert Systems

 - Introduction to Expert Systems

 - Components of Expert Systems

 - Rule-Based Expert Systems (Forward and Backward Chaining)

Intermediate Level

Module 1. Planning in AI

 - Introduction to Planning

 - Classical Planning Techniques

 - Partial-Order Planning

 - Hierarchical Planning

Module 2. Uncertainty in AI

 - Introduction to Uncertainty and Probabilistic Reasoning

 - Bayesian Networks

 - Markov Models

 - Hidden Markov Models (HMMs)

 - Decision Theory and Utility Theory

Module 3. Natural Language Processing (NLP)

 - Introduction to NLP

 - Tokenization, Stemming, and Lemmatization

 - POS Tagging, Named Entity Recognition (NER)

 - Language Models (n-Grams, Bag-of-Words)

 - Sentiment Analysis, Text Classification

Module 4. Computer Vision

 - Basics of Image Processing

 - Image Classification Techniques

 - Object Detection and Recognition

 - Convolutional Neural Networks (CNNs)

 - Applications of AI in Computer Vision (Facial Recognition, Autonomous Driving)

Module 5. AI Ethics and Challenges

 - Ethical Considerations in AI

 - AI Bias and Fairness

 - AI Safety and Security

 - Social and Economic Impacts of AI

Advanced Level

Module 1. Advanced Search Techniques

 - Local Search Algorithms (Hill Climbing, Simulated Annealing)

 - Adversarial Search (Minimax Algorithm, Alpha-Beta Pruning)

 - Game Theory in AI (Zero-Sum Games, Nash Equilibrium)

Module 2. Reinforcement Learning

 - Introduction to Reinforcement Learning

 - Markov Decision Processes (MDPs)

 - Q-Learning, Deep Q Networks (DQN)

 - Policy Gradient Methods

 - Applications of Reinforcement Learning (Robotics, Game AI)

Module 3. Deep Learning in AI

 - Introduction to Neural Networks

 - Deep Neural Networks (DNNs)

 - Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM)

 - Generative Adversarial Networks (GANs)

 - Transfer Learning

Module 4. AI Applications

 - AI in Healthcare (Diagnosis, Drug Discovery)

 - AI in Finance (Fraud Detection, Algorithmic Trading)

- AI in Autonomous Systems (Drones, Self-Driving Cars)

- AI for Social Good (Disaster Response, Climate Change Solutions)

- Machine Learning Syllabus (Basic to Advanced)

Basic Level

Module 1. Introduction to Machine Learning

 - What is Machine Learning?

 - Types of Machine Learning (Supervised, Unsupervised, Reinforcement)

 - Key Concepts: Features, Labels, Training, Testing

 - Applications of Machine Learning

Module 2. Supervised Learning Basics

 - Linear Regression

 - Logistic Regression

 - Evaluation Metrics (Accuracy, Precision, Recall, F1-Score)

 - Overfitting and Underfitting

Module 3. Unsupervised Learning Basics

 - K-Means Clustering

 - Hierarchical Clustering

 - Principal Component Analysis (PCA)

 - Applications of Clustering (Customer Segmentation, Anomaly Detection)

Module 4. Introduction to Neural Networks

 - Perceptron Model

 - Activation Functions (Sigmoid, ReLU, Tanh)

 - Introduction to Backpropagation and Gradient Descent

Intermediate Level

Module 1. Supervised Learning – Advanced Algorithms

- Decision Trees

- Random Forest

- Support Vector Machines (SVM)

- k-Nearest Neighbors (k-NN)

Module 2. Unsupervised Learning – Advanced Algorithms

- Gaussian Mixture Models (GMM)

- Self-Organizing Maps (SOM)

- DBSCAN (Density-Based Spatial Clustering)

Module 3. Dimensionality Reduction

- Principal Component Analysis (PCA)

- Linear Discriminant Analysis (LDA)

- t-SNE (t-Distributed Stochastic Neighbor Embedding)

Module 4. Model Evaluation and Selection

- Cross-Validation Techniques (K-Fold, Leave-One-Out)

- Confusion Matrix and ROC Curve

- Hyperparameter Tuning (Grid Search, Random Search)

Module 5. Feature Engineering

- Feature Scaling and Normalization

- Feature Extraction and Selection Techniques

- Handling Missing Data and Outliers

Advanced Level

Module 1. Deep Learning

- Multilayer Perceptron (MLP)

- Convolutional Neural Networks (CNNs)

- Recurrent Neural Networks (RNNs)

- Long Short-Term Memory (LSTM) Networks

- Autoencoders

Module 2. Advanced Neural Networks

- Transfer Learning

- Generative Adversarial Networks (GANs)

- Reinforcement Learning

- Neural Architecture Search

Module 3. Ensemble Methods

- Bagging and Boosting

- Random Forest and Gradient Boosting

- XGBoost, AdaBoost, LightGBM

Module 4. Natural Language Processing (NLP) with Machine Learning

- Text Preprocessing Techniques

- Word Embeddings (Word2Vec, GloVe)

- Text Classification using ML Models

- Sequence-to-Sequence Models

Module 5. Time Series Forecasting

- Time Series Decomposition

- ARIMA (AutoRegressive Integrated Moving Average)

- Long Short-Term Memory Networks (LSTMs) for Time Series

- Applications of Time Series Analysis (Stock Prediction, Weather Forecasting)

Module 6. Big Data and Machine Learning

- Introduction to Big Data

- Using Hadoop and Spark for Machine Learning

- Distributed Machine Learning

Module 7. ML Deployment

 - Model Deployment (APIs, Cloud Services)

 - Monitoring and Updating Models

 - Model Interpretability (SHAP, LIME)