Algorithm Mastery Roadmap to AIML

Duration: 48 hours

Overview

This comprehensive course on Algorithms offers a structured progression from foundational concepts to real-world applications, tailoring skills for AI and ML. It begins with Fundamentals of Algorithms, exploring sorting, searching, recursion, and data structures, alongside hands-on exercises like implementing sorting algorithms and analysing Big-O complexity. In Core Algorithmic Techniques, learners tackle intermediate concepts such as divide-and-conquer methods, greedy strategies, dynamic programming, and graph algorithms, supported by labs like Huffman coding and graph traversal simulations. The Advanced Algorithms for AI/ML module delves into innovative areas, including genetic algorithms, reinforcement learning, and probabilistic methods, complemented by practical experiments in Bayesian inference and Q-Learning. Finally, the Expert-Level Applications focus on integrating algorithms in data science workflows, optimizing hyperparameters, and addressing ethical considerations, culminating in end-to-end ML pipeline projects and scenario-based evaluations. This course equips learners with theoretical insights and practical expertise to excel in AI/ML-driven environments.

Audience Profile

- AI/ML Enthusiasts & Data Scientists
- Software Developers & Engineers
- Competitive Programmers & Researchers
- Business Analysts & AI Practitioners

Tools and Lab Platform

- Python
- Jupyter Notebook/Colab

Course Agenda

Module 1: Fundamentals of Algorithms (Beginner Level)

- Introduction to Algorithms in AI/ML
- Time & Space Complexity (Big-O)
- Basic Sorting (Bubble, Selection, Insertion)
- Searching (Linear, Binary)
- Recursion & Backtracking Basics
- Data Structures Intro (Arrays, Linked Lists)

Practice exercises

- Sorting algorithm implementations
- Recursive function exercises
- Big-O complexity analysis with code
- Linked list traversal & manipulation

Module 2: Core Algorithmic Techniques (Intermediate Level)

- Divide & Conquer (Merge Sort, Quick Sort)
- Greedy Algorithms (Huffman Coding, Kruskal's Algorithm)
- Dynamic Programming (Fibonacci, Knapsack)
- Graph Algorithms (DFS, BFS, Dijkstra's, A*)
- Hashing & Hash Maps
- Tree & Heap Algorithms

Practice exercises

- DP problems: Memoization & Tabulation
- Graph traversal simulations
- Huffman coding lab
- Hash map collision handling

Module 3: Advanced Algorithms for AI/ML (Pro-Level)

- Advanced DP Patterns
- Randomized & Monte Carlo Algorithms
- Genetic Algorithms & Simulated Annealing

- Neural Network Optimizations
- Reinforcement Learning (Q-Learning, DQN)
- Probabilistic Algorithms (Bayesian Networks, Markov Chains)

Practice exercises

- Implement Genetic Algorithm for optimization
- Simulate Q-Learning for simple environment
- Bayesian inference experiments
- ARIMA-based time-series lab

Module 4: Expert Level (Real-World Applications & Certifications)

- Algorithms in Data Science Pipelines
- Ethics in Algorithmic Decision-Making
- Hyperparameter Optimization Techniques (Grid/Random Search, Bayesian Opt)
- Model Deployment Pipelines

Practice exercises

- End-to-end ML workflow optimization
- A/B testing with algorithm variants
- Ethics simulation scenarios
- Real-world case study