MLOps Fundamentals Training

Duration: **3 Day**

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Overview

MLOps Fundamentals Training provides an in-depth introduction to the principles, components, and technologies involved in Machine Learning Operations (MLOps). The course examines the machine learning lifecycle, MLOps workflows, and the role of tools such as MLflow and Kubeflow in managing and automating machine learning processes.

Participants begin by preparing a machine learning project environment using Git, GitHub, virtual environments, and pre-commit hooks. The program then explores essential data management practices, including data lifecycles, version control, governance, and storage solutions.

Hands-on exercises demonstrate Exploratory Data Analysis (EDA), feature engineering, and data cleaning using pandas and matplotlib. The training also examines feature stores, model development, experiment tracking, hyperparameter optimization, deployment strategies, and CI/CD automation.

Technologies such as Docker, Ray Serve, GitHub Actions, Prometheus, and Grafana are introduced to support the deployment, monitoring, and maintenance of machine learning systems in production environments.

Prerequisites

Participants should have:

- Proficiency in Python programming
- A strong beginner-to-intermediate understanding of machine learning
- Familiarity with Git and version control
- Experience working with cloud platforms

Recommended Prerequisite Course: Building Intelligent Applications with AI/ML Level 2

Who Should Attend

This course is intended for professionals seeking to move beyond experimental machine learning demonstrations and develop production-ready ML applications.

- Data Scientists
- Developers
- Software Engineers
- Machine Learning Practitioners

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What You Will Learn

Upon completing this training, you will be able to:

- Explain the MLOps lifecycle and its core components.
- Set up machine learning projects using Git, GitHub, and Python environments.
- Apply data management, versioning, EDA, and feature engineering techniques.
- Develop, test, and compare machine learning models.
- Track experiments and manage models using MLflow.
- Apply hyperparameter optimization and model evaluation techniques.
- Deploy machine learning models using Docker and cloud technologies.
- Automate CI/CD workflows with GitHub Actions.
- Monitor model drift and changes in model performance.
- Build model monitoring solutions using Prometheus and Grafana.
- Design an end-to-end MLOps pipeline.

Outline

1. Introduction to MLOps

- Understanding MLOps and Its Purpose
- Overview of the Machine Learning Lifecycle

2. MLOps Components and Tools

- MLOps Lifecycle, Core Components, and Benefits
- The Role of MLflow, Kubeflow, and Similar Tools in Automating ML Pipelines

3. Setting Up a Machine Learning Project

- Configuring Git and GitHub
- Creating Virtual Environments
- Using Pre-commit Hooks

4. Data Management Fundamentals

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- Understanding Data Lifecycles
- Data Versioning
- Data Governance
- Data Storage Solutions

5. Hands-On: Exploratory Data Analysis, Feature Engineering, and Data Cleaning

- Exploring and Summarizing Datasets with pandas
- Creating Histograms and Scatter Plots with matplotlib
- Generating New Features
- Handling Missing Values and Outliers

6. Feature Stores

- Introduction to Feature Stores
- Types of Feature Stores
- Understanding How Feature Stores Work
- Best Practices for Feature Store Usage
- Common Feature Store Implementation Challenges

7. Model Development

- Understanding the Model Development Lifecycle
- Selecting Suitable Algorithms
- Model Training and Validation
- Preventing Overfitting
- Model Evaluation Metrics

8. Building a Basic Machine Learning Pipeline

- Creating an ML Pipeline
- Combining Preprocessing and Model Development
- Training and Evaluating the Pipeline
- Introduction to Pipeline Automation

9. Model Development Strategies

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- Overview of Model Development Approaches
- Data-Centric vs. Model-Centric Development
- Experimentation in Model Development
- Collaborative Development in MLOps

10. Machine Learning Model Interpretability and Explainability

- Fundamentals of Model Interpretability and Explainability
- Model Interpretation Techniques
- Explainability Across Different Model Types
- Tools for Model Interpretability
- Challenges in Model Explainability

11. Implementing Machine Learning Algorithms

- Selecting an Appropriate Algorithm
- Implementing the Selected Algorithm
- Evaluating Algorithm Performance
- Comparing Multiple Algorithms

12. Hands-On: Algorithm Selection, Implementation, and Evaluation

- Selecting a Dataset and Two Algorithms, Such as Decision Tree and SVM
- Implementing Algorithms with scikit-learn
- Measuring Algorithm Performance
- Comparing Results Using Accuracy, Precision, and Other Metrics

13. Experiment Tracking and Model Evaluation

- Introduction to Experiment Tracking
- Configuring an Experiment Tracking Environment
- Evaluating Model Performance
- Visualizing Performance Results

14. Experiment Tracking with MLflow

- Introduction to MLflow

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- Recording and Managing Experiments
- Comparing Multiple Experiment Runs
- Storing and Retrieving Models

15. Model Evaluation

- Preparing the Evaluation Environment
- Measuring Model Performance
- Comparing Models Based on Evaluation Results

16. Hyperparameter Tuning Techniques

- Introduction to Hyperparameter Optimization
- Grid Search vs. Random Search
- Bayesian Optimization
- Practical Considerations for Hyperparameter Tuning

17. Automated Hyperparameter Tuning

- Understanding Automated Hyperparameter Optimization
- Running Hyperparameter Tuning Processes
- Analyzing Optimization Results

18. Model Serving and Deployment Strategies

- Introduction to Model Serving
- Model Deployment Approaches
- Containerizing Machine Learning Models
- Serving Models with Docker
- Model Serving Frameworks
- Deploying Models to Cloud Platforms

19. Legal and Compliance Considerations in MLOps

- Introduction to Legal and Compliance Requirements
- Key Regulatory Standards
- Model Governance and Compliance

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- Challenges in Legal and Regulatory Compliance

20. Containerizing Machine Learning Models with Docker

- Introduction to Docker
- Configuring the Docker Environment
- Building Docker Images
- Deploying Docker Containers on Cloud Platforms

21. Deploying Models to Cloud Platforms

- Introduction to Cloud-Based Model Deployment
- Preparing Models for Deployment
- Configuring Cloud Infrastructure
- Deploying Models Using Ray Serve

22. Federated Training and Edge Deployment

- Introduction to Federated Learning and Edge Computing
- Federated Training Architecture
- Deploying Models in Edge Environments
- Relevant Tools and Frameworks
- Challenges in Federated Learning and Edge Computing

23. CI/CD for Machine Learning

- Introduction to CI/CD in ML Projects
- Building CI/CD Pipelines for Machine Learning
- Integrating CI/CD with Experiment Tracking
- Automating Model Validation and Testing

24. Building CI/CD Pipelines for ML

- Introduction to GitHub Actions
- Automating Model Training and Deployment
- Integrating MLflow with CI/CD Workflows
- Testing CI/CD Pipelines

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25. Monitoring and Maintaining Machine Learning Systems

- Introduction to ML System Monitoring
- Tools for Monitoring Machine Learning Models
- Configuring Alerts for Model Drift
- Monitoring Model Performance in Real Time
- Continuous Feedback Loops
- Scaling Monitoring Infrastructure for Large Deployments

26. Implementing Monitoring Tools

- Introduction to Monitoring Technologies
- Instrumenting ML Models for Monitoring
- Exposing Metrics to Prometheus Through Code
- Visualizing Metrics with Grafana