MLOps – 100+ Lab Exercises (Basic, Intermediate, Advanced)

□ Basic Level (30+ Exercises)

Objective: Establish core understanding of machine learning workflows, DevOps fundamentals, and cloud basics for MLOps.

Foundations of MLOps

- Introduction to MLOps concepts and lifecycle.
- Overview of ML model development workflow.
- Understand version control (Git) for code and data.
- Set up Python environments and package management.
- Build and train simple ML models (scikit-learn, TensorFlow).

Data Engineering Basics

- Data collection, cleaning, and preprocessing pipelines.
- Work with data versioning tools (DVC, Delta Lake).
- Automate data validation and monitoring.
- Use Jupyter notebooks for experimentation.
- Understand data storage and database options.

Infrastructure Setup

- Introduction to cloud platforms (AWS, Azure, GCP).
- Set up Kubernetes clusters for ML workloads.
- Use Docker for containerizing ML models.
- Deploy models locally using Flask or FastAPI.
- Monitor compute resource usage and logs.

□ Intermediate Level (40+ Exercises)

Objective: Develop proficiency in automation, continuous integration/delivery (CI/CD), and scalable model deployment.

Model Deployment & Serving

- Package ML models as REST APIs.
- Use TensorFlow Serving and TorchServe.
- Implement model versioning and rollback strategies.
- Deploy ML models on Kubernetes with Kubeflow.
- Set up serverless ML deployments (AWS Lambda, Azure Functions).

Automation & CI/CD Pipelines

- Build automated ML pipelines using Jenkins or GitHub Actions.
- Integrate testing frameworks for ML code and models.
- Automate data and model validation.
- Implement continuous training and retraining pipelines.
- Use ML pipeline orchestration tools (Airflow, Prefect).

Monitoring & Observability

- Monitor model performance and data drift.
- Set up alerting and logging (Prometheus, Grafana).
- Use explainability tools for model transparency.
- Implement A/B testing and canary deployments.
- Track metrics with MLflow or Weights & Biases.

□ Advanced Level (40+ Exercises)

Objective: Master enterprise-grade MLOps practices, governance, security, and innovation in AI lifecycle management.

Advanced Pipeline Engineering

- Design scalable, distributed training pipelines.
- Implement feature stores and metadata management.
- Automate hyperparameter tuning and experimentation.
- Use advanced orchestration with Kubeflow Pipelines.
- Integrate with big data platforms (Spark, Hadoop).

Governance & Compliance

- Implement data privacy and security best practices.
- Manage model audit trails and reproducibility.

- Ensure compliance with regulations (GDPR, HIPAA).
- Apply role-based access controls and secrets management.
- Conduct risk assessment and mitigation for ML models.

Innovation & Emerging Trends

- Integrate edge AI and IoT with MLOps.
- Use federated learning and privacy-preserving ML.
- Explore AI model compression and optimization.
- Implement reinforcement learning pipelines.
- Leverage AI Ops for automated incident management.

Capstone Projects

- Develop a fully automated end-to-end MLOps pipeline.
- Deploy and monitor a real-time streaming ML model.
- Implement scalable multi-model serving infrastructure.
- Design a compliant ML governance framework.
- Build an AI-driven monitoring dashboard with alerting.

□ Tools & Technologies

- Python, scikit-learn, TensorFlow, PyTorch
- Docker, Kubernetes, Kubeflow, MLflow
- Jenkins, GitHub Actions, Airflow, Prefect
- Prometheus, Grafana, Weights & Biases
- AWS SageMaker, Azure ML, GCP AI Platform