IE7374 - Machine Learning Operations (MLOps)

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Spring 2025

Course Description

This **MLOps course** explores the intersection of machine learning and operational scalability, focusing on the end-to-end lifecycle of ML models. Students will gain practical skills in deploying, monitoring, and maintaining machine learning models at scale. Topics include model versioning, CI/CD for ML, containerization, orchestration, and automated model retraining. The course integrates hands-on projects using state-of-the-art MLOps tools such as TensorFlow Extended (TFX), Kubernetes, MLflow, and GitHub Actions.

Prerequisites

- IE-7300, or any equivalent machine learning course.
- Proficiency in Python programming.
- Experience with TensorFlow or PyTorch.

Course Objectives

By the end of this course, students will be able to:

1. **Understand MLOps Fundamentals** - Define MLOps principles and best practices.
2. **Develop and Manage ML Pipelines** - Implement automated workflows for model training, validation, and deployment.
3. **Containerize and Deploy ML Models** - Utilize Docker and Kubernetes for efficient model serving.
4. **Monitor and Scale ML Systems** - Implement real-time monitoring, logging, and performance optimization.
5. **Implement CI/CD for ML** - Automate the ML lifecycle using GitHub Actions, Jenkins, and Airflow.
6. **Ensure Security and Compliance** - Address challenges in ML governance and data privacy.
7. **Apply MLOps to Real-World Projects** - Develop scalable ML solutions using cloud platforms.

Weekly Syllabus

Week	Topic	Description
1	Introduction to MLOps	Overview of MLOps, objectives, and key principles.
2, 3, 4, 5	Data Management	Data versioning, quality validation, and pipeline automation.
6, 7	Model Development	Experiment tracking, model validation, and hyperparameter tuning.
8, 9	Deployment Strategies	Containerization, orchestration with Kubernetes, and CI/CD for ML.
10, 11	Model Monitoring	Performance metrics, drift detection, and alerting.
12	Scaling ML Systems	Distributed training, cloud services, and cost optimization.

Week	Topic	Description
13	Security and Compliance	ML security best practices, governance, and ethical considerations.
14	Final Project Review	Project implementation, deployment, and presentation.

Course Evaluation

- **Reading Assignments:** 10%
- **Final Project:** 90% (Scoping - 15%, Data Pipeline - 25%, Model Pipeline - 25%, Deployment - 25%)

Grading Scale

Grade	Percentage
A	100 – 94
A-	94 – 88
B+	88 – 82
B	82 – 76
B-	76 – 70
C+	70 – 64
C	64 – 58
C-	58 – 52
F	< 52

Table 2: Grading Scale

Software Requirements

Python >= 3.8, TensorFlow Extended (TFX), MLflow, Kubernetes, Docker, Airflow.

Academic Honesty

Plagiarism, cheating, and any form of unauthorized collaboration are strictly prohibited and will be handled in accordance with University policies as outlined in the Student Handbook. Penalties for academic dishonesty may include, but are not limited to, receiving zero credit on the assignment, being placed on probation, having judicial findings recorded in the student's permanent record, and risking the student's status in the Engineering Program. Acts of academic dishonesty will be referred to OSCCR (Office of Student Conduct and Conflict Resolution). Visit Northeastern University Academic Integrity Policy for additional information on the University's academic integrity policy.

Student Accommodations

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current, substantially limiting disability. For more information, visit the Northeastern DRC website.

Diversity and Inclusion

Northeastern University is committed to equal opportunity, affirmative action, diversity, and social justice while building a climate of inclusion on and beyond campus. In the classroom, members of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration, and an awareness of global perspectives on social justice.

It is my intention that students from all backgrounds and perspectives will be well served by this course, and that the diversity students bring to this class will be viewed as an asset. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic backgrounds, family education levels, abilities – and other visible and nonvisible differences.
All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated.
Please visit the Northeastern University Diversity and Inclusion website for complete information on Diversity and Inclusion.

Title IX

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender identity, in educational programs and activities that receive federal financial assistance. Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. This policy applies to the entire community, including male, female, and transgender students, as well as faculty and staff.
In case of an emergency, please call 911. For a complete list of reporting options and resources available both on- and off-campus, please visit the Northeastern Title IX website.

Contact

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