THE UNIVERSITY OF CHICAGO

Master of Science in Applied Data Science

Course Syllabus

COURSE SYLLABUS – ADSP 32021: MACHINE LEARNING OPERATIONS (MLOPS)

Term: Autumn 2025 (September – December, 2025)
Class Time: Thursday, 6–9 PM CST (online)
Instructor: Sanjay Boddhu, Ph.D., Lecturer
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COURSE OVERVIEW

This course focuses on the operationalization of machine learning (ML) models in enterprise environments, introducing key concepts of **Machine Learning Operations (MLOps)** and extending them to **LLMOps** (Large Language Model Ops), under 3 different paradigms of practices that are **Data-Centric AI** , **Model-Centric AI** and **Embodied AI**. Students will explore state-of-the-art practices related to these 3 paradigms of MLOps life cycle execution grounded in the engineering verticals below:

- Software Engineering
- Model Engineering
- Deployment Engineering

Students will explore platforms such as Databricks, Azure ML, AWS SageMaker, Google Vertex AI, Ray along with GitHub, Jenkins, Docker, Kubernetes, MLflow, Airflow and more. This course crosses the chasm that separates machine learning projects/experiments and enterprise production deployment. MLOps extends the software development and testing principles of DevOps to data and model management. It covers 3 pillars in MLOps: data engineering such as software architecture, Continuous Integration/Continuous Delivery (CI/CD), and data versioning; model engineering such as AI/ML pipelines, AutoML, and A/B experimentation; and deployment engineering such as testing, docker containers, and model monitoring. The course focuses on best practices in the industry that are critical to enterprise production deployment of machine learning projects.

PREREQUISITES

- Prior completion of Big Data and Machine Learning courses.
- Working knowledge of **Python**.

COURSE MATERIALS

Main Textbook

- ***"Production Engineering from DevOps to MLOps" by Arnab Bose and Stefano Donadio –*** Leanpub Link

Optional References

Books from O'Reilly and others on MLOps, ML pipelines, fairness, DevOps, Spark, etc. (e.g., books by Huyen, Gift & Deza, Ameisen, Sharma, etc.)

Class notes, readings, and case studies will be shared via Canvas.

Learning Objectives

Students will learn to:

- Apply software development best practices
- Use MLOps platforms
- Manage data and model versioning
- Understand retraining and model lifecycle
- Deploy and monitor ML/LLM models
- Address challenges in enterprise AI systems

Grading and Evaluation

Students are graded as follows. Each student must complete 4 individual and a (group) class project. Each student needs to form a group for the final class project. The size of a class group depends on the class size and will be announced in class. The group will present their work in the final class.

To determine whether a student has met the objectives of this course, the grading includes homework assignments and class projects are weighted as follows:

Assignments (4 total)	40%
Final Project (Group)	40%
Quizzes (best 5 of 6)	10%
Class Participation	10%

With below grading scale:

A = 94%–100%	B+ = 87%–90%	C+ = 77%–80% F = 0%–70%
A- = 90%–94%	B = 84%–87%	C = 74%–77%
B- = 80%–84%	C- = 70%–74%	

Details on the assignments, final project , quizzes and class participation through discussion boards would be provided during the introductory class session or thru email prior to the interested students.

Weekly Module Breakdown

Week 1 – Introduction to MLOps and Reproducibility

- Overview of MLOps lifecycle, comparison with DevOps, Git basics, project environment setup.

Week 2 – Data Versioning & Data-Centric AI

- Data versioning with DVC, schema validation, label drift detection.

Week 3 – Model Development & Model-Centric AI

- MLflow for experiment tracking, metrics logging, and model versioning.

Week 4 – Pipeline Orchestration

- Build and automate training pipelines using Airflow, intro to DAGs.

Week 5 – Model Packaging & Dockerization

- Create reproducible Docker containers, serve models with FastAPI.

Week 6 – Model Deployment (Batch/Real-Time)

- Deploy containers using Docker/Kubernetes, deployment strategies.

Week 7 – Monitoring & Logging

- Implement model monitoring and drift detection using Evidently.

Week 8 – Automated Retraining & CI/CD

- Trigger retraining pipelines, automate using GitHub Actions.

Week 9 – Infrastructure as Code & Cloud-Native MLOps & Industry Case Studies

- Terraform, Kubernetes basics, and cloud infrastructure setup. Real-world MLOps implementations

Week 10 – Final Project Presentations

- Student project presentations.

Each session will introduce a variety of MLOps platforms, enabling students to explore and select one or more for their final group project. Additionally, assignments and quizzes are structured to progressively build understanding of End-to-End MLOps concepts, guiding students through increasing levels of toolchain complexity—from do-it-yourself open-source stacks to enterprise-grade MLOps solutions.

Use of AI tools

All assignments in this class may be completed with the aid of AI tools or other online reference sources. Within each submitted assignment, list your assisting sources (by product name and version if an AI tool). Failure to disclose your assisting sources may result in a penalty or a zero grade for the assignment. However, each student's work must remain their own. Discussion of the assignment with classmates in a study group or during office hours is permitted, but your assignment submissions should be unique and should not appear to be substantially copied from other students. Failure to work independently may result in a penalty or a zero grade for the assignment.

Attendance

Your class attendance is required and paramount to your success in this class. You are allowed to miss at most two sessions, provided that you make arrangements with the instructor in advance. Poor attendance will negatively impact class participation score. If available, at the discretion of the instructor, remote access to the class meeting or access to a recording of the class meeting may be provided. You should discuss with your instructor regarding joining the session remotely or utilizing the recording of the session prior to missing the meeting, if possible. If available, recordings may also be provided for reference after attendance for all students.

Late Work

All assignments must be submitted to this course's Canvas site on the due date. A student is allowed one assignment due date extension (no more than 3 days from due date) with no penalty and one delayed submissions (no more than 2 weeks from due date) with a 20% penalty. Beyond these 2 allowed extensions/delays, no credit is given for other late assignments. Please do not expect any extension beyond 3 days for the last assignment since evaluation has to be completed on time for grades submission.