

Machine Learning Operation (CPE393)

2/2024 Semester

Department of Computer Engineering, Faculty of Engineering

King Mongkut's University of Technology Thonburi

Instructor: Asst. Prof. Dr. Santitham Prom-on

Email: santitham.pro@kmutt.ac.th

Instructor: Dr. Aye Hninn Khine

Email: aye.hnin@kmutt.ac.th

Lecture Room: CB2605

Schedule: Every Thursday (13:30 – 16:30)

Office Hours: <https://calendly.com/aye-hnin-mail/30min> (Online/CPE Department)

Teaching Assistants: Kaung Htet Lin (Master Student, CPE)

Course Description

This course introduces students to the concept of MLOps (Machine Learning Operations), which combines machine learning, software engineering, and DevOps practices to streamline the development, deployment, and monitoring of machine learning models in production. We will cover key areas such as the ML project lifecycle, model deployment, experiment tracking, data pipelines, CI/CD, and more. By the end of the course, students will have practical experience in managing end-to-end ML projects and deploying models using industry-standard tools.

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

- (1) Understand full life cycle of ML development
- (2) Understand different role in end-to-end MLOps architecture
- (3) Be familiar with some of MLOps tools and infrastructure
- (4) Develop end-to-end ML project which can be extended to senior projects

Pre-requisites

Students should have prior knowledge of:

- Basic machine learning and deep learning concepts (classification, regression, loss functions, etc.)
- Python programming
- Experience with machine learning frameworks (e.g., TensorFlow, PyTorch, or scikit-learn)

- Familiarity with version control (e.g., Git)

Course Schedule

No	Date	Topic	Description	Instructor
1	Jan 16	Intro to Machine Learning System: ML project life cycle and understanding different roles in ML projects	Phases of an ML project, understanding roles (business analysts, data scientists, ML engineers)	Dr. Aye
2	Jan 23	Intro to ML Fundamentals	Overview of MLOps, Recap of ML fundamentals (Classification, loss functions, confusion matrix)	Dr. Santitham
3	Jan 30	Introduction to Version Control with Gits	Setting up repositories, collaboration, and versioning for ML projects	Dr. Aye
4	Feb 6	Data management and dataset curation	Sourcing, cleaning, and managing datasets for machine learning	Dr. Santitham
5	Feb 13	Building data pipelines	Automated data ingestion, transformation, and storage (using tools like Apache Airflow)	Dr. Santitham
Break (No classes) – February 17-21				
6	Feb 27	Feature Engineering	Techniques for feature extraction, selection, and transformation for model building	Dr. Santitham
7	Mar 6	Model selection and development	Choosing the right models, training, hyperparameter tuning, and model validation	Dr. Santitham
8	Mar 13	Experiment Tracking	Using MLflow or other tools for managing and tracking experiments	Dr. Aye
9	Mar 20	Docker fundamentals	Introduction to containerization, Docker installation, creating and using containers	Dr. Aye
10	Mar 27	Model deployment	Deploying models to production environments (e.g., using Docker, Kubernetes, or cloud platforms like AWS SageMaker)	Dr. Aye
No classes – March 31 – April 16				
11	Apr 17	Model serving and API integration	Exposing models as services via REST APIs, integrating into applications	Dr. Aye

12	Apr 24	Model monitoring and management (Evidently AI)	Techniques for monitoring model performance in production, managing model drift	Dr. Aye
12		Theoretical Exam – April 3rd week (Tentative)		
13	May 1	Project Discussion	Discuss project suitability Group formation Deliverables	Dr. Santitham Dr. Aye
14	May 8	Continuous integration and continuous deployment	Implementing CI/CD pipelines for ML workflows using tools like Jenkins, GitLab CI	Dr. Aye
15	May 15	Project Progress Discussion	Discuss progress Technical challenges	Dr. Santitham Dr. Aye
Final Project Presentation – June 1st week (Tentative)				

Assessment (Tentative)

- Theoretical Exam – 20%
- Assignment – 20 %
- Peer-review report – 20%
- Project – 40%

Final Project

For the project, we will ask you to build an end-to-end ML project.

For that, you will need:

- Select a dataset that you're interested in (You can use the datasets hosted on Kaggle platform)
- Train a model on that dataset tracking your experiments
- Create a model training pipeline
- Deploy the model in batch, web service or streaming
- Monitor the performance of your model
- Follow the best practices such as documentation, CI/CD pipeline

Development Environment

To ensure uniformity and facilitate collaboration, students are required to use the following software and platforms:

1. Docker: For containerization of ML environments
2. Python 3.x: Main programming language

3. MLflow: For experiment tracking and model management
4. Git: For version control
5. Jupyter Notebooks/VS Code: For development and prototyping
6. Cloud Platforms (optional): AWS, GCP, or Azure for deploying and managing models
7. Kubernetes: For container orchestration (optional for advanced sections)

Students should ensure their machines have adequate computational resources or use cloud-based environments to run machine learning experiments efficiently.

Recommended Textbooks

- Designing Machine Learning System – Chip Huyen
- Introducing MLOps - Mark Treveil
- Designing Data Intensive Applications – Martin Kleppmann

Tentative Schedule

No	Date	Topic	Instructor	Quiz/Lab
1	Jan 16	Intro to Machine Learning System: ML project life cycle and understanding different roles in ML projects	Dr. Aye	Quiz
2	Jan 23	Intro to ML Fundamentals	Dr. Santitham	Quiz
3	Jan 30	Introduction to Version Control with Gits	Dr. Aye	Git/Github
4	Feb 6	Data management and dataset curation	Dr. Santitham	Label Studio
5	Feb 13	Building data pipelines	Dr. Santitham	Airflow
Break (No classes) – February 17-21				
6	Feb 27	Feature Engineering	Dr. Santitham	Feature Engineering – Kaggle
7	Mar 6	Model selection and development	Dr. Santitham	Model Development – Kaggle
8	Mar 13	Experiment Tracking	Dr. Aye	MLflow
9	Mar 20	Docker fundamentals	Dr. Aye	Docker
10	Mar 27	Model deployment	Dr. Aye	Lab
No classes – March 31 – April 16				
11	Apr 17	Model serving and API integration	Dr. Aye	Lab
12	Apr 24	Model monitoring and management (Evidently AI)	Dr. Aye	Evidently AI
12	Theoretical Exam – April 3rd week (Tentative)			
13	May 1	Project Discussion (Feasibility)	Dr. Santitham/ Dr. Aye	
14	May 8	Continuous integration and continuous deployment (CI/CD)	Dr. Aye	Lab
15	May 15	Project Progress Discussion	Dr. Santitham Dr. Aye	
Final Project Presentation – June 1st week (Tentative)				