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| **Title** | **EMIA4110 Practical Machine Learning** |
| **Course Aims** | This course aims to provide a foundational understanding of machine learning, its history, and core algorithms, while also introducing students to the leading open platforms and resources for practical machine learning applications. Through a series of case studies, the course will illustrate the use of machine learning in solving problems from diverse fields, ensuring that students from various backgrounds gain the essential knowledge and practical skills to leverage machine learning techniques in real-world situations. The course is tailored specifically for individuals enrolled in extended major programs, with a goal to build a deep, applied proficiency in the field. |
| **Description** | This course consists of three parts: 1) the foundation of machine learning including its history and core algorithms; 2) the mainstream open platforms and sources for machine learning with an emphasis on practical applications; 3) case studies to illustrate how machine learning can be used to solve the problems from different fields. This course will equip students from different backgrounds with the essential knowledge about machine learning and practical algorithms, systems, and platforms available for solving real-world problems. For students enrolled in extended major programs only. |
| **Prerequisite** | COMP 2011 Programming with C++ |
| **Instructor** | Prof. Wei XUE, EMIA, weixue@ust.hk |

**Course Intended Learning Outcomes (CILOs)**

Upon completion of this course, students should be able to

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| **No.** | **Course Intended Learning Outcomes (CILOs)** |
|  | **Knowledge** |
| 1 | Understand the essential knowledge about machine learning algorithms |
| 2 | Be able to use mainstream machine learning platforms to build the machine learning systems |
| 3 | Understand how the machine learning is applied to different practical areas in engineering, science, business and art, and be able to build new practical systems in these areas by conducting problem analysis and modelling |
|  | **Personal Skills** |
| 4 | Use AI tools such as ChatGPT to learn new knowledge in an interactive manner |

**Teaching and Learning Activities (TLAs)**

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| **CILOs** | **Type of TLA** |
| 1,2,3 | Lectures |
| 2,3 | Tutorial classes |
| 1,2,3,4 | Assignments, such as exercises and quiz. |

**Assessment**

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| **No.** | **Assessment Method** | **Weighting (%)** | **CILOs to be addressed** |
| 1 | Attendance | 10 | 1,2,3,4 |
| 2 | Assignments | 30 | 1,2,3,4 |
| 3 | Mid-term Quiz | 20 | 1,2,3 |
| 4 | Final Exam | 40 | 1,2,3 |

* The instructor and teaching assistants will conduct random attendance checks. You are allowed up to three absences without penalty. If you are absent between four and eight times, you will receive only half the points for attendance and assignments. More than eight absences will result in a failing grade for the course.
* Assignments are expected to be completed on a weekly basis. Late submissions will not be accepted under normal circumstances. Should you encounter any issues that prevent you from submitting on time or completing an assignment, you must communicate with the TAs well in advance of the deadline.
* Both the mid-term quiz and the final exam are closed-book.

**Assessment Rubrics**

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| **Excellent (A)** | * Achieves all CILOs, demonstrating a good mastery of both the theoretical and practical aspects of the knowledge and skills associated with machine learning concepts for real-world applications. * Able to use the learned knowledge and skills to solve new practical problems effectively. |
| **Good (B)** | * Achieves all CILOs, demonstrating a good understanding of both the theoretical and practical aspects of the knowledge and skills associated with machine learning concepts for real-world applications. * Demonstrate a competent level of using the learned knowledge and skills to solve new practical problems. |
| **Satisfactory (C)** | * Achieves most of the four CILOs, demonstrating a basic understanding of both the theoretical and practical aspects of the knowledge and skills associated with machine learning. * Can use some of the learned knowledge and skills to solve new practical problems. |
| **Marginal Pass (D)** | * Achieves most of the four CILOs, demonstrating a minimal understanding of both the theoretical and practical aspects of the knowledge and skills associated with machine learning. * Can use some of the learned knowledge to solve simple and limited practical problems. |
| **Fail (F)** | * Achieves less than three of the four CILOs, with little understanding of both the theoretical and practical aspects of the knowledge and skills associated with machine learning. * Unable to use some of the learned knowledge to solve even simple and limited practical problems. * Fail to attend the classes and submit assignments regularly. |

**Course Content**

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| **Topic** | **Week** |
| **Machine Learning Theories and Algorithms** |  |
| Introduction to Machine Learning, Regression Methods | 1 |
| Supervised Learning and Classification | 2 |
| Unsupervised Learning | 3 |
| Deep Learning | 4 |
| Reinforcement Learning | 5 |
| Generative Models | 6 |
| **Machine Learning Frameworks** |  |
| Scikit-learn | 7 |
| Pytorch | 8 |
| **Machine Learning Applications** |  |
| Solving Engineering Problems with Machine Learning | 9 |
| Solving Science Problems with Machine Learning | 10 |
| Solving Business Problems with Machine Learning | 11 |
| Art Generation with Machine Learning | 12 |
| How to build ChatGPT with Generative Modelling | 13 |

**References**

1. Sarkar, Dipanjan, Raghav Bali, and Tushar Sharma. "Practical machine learning with Python." (2018): 25-30.
2. Subasi, Abdulhamit. Practical machine learning for data analysis using python. Academic Press, 2020.
3. Géron, Aurélien. Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. " O'Reilly Media, Inc.", 2022.
4. Theobald, Oliver. Machine learning for absolute beginners: a plain English introduction. Vol. 157. London, UK: Scatterplot press, 2017.