Program: ECE
Degree Level: Master

Faculty/College: TGGS

Course 090245337

Machine Learning

King Mongkut's University of Technology North Bangkok
The Sirindhorn International Thai-German Graduate School of Engineering
Electrical and Computer Engineering Program

Section 1: General Information

1. **Course code and course title**

   090245337 Machine Learning

2. **Total credits**

   3 credits ☐ (2-2-5) ☑ (3-0-6) ☐ (3-0-9) ☐ (2-3-7)

3. **Curriculum and course category**:

   Curriculum: *Master of Engineering in Electrical and Computer Engineering*

   Course category: Required Courses

   ☐ Core Course ☐ Specific Core Course

   ☐ Industrial Internship ☐ Master Thesis

   Elective Courses

   ☐ General Elective ☑ Specific Elective ☐ Other Elective

4. **Course coordinator/ Instructors**

   Course Coordinator: _____

   Instructor(s): Dr. Sansiri Tanachutiwat

5. **Semester/ year of study**

   ☐ Semester 1 (Aug. to Dec.) ☑ Semester 2 (Jan. to May) Academic Year: 2021

6. **Pre-requisite (if any)**

   ☑ No ☐ Yes, please provide: .....

7. **Co-requisites (if any)**

   ☑ No ☐ Yes, please provide: .....

8. **Venue of study**

   Lecture Day/Time: Friday at 9.00 AM - 12.00 PM

   ☑ On-site: Lecture Room No.: 1103 Floor: 11

   ☑ TGGS, KMUTNB ☐ Faculty of Engineering, CU ☐ RWTH

   ☑ On-line*: Teaching Media: ☐ Microsoft Teams ☐ Google Meet

   ☐ Zoom ☑ WebEx

   ☐ Other (specify) .....

Remark: * *During COVID-19, the teaching can be on-site and/or on-line according to TGGS Policy*.

9. Information for quality assurance in education

This course shows evidence of:

- ☑ Development of implementation from previous practices, e.g. the improvement of class teaching, course content, content classification and methods used for learning assessment
- ☐ Involvement from professional bodies/ external agencies in instruction; thus Enhancing student academic and professional experiences
- ☑ Integration of research or creative activities with instruction; use of research-based learning management; knowledge management practices for learning improvement
- ☐ Integration of academic services and course implementation
- ☐ Combination of cultural heritage preservation efforts into instruction or student activities

10. Date of latest revision:

November 2021

Section 2: Course Description and Implementation

1. Course Description (*As written in the Official Approved Curriculum*)

Introduction of machine learning. Mathematics and statistics for machine learning. Data processing. Various machine learning models both supervise and unsupervised learning e.g. Regression, Classification, Clustering, Reinforcement learning models.

2. Number of hours per semester

Lecture	Practice	Self-study
45 hours/semester (3 hours/week)*	*30 hours (2 hours/week*)*	*75 hours/semester (5 hours/week*)*

Remark: * *Based on 15 weeks of lecture*

Course Category: ☑ Lecture ☐ Practice ☐ Laboratory

Course Evaluation: ☑ A-F ☐ S/U ☐ P

3. Number of hours per week for academic guidance to individual students

☐ 1. Giving academic advice (minimally number hour per week) during the office hour

☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ .....

Wednesdays at 13.00-14.00

The student can arrange the time other than the office hour via email or instant messages for the meeting date/time.

☐ 2. Adopting information technology-based academic advising

☐ Email: sansiri.t@tggs.kmutnb.ac.th

☐ Phone: 0615593980

☐ Communication Apps: Line ID: ajsansiri

☐ Meeting Online: Google Classroom/WebEx. A meeting id and url will be created upon request.

☐ Other (specify) ……

☐ 3. ……

4. Course Learning Outcomes (CLOs): Students should be able to:

CLO 1. To explain the theoretical concepts in the followings:

- Statistics for machine learning
- Training of machine learning models
- Machine learning models for regression, classification, clustering applications
- Deep Learning
- Deep Learning models for image classification, object detection applications
- Deep Learning models for natural language processing applications

CLO 2. To apply the knowledge of machine learning to actual industrial problems.

CLO 3. To analyze machine learning model and improve its performance.

Remark: 1. Guidelines according to Bloom's Taxonomy is available at https://courses.dcs.wisc.edu/design-teaching/PlanDesign_Fall2016/2-Online-Course-Design/2_Learning-Objectives-Alignment/6_objectives_blooms-taxonomy.html

2. For the master level course, CLOs should be "apply" and "analyze" or possibly to consider the doctoral CLOs "evaluate" and "create". "Remember" and "Understand" are for the undergraduate level courses, however, they can be implemented only at the beginning of the course.

3. CLOs can be defined as many as appropriated for the course.

5. The mapping between Expected Learning Outcomes (ELOs) from the curriculum and Course Learning Outcomes (CLOs)

Table 5.1 ELOs-CLOs Consistency ***(for a subject-specific course/ a specific curriculum)***

ELOs/CLOs consistency	CLO 1	CLO 2	CLO 3
ELO1			
ELO2	✓		
ELO3			
ELO4	✓	✓	✓

ELOs/CLOs consistency	CLO 1	CLO 2	CLO 3
ELO5			
ELO6		✓	✓
ELO7			
ELO8	✓	✓	✓
ELO9			
ELO10			

Remark: All ELOs and ELOs for the course (highlighted row) are as written in the Official Approved Curriculum.

Table 5.2 Mapping desirable characteristics of KMUTNB graduates and CLOs *(for non-specific courses designed for various curriculums)*

Consistency between desirable characteristics of KMUTNB Graduates-CLOs	CLO 1	CLO 2	CLO 3
1. **Professional credentials with critical thinking skills**		✓	✓
2. **Integrity and social responsibility**	✓		
3. **Innovative and technopreneur mindset**		✓	✓
4. **Global Competence**	✓	✓	✓

Section 3: Student Improvement in relation to Course Learning Outcomes (CLOs)

Organizing learning to develop skills/ knowledge; evaluation of CLOs in accordance with the ones identified in Section 2.4

Course Learning Outcomes (CLOs)	Teaching Methods compliant with CLOs	Evaluation Methods compliant with CLOs
CLO 1	• Lecture* • Active learning** • In-class exercises • Individual and/or group assignment • Additional reading assignments from research and/or literature journals	• Assignment evaluation • Assessment of assigned exercises • Exam***
CLO 2	• Case studies, project-based learning • In-class exercises • Individual and/or group assignment	• Assignment evaluation • Assessment of assigned exercises • Exam***

Course Learning Outcomes (CLOs)	Teaching Methods compliant with CLOs	Evaluation Methods compliant with CLOs
	• Demonstration on the use of computer software and/or coding machine learning application • Group discussions	
CLO 3	• Case studies, project-based learning • In-class exercises • Additional reading assignments from research and/or literature journals • Group discussions on project updates • Mentoring on the problem solving	• Assignment evaluation • Assessment of assigned exercises • Class project to extend an opensource software for a selected platform related to the industrial applications

*Remark: * Lecture on the concept of the topic is introduced with basic or fundamental definitions, visualization and correlations. For the complicated equation, the derivation from the basic laws can be shown to students. So, the students do not memorize the equations but understand the basic concept and basic equation. The lecturer will introduce the advanced and new concepts, technologies, and findings to students from publications such as journals and websites and from the research and industrial experiences.*

*** Active learning by asking questions related to the topic in the lecture and encouraging the students to response to the questions. If the students cannot response with answers, then the lecturer will give some guidance until the students can response.*

**** Exam on the basic concepts and equations with simple problem solving in the closed-book format as a review, whereas the complicated/integrated problem solving will be worked in the open-book format.*

Section 4: Lesson Plan and Evaluation

1. **Lesson Plan**

Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
1	Introduction of machine learning program		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
2	Python for ML		3.0	Lecture, Case studies, Q&A	Dr. Sansiri

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Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
3	Statistics for ML		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
4	Basic ML models		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
5	Deep Learning		3.0	Student Presentations, Q&A	Dr. Sansiri
6	Regression models		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
7	Classification models		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
8	Clustering models		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
9	Mid-term exam		3.0	Exam	Dr. Sansiri
10	Time-Series analysis		3.0	Student Presentations, Q&A	Dr. Sansiri
11	Time-Series analysis (workshop)		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
12	Image recognition		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
13	Image recognition (workshop)		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
14	Real-time Object Detection		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
15	Real-time Object Detection (workshop)		3.0	Student Presentations, Q&A	Dr. Sansiri
16	Review		3.0	Lecture, Case studies, Q&A	Dr. Sansiri
17	Final exam		3.0	Exam	Dr. Sansiri
		Total	51.0		

2. **Evaluation Plan** (**in accordance with OBE** 2 **mapping framework**)

Course Learning Outcomes (CLOs)	Evaluation Methods	Week of Evaluation	Percentage of Evaluation
CLO 1, 2	Individual assignment	1-16	30%
CLO 3	Group assignment	1-16	30%
CLO 1, 2, 3	Midterm exam	9	20%
CLO 1, 2, 3	Final exam	17	20%

Section 5 Teaching/Learning Resources

Textbooks and materials

Main Text:

S. Tanachutiwat, Lecture Notes in Machine Learning

Additional Documents

- Learn Python
  - EdX https://www.edx.org/course/introduction-python-data-science-2
- Statistics & Probability
  - KhanAcademy https://www.khanacademy.org/math/statistics-probability
- Data Pre-processing, Data Vis, Exploratory Data Analysis
  - EdX https://www.edx.org/course/introduction-to-computing-for-data-analysis
- Algorithms & Machine Learning
  - Columbia https://courses.edx.org/courses/course-v1:ColumbiaX+DS102X+2T2018/course/
- Deep Learning

  DL Book https://www.deeplearningbook.org

Section 6 Course Evaluation and Improvement

1. Course evaluation by students

The students will have an opportunity to evaluate the effectiveness of the course in a form of paper survey and group interview at the end of each semester. The results of survey and interview including the grading will be reviewed by the curriculum meeting to evaluate the course's effectiveness.

2. Strategies for assessing learning management

The students will have an opportunity to evaluate the teaching of the course in a form of paper survey and group interview at the end of each semester. The results of survey and interview including

the grading will be reviewed by the curriculum meeting to evaluate the teaching as well as returning to the lecturer for further improvement.

3. **Improvement schemes of course implementation**

The evaluation from the students including the grading will be submitted to the curriculum meeting for reviewing and brainstorming to improve teaching of each course. Comments and suggestions given by the curriculum meeting will be informed to the responsible lecturer of each course.

4. **Verification of students' learning outcomes, referred to OBE 2 and 3**

The grading of this course will be evaluated and reviewed by the Department meeting and the TGGS executive board meeting in order to verify its appropriateness before the final approval.

5. **Course review and improvement plans**

The results of the grading evaluation and student evaluation will be submitted to the curriculum meeting for reviewing and brainstorming to improve the effectiveness of the offered courses. Comments and suggestions will be informed to the responsible lecturer of each course.