SYE6110: DATA ANALYSIS AND ARTIFICIAL INTELLIGENCE FOR SYSTEMS ENGINEERING

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Data Analysis and Artificial Intelligence for Systems Engineering

Subject Code
SYE - Systems Engineering
Course Number
6110

Academic Unit
Systems Engineering (SYE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
SYE4003 Artificial Intelligence and Advanced Technology in Manufacturing and Operations or SYE6106 Intelligent Manufacturing for Engineering Managers

Precursors
Nil

Equivalent Courses
ADSE6110 Data Analysis and Artificial Intelligence for Systems Engineering (offered until 2023/24)

Exclusive Courses
Nil

Part II Course Details

Abstract

As one of the most popular disciplines in recent years, data-driven Artificial Intelligence (AI), particularly machine learning-based approaches, is gradually transforming nearly all industries, such as domain of the engineering management Advances in artificial intelligence, such as deep learning methods, are widely employed in many engineering industries for data analysis and research. Therefore, for those who wish to join the waves of AI, this course covers fundamental but comprehensive concepts and experiments of data analysis and machine learning, including but not limited to topics such as classification and regression, unsupervised clustering, machine learning, and an introduction to deep learning. This course provides hands-on opportunities to develop fundamental statistical, data-analysis, and AI models using the popular Python tools for smart manufacturing cases. This course will construct a solid foundation for more advanced courses in engineering, marketing, finance, economics, and more advanced data science, deep learning, and AI.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the state-of-the-art key issues of a data analysis problem engineering management or manufacturing; and formulate these issues into machine learning or AI models for further analysis.	30	x	x	x
2	Apply the data analysis, machine learning knowledge acquired through the course to select the most appropriate technique for a given problem.	25		x	x
3	Analyze relevant data effectively using appropriate data analysis/machine learning techniques to solve the problems and evaluate the results in the context of the problems.	25		x	x
4	Develop the ability to use python module to conduct data analysis for manufacturing related problems.	20		x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Concepts and specific subject knowledge are explained	1, 2, 3	13 hours/sem

2	In-class exercise	With the teacher acting as a facilitator, students work together on assigned engineering problem sets to consolidate their understanding of the concepts and methods. They are required to formulate the problem into a data driven model (define the machine learning inputs and targets) and proceed to solve the problem (the method). These exercises are based on data from real-life applications.	1, 2, 3, 4	26 hours/sem

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignment or midterm	1, 2, 3, 4	50	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Assignment (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Core concepts, ideas and coding of data driven software

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure
F) Not even reaching marginal levels

Assessment Task
2. Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Core concepts and ideas; use of appropriate data-driven, machine learning, or AI methods

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
1. Assignment (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Core concepts, ideas and coding of data driven software

Excellent
(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

Assessment Task
2. Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Core concepts and ideas; use of appropriate data-driven, machine learning or AI methods

Excellent
(A+, A, A-) Excellent

Good

(B+, B) Good

Marginal

(B-, C+, C) Marginal

Failure

(F) Failure

Part III Other Information

Keyword Syllabus

- Introduction to AI, machine learning, deep learning, and their applications in engineering and engineering management
- Python programming
- Linear regression with multiple approaches
- Bayes' Theorem
- Unsupervised learning and kmeans
- Logistic regression
- Decision tree
- Support vector machine
- Deep learning and neural networks
- Case studies for engineering and manufacturing applications

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming 2nd Edition
2	Statistics for Business: Decision Making and Analysis, by Robert Stine and Dean Foster
3	Deep Learning with Python
4	Machine Learning, Andrew Ng, coursera.org