

Artificial Intelligence and Machine Learning

Programme(s):	Bachelor of Computer Science
Year / Stage:	Year 2 Sem 2
Module Code:	
Effective Academic Year:	Autumn 2022

Instructional Hours

This module consists of 120 curriculum hours.

Module Aims:

The aim of this module is to provide students with fundamental knowledge in artificial intelligence (AI) and machine learning. Students will have hands-on experience in building applications that make use of machine learning algorithms. This module covers both supervised, and unsupervised learning techniques as well as ensemble techniques, machine learning pipelines, and data engineering.

Teaching Methods / Learning Tasks:

The module will be taught using tutorial sessions and practical sessions.

During the tutorial sessions, students will learn the key concepts and principles of AI and Machine Learning. In addition, Activities such as small-group discussions and presentations will be held during the tutorials. This allows students to have more opportunities to participate in discussions and to have better class interactions.

In the practical lessons, students will be working on practical exercises that are designed for students to solve problems using the knowledge learned from the tutorial lessons.

Means of Assessment:

CA1	20%
CA2	20%
CA3	20%
CA4	40%
Total	100%

CA1: Quizzes

A 20-minute online quiz will be conducted upon the completion of every 2 topics of the module to continually test students' understanding of the subject. In total, there are 4 quizzes and each quiz is worth 5% of the total weightage.

CA2: Lab Assessment

Each student will be given two lab assignments covering data engineering, supervised learning, unsupervised learning, and ensemble learning. Each assignment carries 20 marks which are 10% of the total weightage.

CA3: Class Test

This is a closed-book written test to be conducted in the middle of the semester.

CA4: Project

This is a group project aimed to enable students to apply what they have learned throughout the semester to create an AI/Machine Learning solution to solve real-world problems. Students are required to deploy their AI/ML application on a live server. Moreover, each group will have to prepare the technical documentation for their AI/Machine Learning application.

E Textbook:**References:**

1. Introduction to Machine Learning with Python (A Guide for Data Scientists) by Andreas C. Muller and Sarah Guido.
2. Hands-on-Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurelien Geron
3. Artificial Intelligence A Modern Approach by Stuart Russell and Peter Norvig
4. Building Machine Learning Pipelines by Hannes Hapke & Catherine Nelson

Special Requirements:

Prerequisite	Nil
Software	Orange, Jupyter Notebook, Visual Studio Code, Google Colab
Hardware	Laptop/PC (16GB RAM)
Others	Nil

Table of Specifications:

	Topics	Abilities (%)				Total
		K	C	A	HA	
A.	Introduction to Artificial Intelligence	1	3	2	0	6
B.	Introduction to Machine Learning	1	3	2	0	6
C.	Data Engineering	1	3	3	4	11
D.	Supervised Learning	3	12	17	15	37
E.	Unsupervised Learning	2	4	9	5	20
F.	Ensemble Learning	1	3	4	6	14
G.	Applications of Machine Learning	1	3	2	0	6
	Total	10	31	39	20	100

Notes:

- The letters K, C, A and HA in the table of specifications denote the knowledge, comprehension, application and higher than application respectively, in the cognitive domain of Bloom's Taxonomy.
- In the detailed syllabus, which follows, all objectives should be understood to be prefixed by the word: "At the end of instruction, the learner should be able to..."

Detailed Syllabus:

<u>Learning Outcomes</u>		Hours 120			
		L	T	P	SDL
A.	<u>Introduction to Artificial Intelligence</u>				
1	Conceptualize Artificial Intelligence		3	3	1
1.1	Explain and compare AI with human intelligence and traditional information processing.				
1.2	Explain the foundations of artificial intelligence.				
1.3	Explain the history of artificial intelligence.				
1.4	Describe and explain the state of the art of an AI.				
B.	<u>Introduction to Machine Learning</u>				

2	Conceptualize Machine Learning		3	3	1
2.1	Explain machine learning.				
2.2	Explain supervised, unsupervised and reinforcement machine learning algorithms.				
2.3	Describe some of the available machine learning tools.				
2.4	Install and Configure machine learning tools				
C.	Data Engineering				
3	Understand Data representation and feature engineering in machine learning.		6	6	2
3.1	Explain and describe different data acquisition techniques from various sources.				
3.2	Explain different data cleansing methods.				
3.3	Implement different data encoding techniques.				
3.4	Apply different techniques of handling missing values.				
3.5	Implement an over sampling technique on an unbalanced dataset.				
3.6	Explain and apply different feature scaling and selection methods.				
D	Supervised Learning				
4	Understand Regression and classification.		6	9	2
4.1	Compare and contrast regression and classification problems.				
4.2	Explain, design and implement various machine learning algorithms e.g. Linear models, k-Nearest Neighbors, Naives Bayes, Support Vector Machine, Decision Trees, and Neural Networks.				
4.3	Evaluate the efficiency of the different machine learning algorithms with the unseen data.				
5	Understand Evaluation Metrics for Supervised Learning		3	5	2
5.1	Explain and evaluate different evaluation metrics involved in regression problems (MSE, MAE, RMSE, R2)				
5.2	Describe and apply cross-validation and grid search techniques.				
5.3	Explain and evaluate different evaluation metrics involved in classification problems (confusion matrix, precision, recall and f1-score).				

6	Implement Machine Learning Pipeline		6	9	2
6.1	Explain the importance of machine learning pipeline in the production system.				
6.2	Describe the steps involved in the machine learning pipeline.				
6.3	Apply machine learning pipeline in solving real-world problems.				
6.4	Deploy the machine learning model with pipeline				
E.	Unsupervised Learning				
7	Understand unsupervised learning techniques		9	13	2
7.1	Describe the clustering techniques in machine learning.				
7.2	Explain, design and implement various unsupervised machine learning algorithms in a range of real-world applications (k-means algorithm, agglomerative clustering and DBSCAN, Apriori Algorithm).				
7.3	Evaluate the efficiency of the different machine learning algorithms with the test data.				
F.	Ensemble Learning				
8	Understand ensemble learning techniques		6	9	2
8.1	Explain the concepts of voting, stacking, bagging				
8.2	Explain and implement random forest classifiers to solve real-world problems.				
8.3	Implement ensemble learning algorithms				
G.	Applications of Machine Learning				
9	Appreciate the real-world applications of machine learning		3	3	1
9.1	Identify the applications in machine learning in industry sectors.				
9.2	Explain the challenges faced in machine learning.				
	Total Running Time: 120		45	60	15

Notes:

- The letters L, T, P and SDL in the detailed syllabus denote lecture, teaching, practical and self-directed learning respectively.