ISLAMIC UNIVERSITY OF TECHNOLOGY

Course Outline and Course Plan

Name of the Teacher	**Dr. Hasan Mahmud**	**Position**	**Associate Professor**
Department	**Computer Science and Engineering (CSE)**	**Programme**	**B.Sc. Engg. in SWE**
Course Code	**CSE 4553**	**Course Title**	**Machine Learning**
Academic Year	**2023-2024**	**Semester**	**Winter**
Contact Hours	**3.0**	**Credit Hours**	**3.0**
Text books and Reference books (if any)	**Text books:** – *TB1: Ethem Alpaydin, Introduction to Machine Learning, Second Edition, 2010.* – *TB2: Bishop, C. (2006). Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.* **Reference books*:*** – *RB1: Mitchell, T., Machine Learning, McGraw Hill, 1997* – *RB2: Introduction to Machine Learning by Alex Smola, 2010* – *RB3: Machine Learning Yearning, Online version, 2018 by Andrew Ng*		
Prerequisites (If any)	1. Math 4341: Linear Algebra 2. Math 4441: Probability and Statistics		
Course Homepage	**Google Classroom: https://classroom.google.com/c/NjE3MzY2NTc2MzY1?cjc=lilpayd**		
Teaching Methods/ Approaches	☒**Lecture**	☒**Group discussion**	☒**Demonstration**	☒**Problem solving**
	☒**Project**	☐**Others:**		
Teaching aids	☒**Multi-media**	☐**OHP**	☒**Board and Marker**	☐**Others**

Course Assessment Method							
Attendance (10%)	**Quiz 15% of Total Marks (Best 3 out of 4)**					**Mid Semester (25%)**	**Semester Final (50%)**
	1st Quiz	**2nd Quiz**	**3rd Quiz**	**4th Quiz**	**Others**	**Week/Date**	**Week/Date**
	Week/Date	**Week/Date**	**Week/Date**	**Week/Date**	**Assignment/Project**		
	4th Week	8th Week	11th Week	13th Week	TBA	As scheduled by IUT	As scheduled by IUT

Course Contents	This course provides the basic introduction to machine learning algorithms. Machine learning is a technique that helps computer system act intelligently. It simulates the human learning process and the decision making capabilities through experience gathered artificially. Throughout the course you will be learning machine learning problems, way to implement machine learning algorithms, knowing different recent application areas of machine learning (such as Human-Computer Interaction, Computer Vision, Robotics, Bio-informatics, Natural Language Processing, Web and text mining, deep learning, etc.).
Course Objective	This course will introduce the field of Machine Learning, in particular focusing on the core concepts of supervised and unsupervised learning. In supervised learning we will discuss algorithms which are trained on input data labelled with a desired output, for instance an image of a face and the name of the person whose face it is, and learn a function mapping from the input to the output. Unsupervised learning aims to discover latent structure in an input signal where no output labels are available, an example of which is grouping web-pages based on the topics they discuss. Students will learn the algorithms which underpin many popular Machine Learning techniques, as well as developing an understanding of the theoretical relationships between these algorithms. Objectives: • Understand the foundation principles and techniques of machine learning: data, feature engineering, model selection, model complexity, etc. • Analyze both strengths and weaknesses of many popular machine learning approaches. • Apply the underlying mathematical relationships and implement Machine Learning algorithms in the paradigms of supervised, un-supervised learning, semi-supervised learning • Design and develop various machine learning algorithms/solutions of for a range of real-world applications.

Course Outcomes	**CO1 - Apply** fundamental concepts of machine learning in different problem scenario (C3) **CO2 – Analyse** strengths and weaknesses of many machine learning approaches (C4). **CO3 – Design** solutions/algorithms for a range of real-world machine learning problems. **CO4 – Develop or Implement** machine learning solutions/algorithms using appropriate software tools and libraries (C6)

Weekly plan for course content

Weeks	Topics	Remarks
1	• ML Course Introduction, topics overview, assessment and grading policies	
	• Introduction to Machine Learning, types of learning, steps in developing machine learning applications, overview of different machine learning applications.	
2	• Regression analysis: Linear regression with single and multiple variables, cost function	
	• Regression analysis: Logistic regression / Non-Linear Regression, Regularization	
3	• Convexity and non-convexity, Gradient Descent, Stochastic Gradient Descent, Batch Gradient Descent	Quiz 1 – CO1
4	• Decision tree: Construction of decision tree, information gain, entropy, splitting dataset.	
5	• Probabilistic classifier: Introduction to probabilistic classifier, • Discriminative and Generative probabilistic models	
6	• Naïve Bayes classifier • Applications of probabilistic classifier	
7	• Basic Practices in Machine Learning: Feature Engineering, Model evaluation techniques, overfitting-underfitting, machine learning model selection and design considerations, Hyperparameter, performance evaluation.	Quiz 2 – CO1, CO2
	Mid Semester Examination	CO1, CO2, CO3
8	• K-nearest neighbor: Intuitive understanding of KNN, How does KNN work? • Distance measurement techniques, how to choose k factor.	
9	• Ensembles: Simple ensembles, max voting, averaging, weighted averaging • Bagging: Random Forest • Ensembles: Boosting technique and algorithms, Adaboost.	Quiz 3 – CO2, CO3
10	• Support vector machine (SVM): What is SVM? How does SVM works? Mathematical formulation of SVM. • Kernel Trick. • Multi-class classification	
11	• Clustering: Unsupervised learning basics, clustering concepts, K-means, • Hierarchical clustering technique: Agglomerative clustering • Density Based Clustering	
12	• Dimensionality reduction: Principal Component Analysis (PCA), Expectation Maximization	
13	• Introduction to neural network: Neural network basics, types of activation functions, feed-forward neural network, back propagation neural network.	
14	• Introduction to deep neural network: Deep neural network basics, limitations of neural network, convolution neural network, recurrent neural network, long-short term memory.	Quiz 4 – CO3, CO4
15	• Time-series classifier: Basics of time-series matching, understanding Dynamic Time Warping algorithm. Applications of time-series classifier	
	Semester Final Examination	CO1, CO2, CO3, CO4

Grading Policy:

Numeric Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00

Class Schedule:

Day	Section 1	Room Number
Tuesday	11:45 AM – 1:00 PM	R-302, AB2
Thursday	11:45 AM – 1:00 PM	Lab 5, AB2

Sessional Schedule:

Day	Section Name	Group	Matching with CO
Tuesday (Alternative Week)	Section 1	8:00 AM – 10:30 AM	CO1, CO2, CO3, CO4

Student's consulting hour: TBD

Instructor contact details:

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