ISLAMIC UNIVERSITY OF TECHNOLOGY

Course Outline and Course Plan

Name of the Teacher	Dr. Md. Hasanul Kabir	**Position**	Professor
Department	Computer Science and Engineering	**Programme**	B.Sc. Engineering in CSE
Course Code	CSE 4621	**Course Title**	Machine Learning
Academic Year	2020-2021	**Semester**	Summer
Contact Hours	3	**Credit Hours**	3
Text books and Reference books (if any)	Text & Reference books: 1. Introduction to Machine Learning, MIT Press, 3rd Ed. 2014 by E. Alpaydin 2. Pattern Recognition and Machine Learning, 1st Ed., 2006 by C. Bishop 3. Machine Learning, 1st Ed., 1997 by T. Mitchell 4. Pattern Classification, 2nd Ed., 2001 by R.O. Duda et al. 5. Machine Learning Yearning, Online version, 2018 by Andrew Ng		
Prerequisites (If any)	1. Math 4341: Linear Algebra 2. Math 4441: Probability and Statistics	**Course Type**	Compulsory
Course Homepage	**Google Classroom: wk3xbql**		
Teaching Methods/ Approaches	Lecture / Problem solving / Project		

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	TBA	As scheduled by IUT	As scheduled by IUT

Course Objectives	The courses aims for students to achieve the followings: 1. Master the basic techniques on machine learning techniques, including supervised learning, unsupervised learning, and reinforcement learning. 2. Apply and implement algorithms to enable machine learning. 3. Analyse both strengths and weakness of the machine learning algorithms. 4. Design and develop solutions/algorithms for small to medium scale problems.

Mapping with CO, PO and Bloom's Taxonomy			
CO No.	**Course Outcomes (CO) Statement**	**Levels of Bloom's Taxonomy**	**Matching with Program Outcome (PO)**
CO1	Apply algorithms to enable machine learning.	C3	PO1
CO2	Analyse both strengths and weakness of the machine learning algorithms.	C4	PO2
CO3	Design solutions/algorithms for small to medium scale problems.	C6, P7	PO3

Weekly plan for Lecture		
Weeks	**Topics**	**Remarks**
1	Introduction to Machine Learning (ML), Overview of the Course, Type of Learning methods, Application of ML	
2	Supervised Learning Setup, Linear Regression with One Variable, Linear Algebra Overview	
3	Linear Regression with Multiple Variables, Non-Linear Regression	**Quiz 1 – CO1**
4	Logistic Regression, Hypothesis Representation, Cost Function, Regularization	
5	Convexity and non-convexity, Gradient Descent, Stochastic Gradient Descent	**Quiz 2 – CO1, CO2**
6	Neural Network, Representation, Learning, Backpropagation Algorithm	
7	Evaluating a Learning Algorithm, Bias/Variance, Machine Learning System Design	
	Mid Term Exam	**CO1, CO2, CO3**
8	Deep Neural Network, CNN, RNN, LSTM, Use of Deep Learning	
9	Probabilistic classifier: Introduction to probabilistic classifier, forms of probabilistic models, Naïve Bayes classifier	**Quiz 3 – CO2, CO3**
10	Decision tree: Construction of decision tree, information gain, entropy, splitting dataset.	
11	Support Vector Machine, Kernels, Multi-class Classification	**Assignment – CO1**
12	Clustering: Unsupervised learning basics, clustering concepts, K-means,, Hierarchical clustering technique: Agglomerative clustering, Density Based Clustering	
13	Principal Component Analysis (PCA), Expectation Maximization (EM)	**Quiz 4 – CO1, CO2**
14	Anomaly Detection, Recommender System	
15	Reinforcement Learning, Large Scale Machine Learning, Various Applications.	**Term Project Submission – CO3**
	Final Exam	**CO1,CO2, CO3**

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	Section 2
Monday	11:45 AM – 01.00 PM	08:00 AM – 09.15 AM
Wednesday	09:15 AM – 10.30 AM	11:45 AM – 01.00 PM

Sessional Schedule:

Day	Section Name	Group	Matching with CO
Monday (Alternative Week)	Section 1	02.30 PM ~ 05.00 PM (A / B)	CO1, CO2, CO3
Thursday (Alternative Week)	**Section 2**	**02.30 PM ~ 05.00 PM (A / B)**	**CO1, CO2, CO3**

Student's consulting hour: Email for appointments.

Instructor contact details:

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Program Outcomes (POs : PO1 ~ PO12)

PO No.	Program Outcomes (POs)
	Students graduating from the Bachelor of Science in Civil Engineering (B.Sc. in Civil Engineering) program, upon graduation students will have the ability to:
PO1	**Engineering knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
PO4	**Investigation:** Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)
PO6	**The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
PO7	**Environment and sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)
PO9	**Individual work and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.