University of Asia Pacific (UAP)
Department of Computer Science and Engineering (CSE)

Course Outline

Program:	Computer Science and Engineering (CSE)
Course Title:	Machine Learning
Course Code:	CSE 427
Semester:	Fall 2020
Level:	7th Semester (4th Year, 1st Semester)
Credit Hour:	3.0
Name & Designation of Teacher:	S M Rafiuddin Rifat, Lecturer
Office/Room:	7th Floor, Teachers' Area
Class Hours:	**Section A:** **Tuesday: 3:00PM – 4:50PM** **Thursday: 2:00PM – 3:50PM**
Consultation Hours:	**Section A:** **Sunday: 5:00PM – 6:15PM**
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Rationale:	The Machine Learning course prepares students for connecting learning algorithms to a broad variety of real-life issues in Science and Engineering. It also prepares students for future endeavor as Data Scientists, Knowledge Workers, Decision Makers and numerous prospective professions to be named.
Pre-requisite (if any)**:**	Students are expected to complete the following courses— MTH 205 (Math IV), CSE 105 (Discrete Mathematics)
Course Synopsis:	***Machine Learning Introduction:*** Machine Learning introduction and Pattern Recognition, Types of Machine Learning algorithms, Supervised, Unsupervised and

Semi-supervised learning, Reinforcement Learning, Q learning, Difference between Regression and Classification.

Regression:

Single variable linear regression, Multi-variable linear regression, Logistic regression and learning process, sigmoid function, Learning derivation, hypothesis function, Cost function, Gradient descent.

Working with datasets and tuning parameters:

Training, Cross-validation and Testing set, K fold cross validation, High bias and high Variance, normalization and normal equation, regularization.

Clustering:

K means Clustering, Hierarchical clustering, Elbow method for choosing the value of K, Application of clustering.

Naïve Bayes, Multinomial Naïve Bayes, Bayesian Rule, Decision Tree and Random Forrest, K nearest neighbor.

Support Vector Machine:

Support Vector points, margin, width, hyper-plane, Inputs and Outputs of Support Vector Machine, Deduction of the width of the margin, Margin of Separation, optimal hyper-plane, Formulation of quadratic programming problem of Support Vector machine, Lagrange Multiplier and its application, The properties of solution of Lagrange multipliers solution, Determination of the value of w using Lagrange Multipliers method, Conversion from primal problem to dual problem, How to classify an unknown point with equations, Idea of Kernel and how to apply it, Kernel types.

Artificial Neural Network:

Structure of Human Neuron, How Artificial Neural Network can Mimic a single human neuron, McCulloch and Pitts Model of a single neuron, Perceptron Model of a single neuron, Single Neuron Perceptron Learning algorithm, Perceptron Activation Functions, Single and Multilayer Neural Network, Significance of Hidden layer, Logic gates implementation with Artificial Neural Network, Backpropagation Learning algorithm, Convolutional Neural Network, Recurrent Neural network and Long Short-Term Memory, Introduction to Deep Neural Network.

Miscellaneous:

Principle Component Analysis and Single Value Decomposition, Hidden Markov Model, ROC and AUC curve, F1 Score, Precision and Recall.

Course Objectives:

The objectives of this course are to—

1. **Provide** knowledge and understanding on principles of Pattern recognition and Machine Learning.
2. **Introduce** the concept of different types of classification and recognition algorithm.
3. **Learn** the regression and classification algorithm.
4. **Enable** the student to gain application of different types pattern recognition tasks.
5. **Emphasize** the design and implement of different types pattern recognition algorithms.

Course Outcomes (CO) and their mapping with Program outcomes (PO) and Teaching-Learning Assessment methods:

CO No.	CO Statements: Upon successful completion of the course, students should be able to—	Corresponding POs (Appendix-1)	Bloom's taxonomy domain/level (Appendix-2)	Delivery methods and activities	Assessment Tools
CO 1	**Understand** the objectives, terminology associated with Regression Algorithms.	1	1/Understand	Lecture, Group discussion	Written exam
CO 2	**Explain** the basic concept of KNN, K-means, Naïve Bayes, and Decision Tree algorithm.	4	Valuing, Understanding	Problem Solving	Written exam
CO 3	**Apply** the techniques and algorithms of Support Vector Machine.	5	1/Apply	Problem Solving	Quiz, Written exam
CO 4	**Design** the model of Artificial Neural Network and Convolutional Neural Network	2, 3	1/Evaluate	Problem Solving	Quiz, Written exam
CO 5	**Analyze** the outcome of result and performance of the algorithms and the parameters associated with the algorithms.	6	1/Analyze	Lecture, Group discussion	Written exam

Weighting COs with Assessment methods:

Assessment Type	% weight	CO1	CO2	CO3	CO4	CO5

Final Exam	**50%**					
Mid Term	**20%**					
Quizzes	**30%**					
Total	**100%**					

Grading Policy: As per the approved grading policy of UAP (Appendix-3)

Course Content Outline and mapping with COs

Lecture	Topic	Course Outcome	Delivery methods and activities	Reading assignment
Lecture 1-2	Introduction to Machine Learning	CO1	Lecture, Group discussion	Pattern Recognition and Machine Learning, Chapter 1
Lecture 3-4	Linear Regression	CO1, CO2	Lecture, Problem Solving	Pattern Recognition and Machine Learning, Chapter 3
Lecture 5-6	Multivariate Linear Regression	CO1, CO2	Lecture, Problem Solving	Pattern Recognition and Machine Learning, Chapter 3
Lecture 7-8	Logistic Regression	CO1, CO3	Lecture, Problem Solving	Pattern Recognition and Machine Learning, Chapter 4
Lecture 9-10	Decision Tree with ID3 Algorithm and Bayesian Theory	CO3	Lecture, Problem Solving	Pattern Recognition and Machine Learning, Chapter 8
Lecture 11-12	Clustering	CO3	Lecture, Group discussion	Online Materials
Lecture 13-16	Support Vector Machine	CO1, CO4	Lecture, Group discussion	Pattern Recognition and Machine Learning, Chapter 6 and 7
Lecture 17-19	Principle Component Analysis	CO4	Lecture, Problem Solving	Pattern Recognition and Machine Learning, Chapter 12
Lecture 20-22	Artificial Neural Network and Convolutional Neural Network (CNN)	CO4, CO5	Lecture, Group discussion	Pattern Recognition and Machine Learning, Chapter 5
Lecture 23-24	Performance analysis of a model e.g. Confusion Matrix	CO3	Lecture, Problem Solving	To be assigned during lecture.

Required References: Pattern Recognition and Machine Learning – Christopher Bishop

Recommended References: Introduction to Machine Learning – Tom Mitchel

Special Instructions:

- Minimum Required Attendance is 70%
- No make-up for quizzes and mid-term exam
- Plagiarism policy: zero tolerance in case of plagiarism

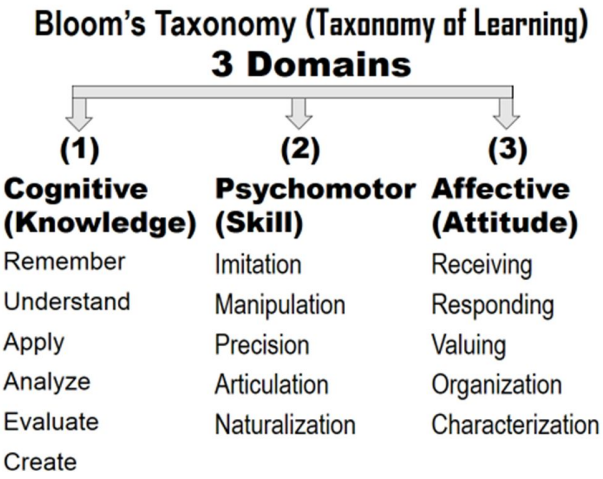
Prepared by	Checked by	Approved by
S M Rafiuddin Rifat (Course Teacher)	Chairman, PSAC committee	Head of the Department

Appendix-1:

Washington Accord Program Outcomes (PO) for engineering programs:

No.	PO	Differentiating Characteristic
1	Engineering Knowledge	Breadth and depth of education and type of knowledge, both theoretical and practical
2	Problem Analysis	Complexity of analysis
3	Design/ development of solutions	Breadth and uniqueness of engineering problems i.e. the extent to which problems are original and to which solutions have previously been identified or codified
4	Investigation	Breadth and depth of investigation and experimentation
5	Modern Tool Usage	Level of understanding of the appropriateness of the tool
6	The Engineer and Society	Level of knowledge and responsibility
7	Environment and Sustainability	Type of solutions.
8	Ethics	Understanding and level of practice
9	Individual and Team work	Role in and diversity of team
10	Communication	Level of communication according to type of activities performed
11	Project Management and Finance	Level of management required for differing types of activity
12	Lifelong learning	Preparation for and depth of Continuing learning.

Appendix-2



Appendix-3

UAP 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