



Bangladesh University of Business and Technology (BUBT)
Faculty of Engineering & Applied Sciences (FEAS)
Department of Computer Science and Engineering (CSE)

THEORY COURSE OUTLINE

1	Program	B.Sc. Engg. in CSE											
2	Course Code	CSE 465											
3	Course Title	Machine Learning											
4	Course Type	Core Course											
5	Academic Session	Fall 2021-22											
6	Credit Hour	3.0											
7	Intake	39											
8	Section	2											
9	Pre-requisites	CSE 351 Artificial Intelligence											
10	Campus	Permanent Campus											
11	Course Teacher	Name: Badhan Chandra Das		Designation: Lecturer									
		Specialization: Machine Learning, Data Mining, NLP, Social Network.											
		Room No. 911/B2	Email: badhan_das@bubt.edu.bd	Cell No. 01670140193									
12	Class Schedule	<table><tr><td>Class Day</td><td>Class Hours</td><td>Class Room</td></tr><tr><td>Sunday</td><td>1:00 PM – 02.00 PM</td><td>808 (B-2)</td></tr><tr><td>Monday</td><td>02:00PM - 03:00PM</td><td>218 (B-2)</td></tr></table>			Class Day	Class Hours	Class Room	Sunday	1:00 PM – 02.00 PM	808 (B-2)	Monday	02:00PM - 03:00PM	218 (B-2)
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13	Counselling Schedule	<table><tr><td>Class Day</td><td>Class Hours</td><td>Class Room</td></tr><tr><td>Tuesday</td><td>10:00 AM – 11.00 AM</td><td>911(B-2)</td></tr><tr><td>Thursday</td><td>12:30 PM – 01.30 PM</td><td>911(B-2)</td></tr></table>			Class Day	Class Hours	Class Room	Tuesday	10:00 AM – 11.00 AM	911(B-2)	Thursday	12:30 PM – 01.30 PM	911(B-2)
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14	Course Objectives	This course introduces several fundamental concepts and methods of machine learning. In particular, the course will cover some basic learning algorithms, techniques and their applications. By the end of the course students should be able to develop an appreciation for what is involved in learning models from data, understand a wide variety of learning algorithms, apply the algorithms to solve the real world problems as well as improve the scope of existing solutions for problems.											
15	Course Synopsis	Introduction to Machine Learning and its application, Machine learning for predictive data analytics, Concept Learning and the learning as search, General to specific ordering hypothesis, Candidate elimination algorithm, Decision Tree Basics, Information theory, Information gain, ID3 algorithm, Similarity based learning, K-NN & Weighted K-NN algorithm, K-dimensional tree algorithm, Smoothing, Error based learning parameterized model, Linear regression, Logistic regression, Gradient decent, Simplified cost function, Support Vector Machines, Large Margin Intuition, Kernel function, Unsupervised Learning, Reinforcement Learning etc.											
16	Text Book	1. Machine Learning (2 nd Edition)- Tom Mitchell (McGraw Hill)											
17	Reference Book	2. FUNDAMENTALS OF MACHINE LEARNING FOR DATA ANALYTICS (6th Edition)- John D. Kelleher et al											

18	Course Outcomes (COs)	Upon completing this course students will be able to: CO1: Understand basic machine learning concepts and terminologies. CO2: Explain various machine learning theories and algorithms. CO3: Apply machine learning algorithms and techniques to solve problems and design solutions. CO4: Evaluate how one algorithm can work differently from others despite being applied in same situation with respect to performance and compute the complexity.																																																																												
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21	Lecture Plan (Weekly Schedule)												
	Week	Lecture #	Selected Topics	Chapter #	COs	Assessment							
	1	1	Introductory Class, Introduction to Machine Learning, application of machine learning , Data to insights to decisions	Ch1	CO1	Mid Term Exam 30							
		2	Machine learning for predictive data analytics: ill-posed problem, overfitting, underfitting	Ch2	CO2								
	2	3	Concept Learning and the learning as search, General to specific ordering hypothesis	Ch2	CO2		Mid Term Exam 30						
		4	Finding a maximally specific hypothesis	Ch2	CO4								
	3	5	Version space & list then eliminate algorithm	Ch2	CO2			Mid Term Exam 30					
		6	Candidate elimination algorithm, Decision Tree Basics: information theory [CT-1]	Ch2	CO3								
	4	7	Measuring entropy & it's role in decision tree, Shannon's entropy model	Ch3	CO3				Mid Term Exam 30				
		8	Decision Tree: information gain	Ch-4	CO3								
	5	9	Decision Tree: Iterative Dichotomize 3 (ID3) algorithm	Ch4	CO3					Mid Term Exam 30			
		10	Measure of similarity, data normalization,	Ch5	CO3								
	6	11	k-NN : Introduction	Ch5	CO1						Mid Term Exam 30		
		12	Weighted K-NN algorithm	Ch5	CO3								
	7	13	K-dimensional tree algorithm	Ch5	CO3							Mid Term Exam 30	
		14	Review class for Midterm Examination										
	8	Midterm Examination											Mid Term Exam 30
	9	15	Error based machine learning: parameterized model, Measuring error & error surface	Ch7	CO1	Mid Term Exam 30							
		16	Linear Regression : Gradient Descent, Multiple Features	Ch7	CO2								
	10	17	Logistic Regression : Simplified Cost Function, Gradient Descent	Ch7	CO2		Mid Term Exam 30						
		18	Logistic Regression : Multi Class Classification [CT-2]	Ch7	CO2								
	11	19	Applying Machine Learning : Evaluating a Hypothesis, Model Selection	Ch4	CO3			Mid Term Exam 30					
		20	Applying Machine Learning : Cross Validation Set	Ch8	CO2								
	12	21	Applying Machine Learning : Diagnosing Bias vs Variance, Regularization and Bias vs Variance	Ch5	CO4				Mid Term Exam 30				
		22	Class Test: 3 General discussion on Support Vector Machine	Ch5	CO1								
	13	23	Support Vector Machine : Optimization Objective, Large Margin Intuition	Ch6	CO1					Mid Term Exam 30			
		24	Support Vector Machine : Mathematics Behind Large Margin Classification	Ch6	CO2								
	14	25	Support Vector Machine : Kernels I	Ch6	CO2						Mid Term Exam 30		
26		Review class for Semester Final Term											

	15	Final Exam						
22	Overall CO Assessment Criteria	Assessment methods of COs are given below:						
		Assessment Area	CO				Assessment Area Mark	
			CO1	CO2	CO3	CO4		
		Class Participation						
		Assignment/Presentation						
		Class Test						
		Midterm Exam	5	10	15		30	
		Final Exam		10	15	15	40	
		Total Mark	5	20	30	15	70	
23	Rubrics	COs (Bloom's Level)	Excellent (80%-100%)	Good (70%-79%)	Satisfactory (60%-69%)	Poor (40%-59%)	Unsatisfactory (0-39%)	Marks (70)
		CO1 (Understanding)	Answer is complete and sufficient detail provided to support issues related to the question. And also deals fully with the entire question.	Answer is brief with sufficient detail provided to support issues were introduced. And most of the basic details are included but some are missing.	Answer is brief with insufficient detail provided to support issues were introduced.	Answer is incomplete and excessive discussion of unrelated issues. And serious gaps in the basic details.	None of the relevant details were included or didn't answer.	
		CO2 (Understanding)	Answer is complete and sufficient detail provided to support issues related to the question. And also deals fully with the entire question.	Answer is brief with sufficient detail provided to support issues were introduced. And most of the basic details are included but some are missing.	Answer is brief with insufficient detail provided to support issues were introduced.	Answer is incomplete and excessive discussion of unrelated issues. And serious gaps in the basic details.	None of the relevant details were included or didn't answer.	
		CO3 (Applying)	The question is answered appropriately by applying the suggested method in the	The question is answered briefly by applying the suggested method in the question.	The question is answered correctly by applying the suggested method in the	The question is answered incompletely by applying the suggested	No attempt to implement the suggested method.	

Bloom's Taxonomy is a set of three hierarchical models used to classify educational learning objectives into levels of complexity and specificity. The three lists cover the learning objectives in Cognitive, Affective and Psychomotor domains. The Cognitive domain list has been the primary focus of most education and is frequently used to structure curriculum learning objectives, assessments and activities. The three domains and respective levels are illustrated below.

Cognitive [C] (Knowledge-based)	Affective [A] (Emotion-based)	Psychomotor [P] (Action-based)
1. Remembering	1. Receiving	1. Imitating
2. Understanding	2. Responding	2. Manipulating
3. Applying	3. Valuing	3. Précising
4. Analyzing	4. Organizing	4. Articulating
5. Evaluating	5. Characterizing	5. Naturalizing
6. Creating		

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Descriptions of Cognitive Domain (Anderson and Krathwohl's Taxonomy 2001):

The **cognitive domain** involves the development of our mental skills and the acquisition of knowledge.

Level	Category	Meaning	Keywords
C1	Remembering	Recognizing or recalling knowledge from memory. Remembering is when memory is used to produce or retrieve definitions, facts, or lists, or to recite previously learned information.	Define, describe, draw, find, identify, label, list, match, name, quote, recall, recite, tell, write
C2	Understanding	Constructing meaning from different types of functions be they written or graphic messages or activities like interpreting, exemplifying, classifying, summarizing, inferring, comparing, or explaining.	Classify, compare, exemplify, conclude, demonstrate, discuss, explain, identify, illustrate, interpret, paraphrase, predict, report
C3	Applying	Carrying out or using a procedure through executing, or implementing. Applying relates to or refers to situations where learned material is used through products like models, presentations, interviews or simulations.	Apply, change, choose, compute, dramatize, implement, interview, prepare, produce, role play, select, show, transfer, use
C4	Analyzing	Breaking materials or concepts into parts, determining how the parts relate to one another or how they interrelate, or how the parts relate to an overall structure or purpose. Mental actions included in this function are differentiating, organizing, and attributing, as well as being able to distinguish between the components or parts. When one is analyzing, he/she can illustrate this mental function by creating spreadsheets, surveys, charts, or diagrams, or graphic representations.	Analyze, characterize, classify, compare, contrast, debate, deconstruct, deduce, differentiate, discriminate, distinguish, examine, organize, outline, relate, research, separate, structure
C5	Evaluating	Making judgments based on criteria and standards through checking and critiquing. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation.	Appraise, argue, assess, choose, conclude, critique, decide, evaluate, judge, justify, predict, prioritize, prove, rank, rate, select, Monitor
C6	Creating	Putting elements together to form a coherent or functional whole ;reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to put parts together in a new way, or synthesize parts into something new and different creating a new form or product. This process is the most difficult mental function.	Construct, design, develop, generate, hypothesize, invent, plan, produce, compose, create, make, perform, plan, produce

29	Graduate Attributes (Program Outcomes) for B.Sc. in Engineering Program based on Washington Accord					
	<p>Program Outcomes (POs) are narrower statements that describe what students are expected to know and be able to do by the Time of graduation. These relate to the knowledge skills and attitudes that students acquire while progressing through the program. The students of the B.Sc. in EEE program are expected to achieve the following graduate attributes or program outcomes at the time of graduation.</p> <p>PO1–Engineering knowledge (Cognitive): Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.</p> <p>PO2–Problem analysis (Cognitive): Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.</p> <p>PO3–Design/development of solutions (Cognitive, Affective): Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.</p> <p>PO4–Investigation (Cognitive, Psychomotor): Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.</p> <p>PO5–Modern tool usage (Psychomotor, Cognitive): Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.</p> <p>PO6–The engineer and society (Affective): Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.</p> <p>PO7–Environment and sustainability (Affective, Cognitive): Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.</p> <p>PO8–Ethics (Affective): Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.</p> <p>PO9–Individual work and teamwork (Psychomotor, Affective): Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.</p> <p>PO10–Communication (Psychomotor, Affective): Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.</p> <p>PO11–Project management and finance (Cognitive, Psychomotor): Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work as a member or a leader of a team to manage projects in multidisciplinary environments.</p> <p>PO12–Life-long learning (Affective, Psychomotor): Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.</p>					
30	Social & Moral Capital					
	<p>Our promises are based on the three cardinal principles: (a) What we do believe (b) What we do practice, and (c) What we will promote</p> <p>However, students are advised to undertake the following commitments for moral development.</p> <table><tr><td><p>1. To be punctual and attentive in class</p><p>2. To maintain inclusive learning environment</p><p>3. To ensure mutual respect</p><p>4. To be cooperative in group learning.</p><p>5. To be innovative and Creative</p><p>6. To follow dress code and wearing ID card</p><p>7. To be always proactive</p></td><td><p>8. Try to follow and review day to day class</p><p>9. To avoid conspiracy</p><p>10. To prioritize honesty & faith</p><p>11. To be motivated for asking question and encourage feedback</p><p>12. To develop attitude for speaking in English</p><p>13. Do not ignore to carry out any assignments or commitments</p><p>14. To be clean and decent in all levels.</p></td><td><p>15. To be sincere for class preparation</p><p>16. Do not forget to switch-off the cell phone in class</p><p>17. Do not forget to carry course pack and learning stuffs in class</p><p>18. To maintain loyalty and trust to the university</p><p>19. Must avoid unfair means and plagiarism in exam, reports and assignments</p><p>20. Must maintain eco-friendly environment in the campus.</p></td></tr></table>			<p>1. To be punctual and attentive in class</p> <p>2. To maintain inclusive learning environment</p> <p>3. To ensure mutual respect</p> <p>4. To be cooperative in group learning.</p> <p>5. To be innovative and Creative</p> <p>6. To follow dress code and wearing ID card</p> <p>7. To be always proactive</p>	<p>8. Try to follow and review day to day class</p> <p>9. To avoid conspiracy</p> <p>10. To prioritize honesty & faith</p> <p>11. To be motivated for asking question and encourage feedback</p> <p>12. To develop attitude for speaking in English</p> <p>13. Do not ignore to carry out any assignments or commitments</p> <p>14. To be clean and decent in all levels.</p>	<p>15. To be sincere for class preparation</p> <p>16. Do not forget to switch-off the cell phone in class</p> <p>17. Do not forget to carry course pack and learning stuffs in class</p> <p>18. To maintain loyalty and trust to the university</p> <p>19. Must avoid unfair means and plagiarism in exam, reports and assignments</p> <p>20. Must maintain eco-friendly environment in the campus.</p>
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Prepared by:

Checked by:

Approved by: