Bangladesh University of Business and Technology (BUBT)
Department of Computer Science and Engineering(CSE)

Course Information

Program	: B.Sc. Engineering in CSE
Course Code	: CSE 467
Course Title	: Pattern Recognition
Course Credit	: 3.00
Contact Hours	: 3$_{hrs}$
Semester	: Fall 2020-21
Intake	: 35
Section	: 5
Prerequisites	**: CSE 351 Artificial Intelligence**

Course Objectives

The course introduces the fundamental concepts of pattern recognition techniques are used to design automated systems that improve their own performance through experience. This course covers the methodologies, technologies, and algorithms of statistical pattern recognition from a variety of perspectives. In this course, students can learn how pattern recognition techniques works and how it can be used to solve new problems as well as improve the scope of existing solutions for problems. Students will learn how pattern recognition techniques can learn, classify and recognize similarity between data and results and make decisions based on the patterns it recognizes.

Course Synopsis

Introduction to Pattern Recognition, Bayesian Classification and its variants, Linear Classifiers: Perceptron Algorithms and its Variants, Linear SVM, Non-Linear Classifiers: Multilayer Perceptron, Non-Linear Support Vector Machines, Template Matching, Context Dependent Classification, and Syntactic Pattern Recognition: Grammar and Graph based Pattern Recognition, Unsupervised Classification: Clustering Algorithms.

Assessment

Class Participation	:	10%
Assignment/Presentation	:	10%
Class Test	:	10%
Midterm Examination	:	30%
Final Examination	:	40%
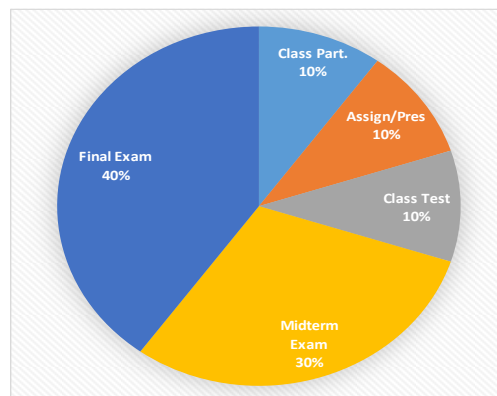
Course Outcomes (COs)

After completion of this course students will be able to:

CO1: **Understand** the basic concepts of pattern recognition, various techniques and its applications.

CO2: **Explain** different pattern recognition techniques, algorithms, models used for classification analysis.

CO3: **Apply** pattern recognition techniques to solve real life problems based on the concepts of Pattern Classification tools.

CO4: **Analyze** the performance of a pattern recognition algorithm for a given real life problem.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√											
CO2	√											
CO3			√									
CO4		√										

Sl. No.	Cos	Corresponding POs	Bloom's taxonomy domain/level	Delivery methods and activities	Assessment tools
1	**Understand** the basic concepts of pattern recognition, various techniques and its applications.	PO1	Understand	Class Lecture and Discussion	Midterm and Final Examination
2	**Explain** different pattern recognition techniques, algorithms, models used for classification analysis.	PO1	Explain	Class Lecture and Discussion	Midterm and Final Examination
3	**Apply** pattern recognition techniques to solve real life problems based on the concepts of Pattern Classification tools.	PO3	Apply	Class Lecture and Discussion	Midterm and Final Examination
4	**Analyze** the performance of a pattern recognition algorithm for a given real life problem.	PO2	Analyze	Class Lecture and Discussion	Final Examination

Descriptions of Program Outcomes (POs)

PO1	**Engineering Knowledge (Cognitive):** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
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.
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.
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.
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.
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.
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.
PO8	**Ethics (Affective):** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.
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.
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.
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.
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.

Week	Lecture	Course Topics	Remarks	CO	Exam (Mark)
1	1	Introduction to Pattern Recognition, Learning , Design Cycle	R. Duda, Ch-1	**CO1**	
	2	Bayesian Classifier and it's variants	S. Theodoridis Ch-2	**CO1, CO2**	
			"	**CO2, CO3**	
2	3	Normal Density, Naïve Bayes Classifiers	"	**CO2, CO3**	
	4	Minimizing the Classification Error Probability	"	**CO2**	
			"	**CO2**	
3	5	Discriminant functions and decision surfaces, Bayesian Belief Networks – Different Representation, BBN Model Building	**[CT-1]**	**CO2**	
	6	Linear Discriminant Functions and Applications, Decision Surfaces	S. Theodoridis Ch-3	**CO3**	**Mid-Term Exam (30)**
4	7	Perceptron Algorithm, Convergence Proof of Perceptron Algorithm	"	"	
	8	Variants of perceptron Algorithm, Generalization of Perceptron Algorithm for M- Class case	Ch-8 "	"	
5	9	Support Vector Machines, Linear SVM for non-separable case		"	
	10	Non Linear Classifier, Non Linear SVM Issues in the design of Non Linear SVM	"	"	
6	11	Two layer Perceptron, Multi-layer Perceptron , Algorithm Based on Exact Classification of Training Examples	"	**CO3**	
	12	Backpropagation Algorithm **[Mid Term Overview]**	"	**CO2,CO3**	
7		**Mid-term Examination**			
8	13	Introduction to Template Matching	S. Theodoridis Ch-8	**CO2**	
	14	TM using Optimal Path Searching	"	**CO2**	**Final Exam (40)**
9	15	Bellman's Optimality Principle, The Edit Distance Algorithm	"	**CO2**	

	16	Application of TM in IWR , Application of TM in Text Matching	"	**CO3**	
10	17	Correlation based TM, Correlation In Image Matching , Deformable Template Matching	"	**CO2**	
	18	Context Dependent Classification, Context Dependent Bayesian Classifier	Ch-9	**CO2**	
11	19	Markov Chain Model, Viterbi Algorithm and its application	"	**CO3, CO4**	
	20	Viterbi Algorithm Application in Channel Equalization	Class Test 2	**CO3, CO4**	
12	21	Calculation of sequence probability, Hidden Markov Model	"	**CO3**	
	22	Main issues using HMMs, Baum-Welch algorithm	"	**CO4**	
13	23	Introduction to system evaluation, Error Counting Approach	Ch-11	**CO2**	
	24	Exploiting the finite size of dataset, Clustering Basis, Clustering Task Stages	"	"	
14	25	Types of Clusters, Sequential Clustering	"	**CO4**	
	26	DBSCAN, K means Clustering **Review class for Semester Final Examination**	"	**CO4**	

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,	Classify, compare, exemplify, conclude, demonstrate, discuss,

		classifying, summarizing, inferring, comparing, or explaining.	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

Teaching Materials/Equipment

- Required References   -   1.**Pattern Recognition - S. Theodoridis & K. Koutrumbas**

    2. Pattern Classification - R. Duda *et al*.

- Recommended References: 1. Pattern Recognition *Statistical, Structural and Neural Approaches –*

    - R. Shalkoff

    2. Introduction to Data Mining

-Tan, Steinbach, Kumar

Overall CO's Assessment Scheme

Assessment Area	COs				Assessment Area Mark
	CO1	CO2	CO3	CO4	
Class Participation					
Assignment/Presentation					
Class Test					
Midterm Exam	10	10	10		30
Final Exam		15	15	10	40
Total Mark	**10**	**25**	**25**	**10**	**70**

Rubrics for CO Assessment Scheme

COs (Bloom's Level)	Excellent (80%-100%)	Good (70%-79%)	Satisfactory (60%-69%)	Poor (40%-59%)	Unsatisfactory (0-39%)	Marks (70)
CO1 (Understand)	Answer is complete and sufficient detail provided to support issues related to the question.	Answer is brief with sufficient detail provided to support issues were introduced.	Answer is brief with insufficient detail provided to support issues were introduced.	Answer is incomplete and excessive discussion of unrelated issues.	None of the relevant details were included or didn't answer.	10
CO2 (Explain)	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	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	None of the relevant details were included or didn't answer.	25

		included but some are missing.		basic details.	
CO3 (Apply)	The question is answered correctly by applying the suggested method in the question.	The question is answered briefly by applying the suggested method in the question	The question is answered by applying the suggested method in the question but some steps are missing.	The question is answered incompletely by applying the suggested method in the question but some steps are correct.	No attempt to implement the suggested method.	25
CO4 (Analyze)	A clear, complete, and properly ordered chain of analyzing steps is followed to answer the question.	The chain of analyzing steps is complete and correctly ordered.	One or more intermediate analyzing steps are missing or unclear, but the correctness of the analysis is not compromised.	One or more intermediate analyzing steps are missing or unclear to answer the question.	The stated chain of analysis does not lead to the stated question.	10

Grading System

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

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Instructor Information

Instructor :	**Md. Hasibur Rahman**
	Lecturer,
	Department of Computer Science & Engineering
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Class Schedule

Day	Time	Room No
Wednesday	08:30 AM to 09:50 AM	B:2-R:318
Thursday	10:00 AM to 11:20 AM	B:2-R:906

Office Hour

Day/Time	08:30 AM to 09:50 AM	10:00 AM to 11:20 AM	11:30 AM to 12:50 AM	01:20 PM to 02:40 PM	02:50 PM to 04:10 PM	06:00 PM to 07:30 PM	07:30 PM to 09:00 PM
SAT	Day Off						
SUN	CSE 426 37[3] B:3-R:506	CSE 426 37[3] B:3-R:506	Office Hour				
MON		Office Hour	Office Hour	CSE 425 37[3] B:2-R:910			
TUE	CSE 425 37[3] B:2-R:908	Office Hour	Office Hour				
WED	CSE 467 35[5] B:2-R:318	Office Hour		CSE 467 35[2] B:2-R:318	Office Hour	CSE 425 28[1] B:2-R:808	CSE 425 28[1] B:2-R:808
THR	CSE 467 35[2] B:1-R:302	CSE 467 35[5] B:2-R:906			Office Hour	CSE 426 28[1] B:3-R:505	CSE 426 28[1] B:3-R:505
FRI	Day Off						

Special Instructions

- Students are expected to attend all classes and examinations. A student MUST have at least 70% class attendance to sit for the final exam.
- Students will not be allowed to enter into the classroom after 20 minutes of the starting time.
- For plagiarism, the grade will automatically become zero for that exam/assignment.
- There is zero tolerance for cheating in exam. The only penalty for cheating is expulsion for several semesters as decided by the Disciplinary Committee of the university.

Prepared by: **Checked by:**   **Approved by:**