

Institute/Department	UNIVERSITY INSTITUTE OF ENGINEERING (UIE)	Program	Bachelor of Engineering - Computer Science & Engineering (CS201)
Master Subject Coordinator Name:	Rohit Kumar Singhal	Master Subject Coordinator E-Code:	E13497
Course Name	Machine Learning	Course Code	20CST-316

Lecture	Tutorial	Practical	Self Study	Credit	Subject Type
3	0	0	0	3.0	T

Course Type	Course Category	Mode of Assessment	Mode of Delivery
Program Core	Graded (GR)	Theory Examination (ET)	Theory (TH)

Mission of the Department	MD1: To provide practical knowledge using state-of-the-art technological support for the experiential learning of our students. MD2: To provide an industry-recommended curriculum and transparent assessment for quality learning experiences. MD3: To create global linkages for interdisciplinary collaborative learning and research. MD4: To nurture an advanced learning platform for research and innovation for students' profound future growth. MD5: To inculcate leadership qualities and strong ethical values through value-based education.
Vision of the Department	"To be recognized as a leading Computer Science and Engineering department through effective teaching practices and excellence in research and innovation for creating competent professionals with ethics, values, and entrepreneurial attitude to deliver service to society and to meet the current industry standards at the global level."

Program Educational Objectives(PEOs)

PEO1	PEO1 Graduates of the Computer Science and Engineering will contribute to the Nation's growth through their ability to solve diverse and complex computer science and engineering problems across a broad range of application areas. (PEO1 is focused on Problem Solving)
PEO2	PEO2 Graduates of the Computer Science and Engineering will be successful professionals, designing and implementing Products & Services of global standards in the field of Computer Science & Engineering, becoming entrepreneurs, Pursuing higher studies & research. (PEO 2 is focused on Professional Success)
PEO3	PEO3 Graduates of the Computer Science and Engineering Program will be able to adapt to changing scenario of dynamic technology with an ability to solve larger societal problems using logical and flexible approach in decision making. (PEO 3 is focused on Attaining Flexibility and Adaptability)

Program Specific OutComes(PSOs)

PSO1	PSO1 Exhibit attitude for continuous learning and deliver efficient solutions for emerging challenges in the computation domain.
PSO2	PSO2 Apply standard software engineering principles to develop viable solutions for Information Technology Enabled Services (ITES).

Program OutComes(POs)

PO1	PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	PO2 Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal, and environmental considerations.
PO4	PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO5	PO5 Modern tool usage: 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	PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7	PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	PO9 Individual or teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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	PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	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 to technological change.

Text Books					
Sr No	Title of the Book	Author Name	Volume/Edition	Publish Hours	Years
1	, Introduction to Machine Learning (Adaptive Computation and Machine Learning)	1. Ethem Alpaydin	24	MIT Press	2006
2	Machine Learning	Mitchell. T	9	, McGraw Hill,	1997
3	Introduction to machine learning: An early draft of a proposed textbook."	3. Nilsson, Nils J.	10	1996	1996

Reference Books					
Sr No	Title of the Book	Author Name	Volume/Edition	Publish Hours	Years
1	Pattern Recognition and Machine Learning	1. Christopher M. Bishop	11	Springer	2006
2	, MachineLearning: An Artificial Intelligence Approach	2. Ryszard S. Michalski, Jaime G. Carbonell, Tom M	5	Tioga Publishing Company	1983

Course OutCome	
SrNo	OutCome
CO1	Apply the basic concept of Machine learning and statistics learning to deal with real-life Problems.
CO2	Understand different machine learning algorithms, as well as underlying theories the behind them.
CO3	Select and apply the appropriate machine learning algorithm to solve problems of moderate complexity
CO4	Interpret and evaluate models generated from data.
CO5	Optimize the models learned and report on the expected accuracy that can be attained by applying the algorithms to a real-world problem.

Lecture Plan Preview-Theory						
Unit No	LectureNo	ChapterName	Topic	Text/ Reference Books	Pedagogical Tool**	Mapped with CO Numer (s)
1	1	Fundamentals of Machine Learning	Introduction to Machine Learning (ML), Different types of Machine Learning	,T-, Introduction to Machine Lear,T- Introduction to machine learni,T- Machine Learning,R- Pattern Recognition and Machi,R-, MachineLearning: An Artifici	Activity,Case Study,Flippe d Classes,Info graphics,Inst ructor Lead WorkShop,P PT,Reports, Simulation,V ideo Lecture	CO1

1	2	Fundamentals of Machine Learning	Machine Learning Life Cycle: Data Discovery, Exploratory Analysis: Data Preparation, Model Planning, Model Building, Model Evaluation	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2
1	3	Fundamentals of Machine Learning	Real-World Case Study. Foundation of ML: ML Techniques.	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1
1	4	Statistics Learning and Exploratory Data Analysis	Mean Median, Mode, Correlation, Covariance, Quartile, Maximum Likelihood	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1
1	5	Statistics Learning and Exploratory Data Analysis	Bayesian Inference, Bias, Variance	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1
1	6	Statistics Learning and Exploratory Data Analysis	Distance metrics: Euclidean Distance, Manhattan Distance	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1
1	7	Statistics Learning and Exploratory Data Analysis	Gaussian (or Normal) Distributions,	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1
1	8	Statistics Learning and Exploratory Data Analysis	statistical hypothesis testing	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1

1	9	Statistics Learning and Exploratory Data Analysis	Missing Value treatment, Outlier Detection	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1
1	10	Fundamentals of Machine Learning	Feature Engineering, Graphs and Plots.	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO1
1	11	Supervised Learning with Regression and Classification techniques -1:	Linear Regression	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO4
1	12	Supervised Learning with Regression and Classification techniques -1:	Multiple Regression	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
1	13	Supervised Learning with Regression and Classification techniques -1:	Bias-Variance Dichotomy, Model Validation Approaches	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO5
1	14	Supervised Learning with Regression and Classification techniques -1:	Evaluation of the performance of an algorithm: Mean Squared Error, Root Mean Squared Error.	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO5
2	15	Supervised Learning with Regression and Classification techniques -2:	Logistic Regression	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3

2	16	Supervised Learning with Regression and Classification techniques -2:	Support Vector Machine (SVM)	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
2	17	Supervised Learning with Regression and Classification techniques -2:	Naive Bayesian Classifier	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
2	18	Supervised Learning with Regression and Classification techniques -2:	K-Nearest Neighbor (KNN)	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2
2	19	Supervised Learning with Regression and Classification techniques -2:	Cross-Validation, Confusion Matrix	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
2	20	Supervised Learning with Regression and Classification techniques -2:	Evaluation of the performance of an algorithm: Accuracy, Error Rate, Precision, Recall, Specificity, F1 Score	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO5
2	21	Supervised Learning with Regression and Classification techniques -2:	Decision Tree	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2
2	22	Supervised Learning with Regression and Classification techniques -2:	Picking the best splitting attribute	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3

2	23	Supervised Learning with Regression and Classification techniques -2:	entropy and information gain	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO5
2	24	Supervised Learning with Regression and Classification techniques -2:	over fitting and under-fitting	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO4
2	25	Supervised Learning with Regression and Classification techniques -2:	data and pruning	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
2	26	Supervised Learning with Regression and Classification techniques -2:	noisy data and pruning	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
2	27	Supervised Learning with Regression and Classification techniques -2:	Ensemble Methods	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2
2	28	Supervised Learning with Regression and Classification techniques -2:	Ensemble Methods: Random Forest	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
2	29	Supervised Learning with Regression and Classification techniques -2:	Ensemble Methods: Random Forest	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3

3	30	Unsupervised Learning	Clustering	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2
3	31	Unsupervised Learning	Partitioning Method - K-means	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2
3	32	Unsupervised Learning	K-medoids	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
3	33	Unsupervised Learning	Hierarchical Clustering	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
3	34	Unsupervised Learning	Agglomerative and divisive clustering	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
3	35	Unsupervised Learning	Evaluation of clustering algorithms	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO5
3	36	Unsupervised Learning	Principal Component Analysis	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2

3	37	Unsupervised Learning	. Principal Component Analysis (Eigen values, Eigen Vectors, Orthogonality).	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classroom, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
3	38	Unsupervised Learning	Association Rules: Association Rule Mining, Apriori Algorithm	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classroom, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO3
3	39	Unsupervised Learning	Support and Confidence Parameters, Lift and Leverage	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classroom, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO4
3	40	Unsupervised Learning	Feature Reduction	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classroom, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO5
3	41	Unsupervised Learning	Dimensionality Reduction.	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classroom, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO4
3	42	Unsupervised Learning	Introduction, Assumptions, Working and Real-World Applications.	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classroom, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2
3	43	Unsupervised Learning	Reinforcement Learning: Introduction, Applications and Examples	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classroom, Instructor Lead Workshop, PT, Reports, Simulation, Video Lecture	CO2

3	44	Unsupervised Learning	Challenges of applying reinforcement learning	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PPT, Reports, Simulation, Video Lecture	CO2
3	45	Unsupervised Learning	reinforcement learning algorithm	,T-, Introduction to Machine Learning, T- Introduction to machine learning, T- Machine Learning, R- Pattern Recognition and Machine Learning: An Artificial Intelligence Approach	Activity, Case Study, Flipped Classes, Instructor Lead Workshop, PPT, Reports, Simulation, Video Lecture	CO2

Assessment Model			
Sr No	Assessment Name	Exam Name	Max Marks
1	20EU01	External Theory	60
2	20EU01	Assignment	10
3	20EU01	Attendance Marks	2
4	20EU01	Mid-Semester Test-1	40
5	20EU01	Quiz	4
6	20EU01	Surprise Test	12
7	20EU01	Mid-Semester Test-2	40

CO vs PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	NA	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO2	3	2	3	3	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO3	2	3	3	3	3	2	NA	NA	NA	NA	NA	NA	NA	3
CO4	3	2	3	2	3	NA	NA	NA	NA	NA	NA	NA	NA	2
CO5	2	3	3	3	3	NA	NA	NA	NA	NA	NA	NA	NA	2
Target	2.6	2.4	3	2.8	2.75	2	NA	NA	NA	NA	NA	NA	NA	2.33

