Course Code	UDS21D02J	Course Name	MACHINE LEARNING FOR ENTERPRISE	Course Category	C	Professional Core Course	L	T	P	C
							4	0	2	5

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Applications		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning
CLR-1 :	To make the participants comfortable with the fundamentals of some of the advanced machine learning concepts, their working principles, and their functions in a business scenario.	1 2 3
CLR-2 :	To make the participants understand the methods of teaching machines in performing cognitive works just as humans do.	
CLR-3 :	To Teach the participants to build intelligent and automated real-world machine learning applications and use cases spanning healthcare, retail, energy verticals by intelligently Analyzing different datasets collected from diverse data sources.	
CLR-4 :	To Select the right set of features the model training in order for the model to learn only the required information eliminating anomalies, outliers, noise and other unnecessary information.	
CLR-5 :	To understand all the steps and process involved the in model engineering process for training, validating, testing, deploying machine learning models in the production system for the user consumption.	
CLR-6 :	To make the learners come to an alignment, apply their learning to a real-world business problem, and then performs research, design, development, and delivers an end-to-end machine learning solution for a given industry problem. The students will be working either in a group or individually.	

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Have skills and expertise to train, validate, test, deploy the models in the production for the consumption of users.	2	85	80
CLO-2 :	Have a firm understanding of the importance and challenges of learning agents that make decisions is of vital importance today	3	85	80
CLO-3 :	a hands-on skills and knowledge to develop an ensembled based learning system by combining diverse machine learning models together	3	85	80

Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
H	H	H	M	H	H	H	H	H	H	M	H	H	H	H
H	H	H	M	H	H	H	H	H	H	M	H	H	H	H
H	H	H	M	H	H	H	H	H	H	M	H	H	H	H

CLO-4 :	Have a hands-on skills, expertise and knowledge to develop Recommendation systems using collaborative filtering or a content-based techniques that suggests an user with Products they are likely to buy, movies to watch etc.	3	85	80	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-5 :	Have a hands-on skills, expertise and knowledge to use and design automated approaches for determining Machine Learning pipelines efficiently.	3	85	80	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-6 :	to design and develop machine learning solution artifacts and ultimately demonstrate an "end-to-end" machine learning solution for a given problem statement either in a group or individually.	3	85	80	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*

Note: All our curriculum, study materials, assignments, quizzes, lab works, and learning resources are personalized and dynamically generated using machine learning models based on the learner's learning ability. Users can review our learning curriculum only through our intelligent learning management platform (iLMSP), and our learning resources and lab infrastructures are available only in the digital form on our cloud infrastructures.

Duration (hour)		**18**	**18**	**18**	**18**	**18**
S-1	SLO-1	**Unit 1: Machine Learning - Deep Dive**	✓ Classification ✓ Binary Class Classification ✓ Multi Class Classification	**Unit 10: Supervised Machine Learning - Classification Type Problems**	Value Based Learning	How does a recommendation engine work? ✓ Data Collection ✓ Data Storage ✓ Filtering the Data
	SLO-2	Machine learning advanced concepts	✓ Clustering ✓ Density-based methods ✓ Hierarchical methods. ✓ Partitioning methods ✓ Grid-based methods	Decision Tree Classification	Policy Based Learning	Why Recommendation systems are needed, What can be Recommended
S-2	SLO-1	Representations, measurements, data types	Neural networks	Random Forest Classification	Model Based Learning	User and Item matching,Types of Recommendation systems, Content based Recommendation systems, Collaborative filtering
	SLO-2	Density Estimation	✓ Anomaly Detection ✓ Point Anomalies ✓ Contextual Anomalies ✓ Collective Anomalies	Linear Support Vector machines	Markov Decision Processes, Bellman Equations	**Unit 18: Auto Machine Learning (Auto ML)**

S-3	SLO-1	Regression, Variance – Bias Trade-off	**Unit 4: Machine Learning in Real World Applications**	Non- Linear Support Vector machines	Reinforcement Learning Models, Monte-Carlo Methods	AutoML overview, Types of AutoML
	SLO-2	Gaussian Processes	✓ Machine learning in Healthcare ✓ Machine learning in Retail ✓ Machine learning in Energy ✓ Machine learning in Oil & Gas ✓ Machine learning in Automobile	Logistic Regression	Temporal-Difference Learning	Working of AutoML,AutoML in Google Cloud, AutoML in Microsoft Azure
S-4	SLO-1	Linear Discriminant Functions	**Unit 5: Data Preprocessing for Machine Learning Models**	Gaussian Naïve Bayes	SARSA: On-Policy TD control, Q-Learning: Off-policy TD control, Deep Q-Network	When to use AutoML,Business Benefits, Business Challenges of Auto Machine Learning
	SLO-2	Support Vector Machines	Data Pre-processing overview, Why is Data Pre-processing Important, Data Pre-processing Best Practices	Multinomial Naïve Bayes	**Unit 15: Reinforcement Learning Real World Example - Self Driving Cars**	AutoML Regression, AutoML Classification, AutoML Time Series Forecasting, AutoML Computer Vision
S-5 & S-6	SLO-1 SLO-2	Lab 1 :	Lab 4 :	Lab 7:	Lab 10 :	Lab 13:
S-7	SLO-1	Structured SVM's	Steps in Data Pre-processing for machine learning models ✓ Data Collection ✓ Data Integration ✓ Data Preparation ✓ Data Provisioning	**Unit 11: Supervised Machine Learning - Classification Type Problems**	Self Driving Cars Overview	**Unit 19: Machine Learning Hands On Lab Work 2- Build, Test and Deploy ML Models (Consumer 2)**
	SLO-2	Ensemble methods	**Unit 6: Feature Engineering**	K-Means Clustering	Components of Self Driving Car system ✓ Cameras ✓ LIDAR ✓ RADAR ✓ Ultrasonics	Customer Segmentation
S-8	SLO-1	Non-parametric Bayesian methods	Features overview, Why are Features Important, Feature Engineering overview, Why is Feature Engineering Important	Density Based Clustering	Scene Understanding, Localization and Mapping	Problem statement

	SLO-2	**Unit 2: Machine Learning Approaches**	Problem Feature Engineering Solves, Importance of Feature Engineering, Feature Engineering Best Practices	Dimensionality Reduction	Planning and Driving policy, Control	Problem type
S-9	SLO-1	Learning Algorithms	Feature Extraction, Feature Selection, Feature Construction, Feature Learning	Collaborative Filtering	State Space Representation	Data engineering
	SLO-2	Supervised Learning	Iterative process of feature engineering	Association Rule Learning	Action Space Representation	Data pipeline
S-10	SLO-1	Unsupervised Learning	Iterative process of feature engineering	Apriori - Association Measures ✓ Support ✓ Confidence ✓ Lift	Reward Function	Model selection
	SLO-2	Semi-Supervised Learning	Decompose Date-Time	**Unit 12: Unsupervised Machine Learning - Clustering Problems**	Discrete Q-Learning Agent	Model engineering
S-11 & S-12	SLO-1	Lab 2 :	Lab 5 :	Lab 8:	Lab 11:	Lab 14:
	SLO-2					
S-13	SLO-1	Reinforcement Learning	**Unit 7: Model Engineering (Model Selection, Model Train, Test, Validate, Analyze, Deploy)**	K-Means Clustering Density Based Clustering Hierarchical Clustering	Deep Q-Network Agent, Deep Q-Training	Model outcome
	SLO-2	Similarity Algorithms	Model Selection Model Training Model Validation Model Testing Model Outcome Model Analysis Model Deployment Model Re-training Model Re-testing	**Unit 13: Unsupervised Machine Learning - Association**	**Unit 16: Machine Learning Ensemble Learning Techniques Including Bagging, Boosting**	Model analysis
S-14	SLO-1	How to select a Machine Learning Algorithm	**Unit 8: Supervised Machine Learning**	Association Rule Learning	Ensembling Techniques overview	Model optimization
	SLO-2	Machine Learning Workflow and applications	Continuous Target Variable, Discrete Target Variable	Apriori - Association Measures ✓ Support	Basis Ensembling Techniques in machine learning ✓ Max Voting	Model pipeline

				✓ Confidence ✓ Lift	✓ Averaging ✓ Weighted Average	
S-15	SLO-1	Challenges and Vision for the future	Perceptron classifier Support Vector Machines (SVM) Decision tree classifier K-nearest classifier Naive Bayes classifier	**Unit 14: Reinforcement Learning**	Advanced Ensembling Techniques in machine learning ✓ Stacking ✓ Blending ✓ Bagging ✓ Boosting	Data visualization
	SLO-2	Analysis of machine learning applications	Decision Tree Classification Random Forest Regression Random Forest Classification	Agent, Action, Environment	Bagging and Boosting Algorithms ✓ Bagging meta-estimator ✓ Random Forest ✓ AdaBoost ✓ GBM ✓ XGB ✓ Light GBM	User interface
S-16	SLO-1	**Unit 3: Machine Learning Techniques**	**Unit 9: Supervised Machine Learning - Regression Type Problems**	State,Reward, Policy, Value	**Unit 17: Machine Learning Recommendation Systems**	
	SLO-2	✓ Simple Non-Linear Regression ✓ Multiple Linear Regression ✓ Multiple Non-Linear Regression	Simple Linear Regression Multiple Linear Regression Polynomial Regression Ridge Regression Lasso Regression Logistic Regression Decision Tree Regression	Q-Value or Action Value, Working of Reinforcement Learning	Recommendation systems overview	
S-17 & S-18	SLO-1 SLO-2	Lab 3:	Lab 6:	Lab 9:	Lab 12:	Lab 15:

Learning Resources	1. Statistical and Machine-Learning Data Mining Techniques for Better Predictive Modeling and Analysis of Big Data, Third Edition -Bruce Ratner 2. Data Mining Practical Machine Learning Tools and Techniques, 3. Second Edition - Ian H. Witten	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	15%	20%	15%	20%	15%	20%	15%	20%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	15%	10%	15%	10%	15%	10%	15%	10%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Jothi, Periyasamy , Chief AI Architect DeepSphere.AI, CA, USA	Dr.S.Gopinathan, Associate Professor, University of Madras, Chennai	Dr.S.Albert Antony Raj, SRMIST
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