Name of the Programme: MSc Integrated
Course Code: IMC- 401
Title of the Course: Machine Learning
Number of Credits: 6(4L-0T-2P)
Effective from AY: 2021-22

Prerequisites for the course:	Familiarity with linear algebra, statistics & probability theory	
Objectives:	This course provides students with an in-depth introduction to three main areas of Machine Learning: supervised and unsupervised and reinforcement learning.this course will cover some of the main models and algorithms for regression, classification, clustering and Markov decision processes. Topics will include linear and logistic regression, regularisation, SVMs and kernel methods, ANNs, clustering, and dimensionality reduction ,sequential learning Like HMM and deep learning CNN and RNN	
Content Theory:	1. **Introduction:** well posed learning problem, designing a learning system, perspectives and issues in machine learning- types of learning - supervised, unsupervised and reinforcement learning 2. **Concept learning:** concept learning task, notation, inductive learning hypothesis, concept learning as search, version space and candidate elimination algorithm, decision tree, random forest. 3. **Linear regression:** logistic regression-Support vector machine kernel, Model selection and feature selection-Ensemble methods: Bagging, boosting, Evaluating and debugging learning algorithms. 4. **Continuous Latent Variables:** Principal Component Analysis, Maximum variance formulation, Minimum error formulation, Applications of PCA, PCA for high-dimensional data. 5. **Neural Networks:** -Feed-forward Network, Functions, perception, -Weight-space symmetries, Network Training, Parameter optimization, Local quadratic approximation, Use of gradient information, Gradient descent optimization, Error Back propagation, Evaluation of error-function derivatives, Efficiency of back propagation. 6. **Deep learning:** Deep Feed forward Networks, Gradient-Based Learning, Hidden Units, -Architecture Design, CNN and RNN (simple RNN and LSTM). 7. **Unsupervised learning;** Clustering, K-means, EM. Mixture of Gaussians. 8. **Sequential Data:** Markov Models, Hidden Markov Models, Maximum likelihood for the HMM, The forward-backward algorithm, the sum-product algorithm for the HMM, Scaling factors, -The Viterbi algorithm. 9. **Reinforcement learning:** introduction- learning task-Q learning, non deterministic rewards and actions-temporal difference learning.	3 hours 5 hours 5 hours 5 hours 10 hours 5 hours 5 hours 5 hours 5 hours

Content Practical:	**Suggested Lab assignments/work with respect to the following using python (scikit /keras libraries) /amazon sage maker/matlab toolbox - each assignment with duration of 4 hrs and 8 hrs for project work** 1. Write a program to implement version space. 2. Write a program to implement a decision tree for given data. 3. Write a program to implement linear regression for given data. 4. Write a program to implement logistic regression. 5. Write a program to implement SVM.	10 * 4 = 40
	6. Write a program to implement perceptron. 7. Write a program to implement a multilayer perceptron. 8. Write a program to implement RNN. 9. Write a program to implement CNN. 10. Write a program to implement HMM. Capstone mini project work is given to assess the overall learning.	hours + 8 hours Mini Project Work = 48 hours
Pedagogy:	lectures/ tutorials/assignments/self-study/lab assignment/ project work	
References/ Readings	Main Reading :- 1. James, Gareth, et al. An introduction to statistical learning. Vol. 112. New York: springer, 2013. 2. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020. 3. Hart, Peter E., David G. Stork, and Richard O. Duda. Pattern classification. Hoboken: Wiley, 2000. 4. Flach, Peter. Machine learning: the art and science of algorithms that make sense of data. Cambridge University Press, 2012. 5. Bishop, Christopher M. "Pattern recognition and machine learning: springer New York." (2006). 6. Goodfellow, Ian, YoshuaBengio, and Aaron Courville. Deep learning. MIT press, 2016. 7. Mitchell, Tom, and Machine Learning McGraw-Hill. "Edition." (1997). 8. machine learning and AI online google course by cassiekozyrkov	
Course Outcomes	1. develop an appreciation for what is involved in learning from data. 2. understand a wide variety of learning algorithms. 3. understand how to apply a variety of learning algorithms to data. 4. understand how to perform evaluation of learning algorithms and model selection. 5. Equips them with a general understanding of deep learning.	