ESSENTIAL MATHEMATICS FOR MACHINE LEARNING
S22

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COURSE OUTLINE	Machine learning (ML) is one of the most popular topics of nowadays research. This particular topic is having applications in all the areas of engineering and sciences. Various tools of machine learning are having a rich mathematical theory. Therefore, in order to develop new algorithms of machine/deep learning, it is necessary to have knowledge of all such mathematical concepts. In this course, we will introduce these basic mathematical concepts related to the machine/deep learning. In particular, we will focus on topics from matrix algebra, calculus, optimization, and probability theory those are having strong linkage with machine learning. Applications of these topics will be introduced in ML with help of some real-life examples.

COURSE DETAILS

S. No	Module ID/ Lecture ID	Lecture Title/Topic
1	L1	Introduction to course and vectors

2	L2	Vector Spaces: Definition and Examples
3	L3	Vector Subspaces: Examples and Properties
4	L4	Vector Subspaces: Basis and Dimensions
5	L5	Linear Transformations
6	L6	Norms and Spaces
7	L7	Orthogonal Complements and Projection operator
8	L8	Eigen pairs and properties
9	L9	Special matrices and Properties
10	L10	Least Square Approximation and Minimum Norm Solution
11	L11	Singular Value Decomposition
12	L12	SVD: Properties and Applications
13	L13	Low Rank Approximation
14	L14	Gram Schmidt process
15	L15	Polar Decomposition
16	L16	Principal Component Analysis-I
17	L17	PCA-II: Derivation and Examples
18	L18	Linear Discriminant Analysis
19	L19	Minimal Polynomial and Jordan Canonical Form-I
20	L20	Minimal Polynomial and Jordan Canonical Form-II
21	L21	Basic Concepts of Calculus-I
22	L22	Basic Concepts of Calculus-II
23	L23	Convex Sets and Functions
24	L24	Properties of convex functions-I

25	L25	Properties of convex functions-II
26	L26	Unconstrained Optimization
27	L27	Constrained Optimization-I
28	L28	Constrained Optimization-II
29	L29	Steepest Descent Method
30	L30	Newton's and Penalty Function Methods
31	L31	Review on Probability
32	L32	Bayes' Theorem and Random Variables
33	L33	Expectation and Variance
34	L34	Few Probability Distributions
35	L35	Joint Probability Distributions and Covariance
36	L36	Introduction to SVM
37	L37	Error minimizing LPP
38	L38	Concepts of Duality
39	L39	Hard Margin Classifier
40	L40	Soft Margin Classifier

References if Any: