



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Computer Engineering (Artificial Intelligence And Data Science)

Course / Subject Code : ME01095081

Subject Name : Mathematics for Machine Learning

WEF Academic Year :	2024-25
Semester :	1 st Semester
Category of the Course :	PEC

Prerequisite :	Basic mathematics
Rationale :	Mathematics concepts provide the foundation of many machine learning methods. To improve and create new algorithms, you must have a solid understanding of statistics, calculus, and linear algebra. These concepts enable you to understand how these algorithms operate. Understanding measures for assessing model performance is aided by mathematics.

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Vectors: Vectors and geometry in two and three-space dimensions. Algebraic properties. Dot products and the norm of a vector. Important inequalities. Vector spaces, subspaces, and vector space axioms. Complex vector spaces.	5	15
2	Independence and orthogonality: Linear independence of vectors. Basis and dimension of a vector space. Orthogonal vectors and subspaces. The Gram-Schmidt orthogonalisation.	7	20
3	Matrices: Matrix operations. Column, row, and null space. The rank of a matrix. Inverse and transpose. Elementary matrices. The Gauss-Jordan method.	5	10
4	Systems of linear equations: Examples of linear systems. Geometry	7	20



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	of linear equations. Gaussian elimination. Row echelon form. Homogeneous and nonhomogeneous systems of linear equations. Application to the intersection of lines and planes.		
5	Elementary matrix factorizations and determinants: LU factorization, related algorithms and operation count. PLU factorization. Calculating the determinant of a matrix. Properties of the determinant of a matrix. Application examples: area, volume and cross product.	5	10
6	Eigen value decomposition, Singular value decomposition, Principal Component Analysis	7	15
7	Linear transformations: Definition and examples. Properties and composition of linear transformations. Rotations, reflections and stretches. Translations using homogeneous coordinates. One-to-one and onto transformations.	9	10
	Total	45	100

Reference Book :

- Introduction to Linear Algebra, Gilbert Strang, Wellesley-Cambridge press.
- Herstein I. N. : Topics in Algebra, 2nd Edition, Willey eastern Limited
- Hoffman, Kenneth and Kunze R: Linear Algebra, Prentice Hill of India Private Limited., 1984.
- Sahi and Bist, Linear Algebra, Narosa Publishing House
- A. R. Rao and P. Bhimashankaran, Linear Algebra, Hidustan Book Agency

Course Outcome :

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
01	Demonstrate applications of vectors and matrix operations	RM
02	Understand the importance of independence and orthogonality	UN
03	Apply matrix factorization for efficient processing of data	AP
04	Evaluate the importance of system of linear equations and linear transformations	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyse, EL: Evaluate, CR: Create



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Suggested Course Practical List :

1. WAP to compute the dot product of two vectors. Also, find the norm of vectors.
2. WAP to check if two vectors are orthogonal or not
3. WAP to perform matrix multiplication
4. WAP to find the determinant of a given matrix
5. WAP to find the transpose of the matrix
6. WAP to find the rank of a given matrix
7. WAP to find check if the given matrix is invertible, find the inverse if there exists
8. WAP to find Eigen vectors and Eigen values of a given matrix
9. WAP to demonstrate the application of PCA of iris-flower data set
10. WAP to demonstrate the use of SVD

List of Laboratory/Learning Resources Required:

- <https://medium.com/@preetikhulbey99/calculus-and-linear-algebra-2cd05ad2e0c1>
- <https://developernation.net/blog/the-convergence-of-linear-algebra-and-machine-learning/>
- https://machinelearningmastery.com/linear_algebra_for_machine_learning/
- <https://catplotlib.medium.com/understanding-linear-algebra-for-machine-learning-a-comprehensive-guide-e268929bf4aa>
- <https://www.mygreatlearning.com/blog/linear-algebra-for-machine-learning/>
- <https://www.analyticsvidhya.com/blog/2017/05/comprehensive-guide-to-linear-algebra/>

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