MATH 2116: Linear Algebra

Course Outline

Insitute of Information Technology (IIT), DU

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MATH 2116: Linear Algebra

Course Information:

- **Course No.:** Math 2116
- **Course Title:** Linear Algebra
- **No of Credits:** 3 Credits (Theory)
- **Lectures:** 3 classes / week, 1 hour / class
- **Course Duration:** 15 weeks

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Contents of the course

Matrix Algebra, Determinant and its properties, Inverse of a square matrices and properties. Elementary matrices and reduction of a matrix to row echelon form and reduced row echelon forms and their application in solving system of linear equations. Vector space and subspaces of a vector space, Linear span and independence of vectors, basis and dimension of a vector space. Row space, Colum Space, Null space, and Null space of the transpose of a matrix. Orthogonality, Orthogonal projection matrices, Orthonormal bases, Gram-Schmidt orthogonalization algorithm and QR factorization. . . .

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Contents of the course, cont. ...

Eigenvalues, Eigenvectors, Orthonormal diagonalization, Diagonalization of symmetric matrices. Normal and Positive definite matrices. Linear transformation and their matrices, Change of bases, Geometrically important linear transformations. Singular Value Decomposition (SVD), Geometric interpretation of SVD, Principal Component Analysis (PCA) from SVD. Jacobi and Gauss-Seidel methods for approximating solutions of linear system. Power Method for approximating Eigenvalues and Eigenvectors.

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Course Textbook

The textbook for this course is: Strang, Gilbert. *Introduction to Linear Algebra*. 5th ed.

Related Resources

1. Poole, David. *Linear Algebra: A Modern Introduction*.
2. Lay, David C. *Linear algebra and its applications*.
3. Leon, Steven J. *Linear Algebra with Applications*.
4. Strang, Gilbert. *Linear Algebra and Its Applications*.

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Course Goals

The goals for **MATH 2116** are using matrices and also understanding them. Here are key computations and some of the ideas behind them:

1. Solving $Ax = b$ for square systems by elimination (pivots, multipliers, back substitution, invertibility of A, factorization into $A = LU$)
2. Complete solution to $Ax = b$ (column space containing b, rank of A, nullspace of A and special solutions to $Ax = 0$ from row reduced R)
3. Basis and dimension (bases for the four fundamental subspaces)

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Course Goals, cont. ...

4. Least squares solutions (closest line by understanding projections)
5. Orthogonalization by Gram-Schmidt (factorization into $A = QR$)
6. Properties of determinants (leading to the cofactor formula and the sum over all $n!$ permutations, applications to $inv(A)$ and volume)
7. Eigenvalues and eigenvectors (diagonalizing A, computing powers A^k)

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Course Goals, cont. ...

8. Symmetric matrices and positive definite matrices (real eigenvalues and orthogonal eigenvectors, tests for $x'Ax > 0$, applications)
9. Linear transformations and change of basis (connected to the Singular Value Decomposition - orthonormal bases that diagonalize A)

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Quizzes

There will be three sudden in class **quiz tests**.

Exams

There will be two **mid-term exams**(one-hour long each) at class times and a three-hours long **final exam**.

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Course Grading

ACTIVITIES	MARKS
Attendance	5
Three Quizzes	15
Two mid-term exams	20
Final exam	60