Elementary Linear Algebra

Class : I M.sc Maths

Subject : Linear Algebra

Subject Code : P22MACC22

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- Linear algebra is a branch of mathematics that deals with linear equations and their representations in the vector space using matrices.
- In other words, linear algebra is the study of linear functions and vectors.
- It is one of the most central topics of mathematics.
- Most modern geometrical concepts are based on linear algebra.

- Linear algebra facilitates the modeling of many natural phenomena and hence, is an integral part of engineering and physics.

- Linear equations, matrices, and vector spaces are the most important components of this subject.

- The branch of mathematics that deals with vectors, matrics, finite or infinite dimensions as well as a linear mapping between such spaces is defined as linear algebra.

- It is used in both pure and applied mathematics along with different technical forms such as physics, engineering, natural sciences, etc

• Linear algebra can be categorized into three branches depending upon the level of difficulty and the kind of topics that are encompassed within each.

• These are
–elementary,
–advanced, and
–applied linear algebra.

Elementary Linear Algebra

- Elementary linear algebra introduces students to the basics of linear algebra.

- This includes simple matrix operations, various computations that can be done on a system of linear equations, and certain aspects of vectors.

Elementary Linear Algebra

•Scalars - A scalar is a quantity that only has magnitude and not direction. It is an element that is used to define a vector space. In linear algebra, scalars are usually real numbers.

• Vectors - A vector is an element in a vector space. It is a quantity that can describe both the direction and magnitude of an element.

• Vector Space - The vector space consists of vectors that may be added together and multiplied by scalars.

Elementary Linear Algebra

•Matrix - A matrix is a rectangular array wherein the information is organized in the form of rows and columns. Most linear algebra properties can be expressed in terms of a matrix.

• Matrix Operations - These are simple arithmetic operations such as addition, subtraction, and multiplication that can be conducted on matrices.

Advanced Linear Algebra

- Once the basics of linear algebra have been introduced to students the focus shifts on more advanced concepts related to linear equations, vectors, and matrices.
- Certain important terms that are used in advanced linear algebra are as follows: – Linear Transformations - The transformation of a function from one vector space to another by preserving the linear structure of each vector space.

Advanced Linear Algebra

- Inverse of a Matrix - When an inverse of a matrix is multiplied with the given original matrix then the resultant will be the identity matrix. Thus, $A^{-1}A = I$.
- Eigenvector - An eigenvector is a non-zero vector that changes by a scalar factor (eigenvalue) when a linear transformation is applied to it.
- Linear Map - It is a type of mapping that preserves vector addition and vector multiplication.

Advanced Linear Algebra

- Applied linear algebra is usually introduced to students at a graduate level in fields of applied mathematics, engineering, and physics.
- This branch of algebra is driven towards integrating the concepts of elementary and advanced linear algebra with their practical implications.
- Topics such as the norm of a vector, QR factorization, Schur's complement of a matrix, etc., fall under this branch of linear algebra

Applied linear algebra

• Signal Processing - Linear algebra is used in encoding and manipulating signals such as audio and video signals. Furthermore, it is required in the analysis of such signals.

• Linear Programming - It is an optimizing technique that is used to determine the best outcome of a linear function.

• Computer Science - Data scientists use several linear algebra algorithms to solve complicated problems.

• Prediction Algorithms - Prediction algorithms use linear models that are developed using concepts of linear algebra.

Scaler / Real


Thank
You!