

**WOMEN’S INSTITUTE OF TECHNOLOGY AND**

**INNOVATION**

**Course Name: Introduction to Mathematical Computing**

**Course Code: CSD115**

**Assignment one**

**Group Six.**

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**Question One**

**Algebra**

Structures such as groups, rings, and fields. Linear algebra, which deals with linear equations and linear mappings, is used for modern presentations of geometry.

**Linear Algebra**

**Linear Algebra** is the branch of mathematics that concerns linear equations (and linear maps) and their representations in vector spaces and through matrices.

**OR**

Linear algebra is the study of linear combinations. It is the study of vector spaces, lines and planes, and some mappings that are required to perform the linear transformations. It includes vectors, matrices and linear functions. It is the study of linear sets of equations and its transformation properties.

**Branches**

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. Each branch covers different aspects of matrices, vectors, and linear functions.

It was initially formalized in the 1800s in order to find unknowns in systems of linear equations, which is why it is considered to be a field of study that is relatively young. A linear equation is simply a series of terms and mathematical operations in which some of the terms are left undefined; for instance,

**Equation**

Linear algebra is the branch of mathematics concerning linear equations such as: a 1 x 1 + ⋯ + a n x n = b , {\display style a\_{1}x\_{1}+\cdots +a\_{n}x\_{n}=b...

y = 4x + 1 is an example of a linear equation.

Equations such as this one are considered linear because they describe a line on a graph with only two dimensions. The line is the result of trying a variety of different values for the variable x in order to determine how the equation or model affects the value of the variable y.

**Applications**

Because it is applicable to almost every subfield of mathematics, linear algebra has a place of importance in almost all of the scientific fields that make use of mathematics. These software programmes can be organized into a few different broad categories.

**1) The geometry of the surrounding space.**

The use of geometry as the foundation for modeling ambient space. The use of geometry is widespread in the scientific disciplines concerned with this space. This is the case with mechanics and robotics, in order to describe the dynamics of rigid bodies; geodesy, in order to describe the shape of the earth; perspective, computer vision, and computer graphics, in order to describe the relationship between a scene and its plane representation; and many other scientific fields.

In all of these applications, synthetic geometry is frequently utilized for providing general descriptions and a qualitative approach; however, the computation of coordinates is required in order to conduct research on explicit scenarios. Quite a bit of linear algebra is going to be needed for this.

**2) Analyses of functionality**

The study of function spaces is called functional analysis. These are vector spaces that also have some additional structure, like Hilbert spaces. Therefore, linear algebra is an essential component of functional analysis as well as the applications of functional analysis, which particularly include quantum mechanics (wave functions).

**3) Research into more complicated systems**

Partial differential equations are used to model the vast majority of physical phenomena. In order to solve them, one must typically decompose the space in which the solutions are searched into numerous small cells that are in constant communication with one another. This interaction requires linear functions when dealing with linear systems. When dealing with nonlinear systems, it is common practice to model this interaction using linear functions. [b] In both instances, the matrices involved are typically of a very large size. In the case of weather forecasting, a typical example, the atmosphere of the entire planet is divided into cells with dimensions of, say, 100 kilometers in width and 100 meters in height.

**4) Scientific computation**

Almost all of the computations that are done in science involve linear algebra. As a direct result of this, linear algebra algorithms have been fine-tuned to an extremely high degree. The most well-known implementations are known as BLAS and LAPACK. Some of them automatically configure the algorithms while the programmer is running in order to improve the system’s overall efficiency by tailoring the algorithms to the characteristics of the computer (cache size, number of available cores).

Some processors, most commonly graphics processing units (GPU), are built with a matrix structure for the purpose of improving the performance of linear algebraic operations.

**5) Cryptography**

It is the study of both decoding and encoding, which are used to communicate secret information. Strong encryption methods are able to be implemented with the use of electronic commerce and communication. In order to decode and encode the messages using these methods, modular arithmetic is required. The more straightforward encoding strategies can be implemented with the help of the matrix transformation idea.

**6) The theory of games**

Another one of the applications of linear algebra, which is a mathematical study that counts the various possibilities, this one uses it to count the number of different choices. During the course of the game, the players decide how to proceed with these various options. According to the findings of psychologists, the social interaction theory is applied when analyzing the player’s options in relation to those of the other competitors in the game.

Game theory may be best known for its application to card games, board games, and other forms of competitive play; however, it is also applicable to the tactics employed by militaries in conflict.

**7) For the purpose of encoding and manipulating signals,** such as audio and video signals, linear algebra is utilized during the processing of signals. In addition to that, it is necessary for the analysis of signals of this kind.

**8) Linear programming** is a method of optimization that can be utilized to ascertain the linear function that will yield the most desirable results.

**9) Data scientists** in the field of computer science employ a number of linear algebra algorithms in order to solve difficult problems.

**10) Algorithms for Prediction –** Prediction algorithms make use of linear models that are developed through the application of linear algebra’s fundamental ideas.

**Application**

Combined with calculus, linear algebra facilitates the solution of linear systems of differential equations. Techniques from linear algebra are also used in analytic geometry, engineering, physics, natural sciences, computer science, computer animation, and the social sciences (particularly in economics).

Linear algebra is also used in most sciences and fields of engineering, because it allows modeling many natural phenomena, and computing efficiently with such models.

Linear algebra is concerned with linear combinations. That is, arithmetic on columns of numbers known as vectors and arrays of numbers known as matrices is used to generate new columns and arrays of numbers. Linear algebra is the study of the lines and planes, vector spaces, and mappings needed for linear transforms.

Although linear algebra is considered to be a subfield of mathematics, the more accurate description of its purpose is “the mathematics of data.” The language of data is represented by matrices and vectors.

Combinations in a linear fashion are the focus of linear algebra. In other words, performing arithmetic operations on columns of numbers, which are referred to as vectors, and arrays of numbers, which are referred to as matrices, in order to produce new columns of numbers and new arrays of numbers? The study of lines and planes, vector spaces, and mappings that are necessary for linear transformations is what is referred to as linear algebra.

**Conclusion**

The study of planes and lines, mapping, and vector spaces, all of which are required for linear transformations, is essentially what linear algebra is all about. As a result, it is essential to have an understanding of the various applications of linear algebra. Although linear algebra is considered to be a subfield of mathematics, the more accurate description of its purpose is “the mathematics of data.” Learn them thoroughly and then look for opportunities to apply what you’ve learned about linear algebra in the real world.

* **Vectors, Combining, scaling**

**Vector**

Vector, in physics, a quantity that has both magnitude and direction. It is typically represented by an arrow whose direction is the same as that of the quantity and whose length is proportional to the quantity's magnitude.

A quantity having direction as well as magnitude, especially as determining the position of one point in space relative to another.

Direct (an aircraft in flight) to a desired point.

"Two Hurricanes were vectored towards the Stukas"

**Scaling**

When we multiply a vector by a scalar it is called "**scaling**" a **vector**, because we change how big or small the vector is.

**Combing**

It’s the same as adding and subtracting Vectors

* **Transforming vectors and matrices**

In general, a vector transformation is an operation applied to a vector that changes its orientation, length, or both.

In [linear algebra](https://en.wikipedia.org/wiki/Linear_algebra), [linear transformations](https://en.wikipedia.org/wiki/Linear_transformation) can be represented by [matrices](https://en.wikipedia.org/wiki/Matrix_(mathematics)). If � is a linear transformation mapping �� to �� and � is a [column vector](https://en.wikipedia.org/wiki/Column_vector) with � entries, then

�(�)=��

for some �×� matrix �, called the **transformation matrix** of � Note that � has � rows and �columns, whereas the transformation � is from �� ��. There are alternative expressions of transformation matrices involving [row vectors](https://en.wikipedia.org/wiki/Row_vector) that are preferred by some authors.

* **System of linear equations and inverse matrices**

A system of linear equations is usually a set of two linear equations with two variables. x + y = 5 x+y=5 x+y=5x, plus, y, equals, 5 and 2 x − y = 1 2x-y=1 2x−y=12, x, minus, y, equals, 1 are both linear equations with two variables.

In simple words, inverse matrix is obtained by dividing the adjugate of the given matrix by the determinant of the given matrix. In this article, you will learn what a matrix inverse is, how to find the inverse of a matrix using different methods, properties of inverse matrix and examples in detail.

* **Dot products**

The dot product, also called scalar product, is a measure of how closely two vectors align, in terms of the directions they point. The measure is a scalar number (single value) that can be used to compare the two vectors and to understand the impact of repositioning one or both of them.

* **Matrix decomposition**

Matrix decomposition is a way of reducing a matrix into its constituent parts. It is an approach that can simplify more complex matrix operations that can be performed on the decomposed matrix rather than on the original matrix itself.

**Or**

“Matrix decomposition refers to the transformation of a given matrix into a given canonical form.” When the given matrix is transformed to a right-hand-side product of canonical matrices the process of producing this decomposition is also called “matrix factorization”. Matrix decomposition is a fundamental theme in linear algebra and applied statistics which has both scientific and engineering significance. The purposes of matrix decomposition typically involve two aspects: computational convenience and analytic simplicity.

**Question Two**

Please write code example for the above subtopics in question one and link with me a link to your GitHub account.