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Optimum Use of Matrix and Linear Algebra for Technological Development for Human Being in Real Life

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***Abstract*: Matrices are nothing but the rectangular arrangement of numbers, expressions, symbols which are arranges in columns and rows. The numbers present in the matrix are known as entities or entries. Matrices have a long history of application in solving linear equations. Matrices are incredibly useful for different technical fields in engineering and scientific research work for development of new technology for human being to solve real life problems. Also, mangers, R&D people and engineers can make decision for development of technology or product based on the function matrix. The steps of creating a technology or function matrix are patent search, reading, analyzing and categorizing patents into all fields of technology or function matrix.**

In this research paper, we are going to see the application of Matrix in development of technology in different field of real life for human being in different sector like entertainment, science, medical, computer, camera, geography, satellite, electrical engineering, computer engineering, mechanical engineering etc.

***Keywords*: Matrices, Linear systems, Inverse of matrix, Determinants, Analytic geometry, Genetics algorithm, Cryptography.**

1. Introduction

Matrices are nothing but the rectangular arrangement of numbers, expressions, symbols which are arranges in columns and rows. The numbers present in the matrix are known as entities or entries. Matrices have a long history of application in solving linear equations. Matrix was developing by English mathematician, poet and musician James Sylvester in 1850 and first use by Japanese in the 10th century. Matrices have a long history of applications in solving linear equations, between 300BC and AD200. Approximately 4000 years ago, the people of Babylon knew how to solve a simple 2X2 system of linear equations with two unknowns. Around 200 BC, the Chinese published that "Nine Chapters of the Mathematical Art," they displayed the ability to solve a 3X3 system of equations. The 19th century Gauss introduced a procedure to be used for solving a system of linear equations the Theory of Linear Transformations in 1855 and 1858. Gaussian elimination still proves to be the best way known to solve a system of linear equations (Tucker, 1993). Matrices were connected with physics issues and for mathematicians, more attention was given to vectors as they proved to be basic mathematical elements.

Matrices are incredibly useful for different technical fields in engineering and scientific research work for development of new technology for human being to solve real life problems. Also, mangers, R&D people and engineers can make decision for development of technology or product based on the function matrix. The steps of creating a technology or function matrix are patent search, reading, analyzing and categorizing patents into all fields of technology or function matrix.

2. Some operation of matrix

A matrix with a single row is called a row matrix, or row vector. A matrix with a single column is called a column matrix or column vector. A matrix with the same number of rows as columns is called a square matrix. The interchange of any two row (R_{ij}).

The 1×3 matrix $A = [2 \quad 1 \quad 4]$ is a row matrix.

The 3×1 matrix $B = \begin{bmatrix} 3 \\ 5 \\ 2 \end{bmatrix}$ is a column matrix.

The 3×3 matrix $C = \begin{bmatrix} 4 & -1 & 3 \\ 1 & 0 & 6 \\ 2 & 1 & 4 \end{bmatrix}$ is a square matrix.

Matrix addition and subtraction:

Two matrices can be added (or subtracted) if and only if they have the same dimensions.

If $A and B$ are $m \times n$ matrices, then $A + B$ and $A - B$ are the $m \times n$ matrices.

Transposition of matrix:

If A is an $m \times n$ matrix, then its transpose is the $n \times m$ matrix. We denote the transpose of the matrix A by A^T.

$e.g. A = [1 \quad 2 \quad 3]_{1\times 3}$ and $A^T = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}_{3\times 1}$

Matrix Multiplication:

If A is an $m \times n$ matrix and B is $n \times p$ matrix then the product of AB is the$m \times p$.

$A = [2 \quad 1 \quad 6]$ and$B = \begin{bmatrix} 3 \\ 5 \\ 2 \end{bmatrix}$ then AB = $[2 \times 3 + 1 \times 5 + 6 \times 2]$=[24]

Matrix Inverse: If A be any n-rowed square matrix then a matrix B if it exits such that, $AB = BA = I_n$is called inverse of A.

Matrix form of a system of linear equations:

Linear equations use one or more variables where one variable is dependent on the other. Almost any situation where there is an unknown quantity can be represented by a linear equation, like figuring out income over time, calculating mileage rates, or predicting profit. Many people use linear equations every day. Linear systems are used to model a wide variety of problems. Construction models for mechanical systems, electrical networks, Indian economy, chemical equations, etc.

System of equations as a matrix equation of the form $AX = B$

The given linear system of x+y= 5

x+2y=1

The matrix form of the system is$\begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 1 \end{bmatrix}$

The standard numerical algorithm used to solve a system of linear equations is called Gaussian elimination. We first form what is called an augmented matrix by combining the matrix A with the column vector b:

The augmented matrix of system is$\begin{bmatrix} 1 & 1 & 5 \\ 1 & 2 & 1 \end{bmatrix}$this matrix reducing row echelon form and find the value of $x = 9, y = -4$

The solution can also be computed via the inverse,$X = A^{-1}B$.

By Above example to the inverse of matrix A^{-1}=$\begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix}$ and B= $\begin{bmatrix} 5 \\ 1 \end{bmatrix}$ then find the value of x and y, the given X=$\begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} 5 \\ 1 \end{bmatrix}$= $\begin{bmatrix} 9 \\ -4 \end{bmatrix}$ then x = 9 and y= -4

The above is the method of coding and decoding messages. One type of code, which is extremely difficult to break, makes use of a large matrix to encode a message. The receiver of the message decodes it using the inverse of the matrix. This first matrix is called the encoding matrix and its inverse is called the decoding.

If A is an n×n matrix, then a nonzero vector x in R^n is called an eigen vector of A if Ax= λx,for some scalar λ.The scalar λ is called an eigen value of A and x is said to be an eigenvector of A corresponding to λ.

Statistics can be defined as a type of mathematical analysis which involves the method of collecting and analysing data and then summing up the data into a numerical form for a given set of factual data or real-world observations.

The genetic algorithm (GA) is an optimization and random search technique based on the principles of natural genetics and natural selection.GA is used for real word problem solving through matrices for selection of population, selection, cross over and mutation process. Genetic algorithm is programme using MATLAB software and GA toolbox to solve very large size matrices for real life calculation.

Now a day engineers use matrices to model and perform accurate calculations needed for complex mechanics to work and implement the calculation result in the real application and it will give optimum result. Some real-life application of matrices and linear algebra in development of technological is listed below.

- In Electrical engineering for optimization of transmission line losses, solution of load flow and power flow, economic load dispatch using Genetic Algorithm method, Gauss-Seidel method,Newton-Raphson method and Fast-Decoupled method use matrix multiplication, matrix transposition and shifting of row and column.
- In Electrical instruments like solar panel, transmission line like short, medium and long calculation, different laws like Kirchhoff's current and voltage laws, mesh laws, Northen's law, Superposition, microprocessor based relay theorem use matrix for better calculations of the circuit parameters
- In Chemical engineering all require perfectly calibrated computations which areobtained from matrix transformations.
- In Electronics and communication instruments like CRO Cathode Ray Oscillator, Audio frequency generator, LCD (Liquid crystal Display) and LED (Light Emitting Diode) screen for display, decoder, encoder, multiplexer, LED and LCD interfacing with microprocessor, electronics networks, aero plane and space craft also.
- In Mechanical engineering, Matrices are used for drawing of machine model using CAD and MATLAB software; actually, without matrices this software design is not possible. Also, Eigen value of matrices are used for Finite Element Analysis (FEA) and Finite Element Methods(FEM) to understand concepts of subject.
- In robotics and automation, matrices are the basic components for the robot movements. The inputs for controlling robots are obtained based on the calculations from matrices and these are very accurate movements.
- Many IT companies also use matrices as data structures to track user information, perform search queries, and manage databases. In the world of information security, many systems are designed to work with matrices. Matrices are used in the storage of biometric data in the new Identity Card in Mauritius. In the field of computing, matrices are used in message encryption, to create three-dimensional graphic images and realistic looking motion on a two-dimensional computer screen and also in the calculation of algorithms that create Google page

rankings, mobile phone in the form of stenography.

- Matrices are one of the most commonly used tools in business. Linear programming optimization uses matrices and is essential to business if you want to calculate maximum profit over a set of restrictions. Matrices are also used heavily in generating charts and graphs to demonstrate the results of business decisions or forecasts.
- Matrix is used for plotting graphs, statistics and also to do scientific studies and research in almost different fields. Matrices are also used in representing the real-world data's like the population of people, infant mortality rate, banking details etc. They are best representation methods for plotting surveys.
- In physics related applications, matrices are used in the study of electrical circuits, quantum mechanics and optics.
- Matrix transforms are very useful within the world of computer graphics. In a video game, this would render the upside-down mirror image of an assassin reflected in a pond of blood. If the video game has curved reflecting surfaces, such as a shiny metal shield, the matrix would be more complicated, to stretch or shrink the reflection. Software and hardware graphics processor uses matrices for performing operation such as scaling, translation, reflection and rotation. Graphic software such as Adobe Photoshop on your personal computer uses matrices to process linear transformations to render images.

A square matrix can represent a linear transformation of a geometric object.

For example, in the Cartesian X-Y plane, the matrix

$$\begin{matrix} 0 & -1 \\ 1 & 0 \end{matrix}$$

reflects an object in the vertical Y axis.

- In hospitals, medical imaging, CAT scans and MRI's, use matrices to operate.
- In biology, matrix is used to study about tissue in animal or plant structure in detail. It is found in various connective tissues. It is generally used as a jelly like structure instead of cytoplasm in connective tissue.
- In geology, matrices are used for making seismic surveys. They are used for plotting graphs, statistics and also to do scientific studies and research in almost different fields. Matrices are also used in representing the real world data's like the population of people, infant mortality rate, etc.
- Matrices are also used in representing the real world data's like the population of people, to calculate mortality rate, etc. They are best representation methods for plotting surveys.
- In economics, Optimization for solving best use of asset either lab our or capital in the manufacturing of a product and managing very large supply chains on chart also.
- Cryptography also utilize matrices, cryptography is science of information security. These technologies hide information in storage or transits. They are best representation methods for plotting the common survey things. Stochastic matrices and Eigen vector solvers are used in the page rank algorithms which are used in the ranking of web pages in Google search.

3. Conclusion

Matrices and linear algebra is used for solve real life issues in different fields like engineering, science, satellite, business, medical, biometric, etc. In mathematics we are try to solve different type of matrices and linear algebra manually up to certain limit size. For real life problem solving size of matrices is very large so it is tuff to solve manually. So programming methods like Linear programming, Genetic programming are use different software like MATLAB, C, C++, CAD, Genetic Algorithm toolbox software. The programming software like MATLAB, Genetic Algorithm solve large size matrices and linear algebra equation more accurately with in less time and more possible number of results to select proper result to analysis.

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