



## STUDY ON LINEAR ALGEBRIC AND ITS APPLICATION

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**Abstract:** At the general intra- stage some operational actions are possible, but there is an absence of relationships between properties. At the inter- stage, the identification of relations between different processes and objects, and transformations are starting to form, but they remain isolated. The trans- stage is defined in terms of the construction of a synthesis between them to form a coherent structure. For example, in the genetic decomposition that we are about to describe, different processes and objects for solving quadratic equations using square roots, completion of square, quadratic formula, factoring, and graphical interpretation are given. The stage of development (intra-, inter-, trans-) of the schema of quadratic equations is a measure of the degree of interconnectedness of these ideas in the students' minds. The progression from action, to process, to object, and to having such constructions organized in schemas is a dialectical progression where there may be passages and returns from one type of construction to the other [Dagar, J. and Kumar, R. **STUDY ON LINEAR ALGEBRIC AND ITS APPLICATION**. *N Y Sci J* 2022;15(7):8-11] ISSN 1554-0200 (print); ISSN 2375-723X (online) <http://www.sciencepub.net/newyork>. 2. doi:10.7537/marsnys150722.02.

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### Introduction

The lobes of the alga *Micrasterias* (Lacalli and Harrison, 1987) and some microtubule arrays near the cell surfaces of ciliates such as *Paramecium* and *Tetrahymena* (Frankel, 1989) are further unicellular examples. Such phenomena show the ability of a living organism to establish a quantitative measure of spacing between adjacent repeats of similar structures and to use it repeatedly in the same direction. Here, "repeatedly" is not intended to imply a time sequence in which structures are formed one by one. In some cases, very numerous parts of the overall pattern are expressed precisely simultaneously, e.g., up to 80 striations in the reproductive cap primordium of *Acetabularia*. In a large taxonomic group wherein one may expect the mechanism for formation of a particular kind of pattern to have been conserved, the pattern formation process can be essentially simultaneous in some species and time sequential in others (e.g., the onset of segmentation in the class *Insecta*). In this research, we consider the problem of generating the parts of a pattern simultaneously. This approach does not lack generality.

Earlier work (Lacalli et al., 1988) has shown that spatially inhomogeneous inputs (such as gradients) to the same kind of pattern-forming mechanism can lead to the parts of the pattern forming sequentially rather than simultaneously. Where a

quantitative spacing mechanism exists, it seems intuitively reasonable to expect the mechanism to work impartially in all available directions. Therefore, when operating in a two-dimensional space, it should generate a spotted pattern. On this basis, one expects that mechanisms for the formation of stripes should contain some additional asymmetrizing element, such as a unidirectional gradient or a highly asymmetric shape of pattern-forming region, to impose unequal treatment of the spatial dimensions. The main purpose of this research is to show that such additional features are not essential.

Some pattern-forming mechanisms have an intrinsic tendency to form stripes. This involves competition between emerging patterns which remains intuitively not obvious to us although we can establish it by computation and, in part, by analysis we describe here. Our conclusions are applicable to a wide range of pattern-forming mechanisms within the general category of kinetic mechanisms. These include reaction-diffusion models, first proposed by Turing (1952) and to date the most extensively developed kind of kinetic mechanism. The category also includes mechanochemical theories (Oster et al., 1983) as well as mechanisms involving complex cell-cell interactions, for example between groups of incipient synapses in the assembly of the nervous system. These last are involved in the formation of

ocular dominance patterns in the primary visual cortex (also known as the striate cortex, area 17 or V1) of higher vertebrates (Fig. 1B). In an earlier publication (Lyons and Harrison, 1991) we showed that the observed patterns are similar to those which can be modelled using reaction-diffusion systems. The present analysis and discussion is applicable to these disparate mechanisms.

The general form of these equations is  $y = mx + b$ , where  $m$  and  $b$  are numbers and  $m$  cannot be zero. The way to identify these types of equations is to look for an  $x$  with no exponents. The  $x$  should be the only variable you see other than the  $y$ . You should not have any other exponents or square roots. The  $x$  is also always in the numerator, never in the denominator.

These equations are called 'linear' because when you graph them, you end up with a single line. So, to help you remember that you should only see one  $x$ , think of linear as having one line, and link the one line to the one  $x$  in your head. For example,  $y = 4x + 3$  is a linear equation. Note that you see the  $x$  and no other  $x$ 's. We can start building a table to keep all of these equations and their names organized.

These questions in turn influence the sense learners make of the subject matter. In this article I focus on the outcomes and implications of research on (a) use of symbols in mathematics, (b) algebraic/trigonometric expressions, (c) solving equations, and (d) functions and calculus. In seeking to explain the complex phenomena of biological pattern formation, one must start with an a priori concept of where the complexity lies. Wortis et al. (in press) have drawn the contrast between complex machines and simple machines with complex behaviour. Molecular biologists seek the former: the complex machine as a multiplicity of genes and gene products, mutually governed by many regulative processes which are complex by their sheer number but each rather simple in character. Physical scientists tend to seek the latter: dynamic processes which can be described by a few simple terms in two or three equations, but which display complex behaviour.

### Numerical Linear Algebra

The application of linear algebra in computers is often called numerical linear algebra.

*"numerical" linear algebra is really applied linear algebra.* — Page ix, [Numerical Linear Algebra](#), 1997.

It is more than just the implementation of linear algebra operations in code libraries; it also includes the careful handling of the problems of

applied mathematics, such as working with the limited floating point precision of digital computers.

Computers are good at performing linear algebra calculations, and much of the dependence on Graphical Processing Units (GPUs) by modern machine learning methods such as deep learning is because of their ability to compute linear algebra operations fast.

Efficient implementations of vector and matrix operations were originally implemented in the FORTRAN programming language in the 1970s and 1980s and a lot of code, or code ported from those implementations, underlies much of the linear algebra performed using modern programming languages, such as Python.

Three popular open source numerical linear algebra libraries that implement these functions are:

- Linear Algebra Package, or LAPACK.
- Basic Linear Algebra Subprograms, or BLAS (a standard for linear algebra libraries).
- Automatically Tuned Linear Algebra Software, or ATLAS.

Often, when you are calculating linear algebra operations directly or indirectly via higher-order algorithms, your code is very likely dipping down to use one of these, or similar linear algebra libraries. The name of one of more of these underlying libraries may be familiar to you if you have installed or compiled any of Python's numerical libraries such as SciPy and NumPy.

### Linear Algebra and Statistics

Linear algebra is a valuable tool in other branches of mathematics, especially statistics.

*Usually students studying statistics are expected to have seen at least one semester of linear algebra (or applied algebra) at the undergraduate level.*

— Page xv, [Linear Algebra and Matrix Analysis for Statistics](#), 2014.

The impact of linear algebra is important to consider, given the foundational relationship both fields have with the field of applied machine learning. Some clear fingerprints of linear algebra on statistics and statistical methods include:

- Use of vector and matrix notation, especially with multivariate statistics.
- Solutions to least squares and weighted least squares, such as for linear regression.

- Estimates of mean and variance of data matrices.
- The covariance matrix that plays a key role in multinomial Gaussian distributions.
- Principal component analysis for data reduction that draws many of these elements together.

As you can see, modern statistics and data analysis, at least as far as the interests of a machine learning practitioner are concerned, depend on the understanding and tools of linear algebra.

### Applications of Linear Algebra

As linear algebra is the mathematics of data, the tools of linear algebra are used in many domains.

In his classical book on the topic titled "[Introduction to Linear Algebra](#)", Gilbert Strang provides a chapter dedicated to the applications of linear algebra. In it, he demonstrates specific mathematical tools rooted in linear algebra.

Here, some of the linear algebra applications are given as:

- **Ranking in Search Engines** – One of the most important applications of linear algebra is in the creation of Google. The most complicated ranking algorithm is created with the help of linear algebra.
- **Signal Analysis** – It is massively used in encoding, analyzing and manipulating the signals that can be either audio, video or images etc.
- **Linear Programming** – Optimization is an important application of linear algebra which is widely used in the field of linear programming.
- **Error-Correcting Codes** – It is used in coding theory. If encoded data is tampered with a little bit and with the help of linear algebra it should be recovered. One such important error-correcting code is called hamming code
- **Prediction** – Predictions of some objects should be found using linear models which are developed using linear algebra.
- **Facial Recognition**- An automated facial recognition technology that uses linear algebraic expression is called principal component analysis.
- **Graphics**- An important part of graphics is projecting a 3-dimensional scene on a

2-dimensional screen which is handled only by linear maps which are explained by linear algebra.

Another interesting application of linear algebra is that it is the type of mathematics used by Albert Einstein in parts of his theory of relativity. Specifically tensors and tensor calculus. He also introduced a new type of linear algebra notation to physics called Einstein notation, or the Einstein summation convention.

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