Elementary Matrix Algorithm of order 3

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Aims/ Objectives:

The aim of our research is to establish relationship between linearly independent vectors and the R^3 Space The means for that are going to be taken from Balanced Ternary analysis e.g triplets with entries (-1,0,1) This is not going to be any specific vector, for instance (-1,0,1) It's going to be rather a Coordinate system with 8 quadrants and directional vectors The novelty of the proposed research lies in the fact that unlike traditional Cartesian system-vector basis our system uses 8 vectors which are at the same time a polyvector We may define it as a multiple of the type: $\sum_{i=-1}^{1}\sum_{j=-1}^{1}\sum_{k=-1}^{1}(i, \text{j}, k)$

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Let's see how the proposed algorithm works for a decimal system For the real numbers, $n \in Z$, n can be expressed as a determinant of a matrix of order 3 which in it's turn can be presented as 3 rows of three component vectors $\bar{A}, \bar{B}, \bar{C}$ which can be related in terms of combination of the three parts: $(\bar{A}x\bar{B})\bar{C}$

For us an important thing would be to present each component of the formula $(\bar{A}x\bar{B})\bar{C} = det$, as an algorithm

For this reason, we have to remind ourselves of some postulates of Matrix Algebra

One of them is saying that a determinant of the matrix depends of the coefficient (We are talking about square matrices of course) In other words $\Delta kA = \Delta kA = \Delta k \begin{bmatrix} a_{11} & \cdots & a_{1m} \\ \vdots & \ddots & \vdots \\ a_{1m} & \cdots & a_{mm} \end{bmatrix}$

Our interest is 3x3 matrix The reason for that was in the formula mentioned earlier, namely: $\overline{(\bar{A}x\bar{B})}\bar{C}$

The three vectors could be placed in the form of a matrix $\begin{pmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{pmatrix}$

The only condition is that $\bar{A}, \bar{B}, \bar{C}$ are linearly independent

To obtain a matrix of three row entries representing linear independence of vectors we are going to apply our Ternary algorithm:

- Step number 1

Rewrite the first row two times as the entry of the first and the second row

- Step 2

Make second row enries equal x,y,z :| $x = b_1 = a_1; y = b_2 = a_2; z = b_3 = a_3;$

The matrix now should look like this:

$$\begin{pmatrix} a_1 & a_2 & a_3 \\ a_1 & a_2 & a_3 \\ c_1 & c_2 & c_3 \end{pmatrix} = \begin{pmatrix} a_1 & a_2 & a_3 \\ x & y & z \\ c_1 & c_2 & c_3 \end{pmatrix}$$

Rewrite the first row as the entry of the second row

- Step 3

Make the entries of the third row equal (-1,0,1) respectively:| $c_1 = 1; c_2 = -1; c_3 = 0;$

- Step 4

The dot product of $(x, y, x) \cdot (-1,0,1)$ should effectively replace our second row entry by the vector $a_1; -a_2; 0;$
Our matrix entries now look as follows:

$$\begin{matrix} a_1 & a_2 & a_3 \\ a_1 & -a_2 & 0 \\ 1 & -1 & 0 \end{matrix}$$

- Step 5

Now it's high time to make our matrix entries equal the determinant Δ
Equalize or place both entries on left and right sides of the equation:

$$\begin{pmatrix} a_1 & a_2 & a_3 \\ a_1 & -a_2 & 0 \\ 1 & -1 & 0 \end{pmatrix} = \Delta;$$

Step 5 is the final step of the sought after algorithm

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Results and Conclusion

Now the question arises as to what did one accomplish by developing the following algorithm?
To answer that we must dig into the basics of discrete mathematics and linear algebra When it comes to the Descartes system of coordinates the answer is simple All you need to care about is ordered pairs (x, y) In the affine system we use the change of basis (In our example it was the third row of entries $(1, -1, 0)$ which is used as a final step to calculate the determinant or in simple words to place our vector product in correspondence with real numbers which in it's own turn places R^3 in correspondence with R^1 and R^2
To prove our theory we can use the transpose of the resultant matrix and make sure that the determinant has not changed
What about other entries? Well we have 27 combinations of the entries $(1, -1, 0)$ making it possible to solve systems of equations in 27 bases That in itself empowers encoding and decoding of data as far as digits are concerned More importantly though is to be able to introduce an alternative system of counting and the algorithm that goes with it

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