A Short Introduction To The Concept Of Symbolic Turiyam Matrix

Mikail Bal, Gaziantep University, Turkey

Prem Kumar Singh[1], Department of Computer science and Engineering, Gandhi institute of Technology and Management-Visakhapatnam 530045, India

Katy D. Ahmad[2], Islamic university Of Gaza, Palestine

[2]**Email:** Katyon765@gmail.com

[1]Email: premsingh.csjm@gmail.com

Abstract:

Recently, Turiyam set is introduced to deal with data set beyond three-way fuzzy space. In this process a problem is addressed while precise representation of Turiyam attributes in matrix format for knowledge processing tasks. To resolve this issue, current paper defines concept of symbolic Turiyam matrix by using the symbolic Turiyam set concept. In addition, the paper illustrates several examples to clarify the algebraic structure of these matrices such as addition, multiplication, and symmetry of these matrices.

Key words: Symbolic Turiyam matrix, symmetric Turiyam matrix, Hermit-Turiyam matrix, Turiyam Set.

Introduction

Recently, the symbolic turiyam set [91-93] was defined in [78] as a new algebraic generalization of the corresponding neutrosophic one [1-10]. It was used to study Symbolic Turiyam rings structures in [78] with its extensive properties [76-78] for dealing the multi-valued attributes attributes [80-90]. It provides a way to represent the Non-Euclidean data sets [85-91]. One of the suitable example of Turiyam attribute is India-Pakistan match. This match is beyond Win, Draw or Loss. It is not based on refined indeterminacy [92]. In case India is out of the series, Pakistan will lose the match from the lower team also. The Turiyam is to defeat India rather than win, draw or lose the particular match and vice versa. The second example is Israel Philistine conflict we can take as human cognition.

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It cannot be defined based on acceptation, rejection and uncertain of particular incident. Some country just support Israel (or Philistine) to fulfill their agenda rather than acceptance of incident, rejection of incident, or refined indeterminacy of incident. It is totally beyond the incident. In these cases their cognition support to fulfill their agenda [93]. Another example is recently observed in India where people start voting NOTA(None of The above). The supreme court of India considers it distinct from acceptance, rejection and uncertain vote. This NOTA can be considered as a Turiyam or Liberated state. The people who refused to vote can be found via 1-(Acceptation+Rejection+NOTA+Uncertain or indeterminant).The precise representation of these types of data sets is one of the crucial tasks as they dependent on time. Hence the current paper tried to introduce Turiyam matrix in this paper for knowledge processing tasks.

In the literature, mant authors have contributed to algebraic structures in neutrosophic systems such as neutrosophic rings [11-20], spaces [21-30], modules [31-40] , refined neutrosophic set [41-50], neutrosophic matrices [51-60] and its topology [61-75].

In this work, we extend the previous efforts to the case of the symbolic Turiyam set, where we define the symbolic Turiyam matrix, the symmetric Turiyam matrix, Fuzzy Turiyam matrix, and Hermit-Turiyam matrix.

This work may be very useful in future studied to generalize classical algebraic structures and to study the rerlationships between Turiyam matrices and classical matrices.

On the other hand, many open questions will come to light according to our work. We will list some of them in the conclusion.

Main Discussion

Definition

We define the symbolic Turiyam matrix as follows:

$A = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix}$; a_{ij} is a symbolic Turiyam number.

If a_{ij} was real symbolic Turiyam number, then A is called real symbolic Turiyam matrix.

If some a_{ij} was complex symbolic Turiyam number, then A is called complex Turiyam matrix.

The following example clarifies operations on Turiyam matrices.

Example

Consider the following 2×2 complex Turiyam matrices:

$$A = \begin{pmatrix} 1 + iT - iF & iF - iY \\ (1 + i)I + Y & -Y \end{pmatrix}$$

$$B = \begin{pmatrix} 3 + T + I & 2 - iI \\ (1 + i) + iY & -iF \end{pmatrix}$$

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We have:

$$A^T = \begin{pmatrix} 1+iT-iF & (1+i)I+Y \\ iF-iY & -Y \end{pmatrix}$$

$$B^T = \begin{pmatrix} 3+T+I & (1+i)+iY \\ 2-iI & -iF \end{pmatrix}$$

$$A+B = \begin{pmatrix} 4+(1+i)T-iF+I & 2+iF-iI-iY \\ 1+i+(1+i)I+(1+i)Y & -iF-Y \end{pmatrix}$$

It is clear that $(A+B)^T = A^T + B^T$.

$$\bar{A} = \begin{pmatrix} 1-iT+iF & -iF+iY \\ (1-i)I+Y & -Y \end{pmatrix}$$

$$\bar{B} = \begin{pmatrix} 3+T+I & 2+iI \\ (1-i)-iY & iF \end{pmatrix}$$

It is clear that $\overline{(A+B)} = \bar{A} + \bar{B}$.

Example

Take:

$$A = \begin{pmatrix} 1+F & 2+T+I \\ -1-Y & Y \end{pmatrix}$$

$$B = \begin{pmatrix} I+F & I-F \\ F & T+Y \end{pmatrix}$$

$$A \times B = \begin{pmatrix} 5F+I & 3T-2F+3Y \\ -F-2I & F-2I+3Y \end{pmatrix}$$

Definition

A Turiyam matrix A is called symmetric if and only if $A^T = A$.

A is called anti-symmetric if $A^T = -A$.

We define $A^* = (\bar{A})^T$, if $A^* = A$, then A is called Hermit -Turiyam matrix.

Example

$A = \begin{pmatrix} 1+3T-F & 1+Y \\ 1+Y & 3-F \end{pmatrix}$ is Turiyam symmetric matrix.

$$B = \begin{pmatrix} 2T & (1-i)Y \\ (1+i)Y & 3F \end{pmatrix}$$

$$\bar{B} = \begin{pmatrix} 2T & (1+i)Y \\ (1-i)Y & 3F \end{pmatrix}$$

$$B^* = (\bar{B})^T = \begin{pmatrix} 2T & (1-i)Y \\ (1+i)Y & 3F \end{pmatrix}$$

Thus, B is Hermit-Turiyam matrix.

Definition

Let $A = (a_{ij})$ be a Turiyam matrix, we say:

1. A is complete Turiyam truth matrix (CTTM) if $a_{ij} = xT; x \in R \text{ or } C$.
2. A is called complete Turiyam Falsity matrix (CTFM) if $a_{ij} = xF; x \in R \text{ or } C$.
3. A is called complete TuriyamIndeterminacy matrix (CTIM) if $a_{ij} = xI; x \in R \text{ or } C$.

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4. A is called complete Turiyamawareness matrix (CTAM) if $a_{ij} = xY; x \in R\ or\ C$.

Example

$A = \begin{pmatrix} 2I & -I \\ I & 5I \end{pmatrix}$ is (CTIM)

$B = \begin{pmatrix} 3Y & 2Y \\ -5Y & Y \end{pmatrix}$ is (CTAM)

$C = \begin{pmatrix} -11T & 3T & 3 \\ T & -T & 2T \\ 5T & 4T & -T \end{pmatrix}$ is (CTTM)

Remark

All square (CTTM),(CTFM),(CTIM),(CTAM) are not invertible because the determinant $\det A$ will be a non invertible Turiyam number.

Example

Consider a (CTIM), $A = \begin{pmatrix} 2I & I \\ I & 5I \end{pmatrix}$.

$\det A = 10I^2 - 9I^2 = I^2 = I$, which is non-invertible.

Remark

We denote to the set of all square (CTTM) by (T_M), andby(F_M) to the (CTFM), and by (I_M) to the (CTIM),and by(A_M) to the(CTAM).

Theorem

1) $(T_M, +), (F_M, +), (I_M, +), (A_M, +)$ are abelian groups.
2) T_M has a multiplicative identity $\begin{pmatrix} T & 0 \\ 0 & T \end{pmatrix}$
3) F_M has a multiplicative identity $\begin{pmatrix} F & 0 \\ 0 & F \end{pmatrix}$
4) I_M has a multiplicative identity $\begin{pmatrix} I & 0 \\ 0 & I \end{pmatrix}$
5) A_M has a multiplicative identity $\begin{pmatrix} A & 0 \\ 0 & A \end{pmatrix}$

Proof.

1) Let $A, B \subset T_M$,for each i, j, we have:
   $a_{ij} - b_{ij} = xT - yT = (x - y)T$, thus $A - B \in T_M$, hence T_M is a subgroup of the additive group of Turiyam matrices.

   We prove that A_M, F_M, I_M are additive abelian groups by the same.

2) Let $A_{n\times n} \in T_M$, hence $A = TA_{n\times n}$ where A is an ordinary square matrix.

We have $U_T = \begin{pmatrix} T & 0 \\ 0 & T \end{pmatrix} = T\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = TU_{n\times n}$; $U_{n\times n}$is the unitary matrix.

$A \times U_T = (T.\acute{A}) \times (T.U_{n\times n}) = T.(\acute{A}.U_{n\times n}) = T\acute{A} = A$.

3), 4), 5) can be proved by the same.

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Remark:

If we take the elements $a_{ij} \in [0,1]$, we get the concept of Fuzzy-Turiyam matrix.

Example:

Consider the matrix $A = \begin{pmatrix} 0.2 + 0,3F + 0,1Y & 0.1 + 0,3F + 0,6I & 0.9 + 0,3I + 0,1Y \\ 0,5T + 0,3I & 0.7 + 0,3I + 0,6Y & 0.1 + 0,3T + 0,1I \end{pmatrix}$.

It is a Fuzzy Turiyam matrix.

Conclusion

In this paper, we have defined for the first time the concept of Turiyam matrix. Also, we have presented many examples about algebraic operations between these matrices.

We suggest many research problems:

1) How can we compute the eigen values of a turiyam matrix?

2) How can we find all eigen vectors of a turiyam matrix?

3) Find an algorithm to diagonalize a Turyiam matrix?

4) What is the algebraic structure of invertible Turiam matrices?. Can we find the invertibility condition depending on the classical parts of a Tutiyam matrix?.

5) Define algebraic operations over Fuzzy-Turiyam Matrices. What are the algebraic properties of these matrices?.

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