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Review Article

USE OF Γ- SOFT MATRIX IN SOLVING DECISION MAKING PROBLEMS

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Abstract
The hypothesis of soft sets started by Molodtsov, in light of soft set hypothesis in this article we characterized some fundamental definitions, for example, Γ-Soft Matrix representation of Γ-Soft, Cartesian product of Γ-Soft sets. In this work we added a another constraint set, Γ which refers the title of an organization or an agency. Based on this theory, we defined Γ- Soft matrix and applied in decision making problem by explain with an example.

Keywords: 'Γ'(GAMMA)- Soft set, Approach matrix, 'Γ'(GAMMA)- soft matrix, Characteristic function, Product of 'Γ'(GAMMA)- soft Matrices

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INTRODUCTION

Molodtsov was first started the soft theory which is the significant Mathematical instrument to take care of the issues with unpredictability's. Molodtsov talked about the functionality of the idea of soft set for applications in some sort of different ways. Maji examined the itemized theoretical investigation of soft-sets alike soft-sub set, not-set, equality involving soft-sets. They discussed applications on soft-sets, for example, 'union', 'intersection', 'and' and 'or' operations. Haci Aktas et.al [1] imported some basic important components of soft sets in addition to compare soft-sets in order to the related ideas associated with fuzzy-sets and rough-sets. Ahmad and A. Kharal [2] introduced notations on mapping of soft classes and also presented some properties of images of soft sets in which these can be applied in the problems of medical diagnosis. P. K. Das and R. Borgahain [3] studied about fuzzy soft set and that may be applied within a multi-observer multi-criteria decision making difficulties. Athar kharal [4] presented an optimum choice problem and also studied the upper and lower soft approximations with some results. Xiaohong Zhang [5] introduced notation on interval soft sets. Also the author discussed that typically the forbidden portrayal of interim soft-sets, interval choice values to take care of dynamic issues. Anjan Mukherjee et. al [6] proposed an IFS based investment model by showing an example and also they presented the effect of non-membership degree of elements on decision making. V. E. Sasikala, D. Siva Raj [7] the authors analyzed regarding foundations of soft-semi open sets and soft-semi closed sets within soft-topological spaces. Zhicai Liu et. al [8] proposed some sort of technique based on soft-set and ideal remedy access in decision-making problems. Jose carlos R. Alcantud and Gustavo Santos-Garcia [9] discussed a new approach to clarify a decision making problem. Quinrong Ferg, Xia Guo [10] considered another way to deal solve group-decision making problems depending on fuzzy soft-sets. Muhammed Akram et. al [11] discussed about bipolar fuzzy-soft advice combining bipolar fuzzy-soft sets with graphs. T.Geetha and S. Usha studied different hyper of matrices in fuzzy soft set theory. S. Senthil kumar [12] introduced a technique of applying threshold for selecting an optimal set is suggested when the user deals with huge amount of data. Pramanik S, et. al [13] the authors presented some operations on Nuetrosophic cubic soft set like 'p-union', 'p-intersection' 'R-union' and 'R-intersection' etc. Wang and Chang [14] discussed about the properties of parameterized vague soft-sets. We introduced in this article a new constraint, 'Γ'(GAMMA) in soft-set building, which demonstrate the title of the organization or name of the agency. We defined an algorithm for decision making which consists of product matrix, approach matrix and optimum set by taking an example.

METHODOLOGY

Preliminaries: We have to discuss in this division some basic definitions and outcomes on 'Γ'(GAMMA)- soft-sets through suitable illustrations.

'Γ'(GAMMA)- soft-set: The universal discourse C also P(C) be the power set of C. Let the sets of parameters attributes be K and 'Γ'(GAMMA). The triode (J, L, 'Γ'(GAMMA)) is named as a 'Γ'(GAMMA)- soft-set above the universal set, C is (J, L, 'Γ'(GAMMA)) = { J(a, γ) : a $\in$ L, γ $\in$ 'Γ'(GAMMA)} in which J is a relation given by J : L X Γ $\rightarrow$ P(C) also K is the super set of L.

Illustration.1. Suppose the universal set, Z = { z_1, z_2, z_3, z_4, z_5 } comprising lot of six Televisions under thought. Let the parameters sets, K = { k_1, k_2, k_3 } and 'Γ'(GAMMA) = { $£_1$, $£_2$ } with respect to Z, where k_1: implies that costly, k_2: implies that less expensive and k_3: implies that good looking and also $£_1$: implies that quality-1 organization, $£_2$: implies that quality -2 organization.

Assume L = { k_1, k_2 } $\subseteq$ K. Then the product, L X 'Γ'(GAMMA) = { (k_1, $£_1$), (k_1, $£_2$), (k_2, $£_1$), (k_2, $£_2$) }.
Assume that R(k_1, γ_1) = { z_1, z_2 }, R(k_1, $£_2$) = { z_2, z_3, z_4 }, R(e_2, $£_1$) = { z_2, z_5 }, R(k_2, $£_2$) = { z_3, z_5 }.
The set (R, L, 'Γ'(GAMMA)) is a 'Γ'(GAMMA)- soft-set, which is a the family of parameters {R(k_i, $£_j$), i , j = 1,2 } of sub sets of the universal set, Z and provides the gathering of alikeness agreed as pursues.
(R, L, 'Γ'(GAMMA)) = { (R(k_1, $£_1$) ,{ z_1, z_2 }), (R(k_1, $£_2$), { z_2, z_3, z_4 }), (R(k_2, $£_1$), { z_2, z_5 }), (R(k_2, $£_2$), { z_3, z_5 })}.
Where

$R(k_1, £_1)$ = Brand -1 company costly Televisions = { z_1, z_2 }
$R(k_1, £_2)$ = Brand -2 company costly Televisions = { z_2, z_3, z_4 }
$R(k_2, £_1)$ = Brand -1 company cheaper Televisions = { z_2, z_5 }
$R(k_2, £_2)$ = Brand -2 company less expensive Televisions = { z_3, z_5 }

'Γ'(GAMMA)- soft-subset: Assume that (R, L, 'Γ'(GAMMA)) and (G, M, 'Γ'(GAMMA)) are the two 'Γ'(GAMMA)- soft-sets above a universal discourse, C, we call (R, L, 'Γ'(GAMMA)) is a 'Γ'(GAMMA)- soft sub set of (G, M, 'Γ'(GAMMA)) if,

(i) L $\subseteq$ M

(ii) every single element e $\in$ L, £ $\in$ 'Γ'(GAMMA), the sets R(e, £), G(e, £) having identical approximations , in which the sets L and M are sub sets of a constraint set K and 'Γ'(GAMMA) is additionally another parameter set.

Illustration.2 Assume Z = { z_1, z_2, z_3, z_4, z_5 } be a universal set, K = { k_1, k_2, k_3, k_4 } and Γ = { $£_1, £_2$ } are the sets of constraints regarding C.
Suppose that (R, L, 'Γ'(GAMMA)) and (G, M, 'Γ'(GAMMA)) are two 'Γ'(GAMMA)- soft sets above a Universal set, Z where L and M are su-sets of K.
Assume L = { k_1, k_2 }, M = { k_1, k_2, k_4 } and the estimations are as follows.
$R(k_1, £_1)$ = { z_1, z_2 }, $R(k_1, £_2)$ = { z_2 }, $R(k_2, £_1)$ = { z_3, z_4 }, $R(k_2, £_2)$ = { z_5 } and
$G(k_1, £_1)$ = { z_1, z_2, z_3 }, $G(k_1, £_2)$ = { z_2, z_5 }, $G(k_2, £_1)$ = { z_3, z_4 }, $G(k_2, £_2)$ = { z_5, z_1 }
$G(k_4, £_1)$ = { z_1 }, $G(k_4, £_2)$ = { z_2 }.

Cartesian product of two 'Γ'(GAMMA)- soft-sets : Cartesian product of two 'Γ'(GAMMA)- soft sets, (J, L, 'Γ'(GAMMA)) and (G, M, 'Γ'(GAMMA)) above a Universal set, C, is indicated by (J, L, 'Γ'(GAMMA)) X (G, M, 'Γ'(GAMMA)) and is characterized as (J, L, 'Γ'(GAMMA)) X (G, M, 'Γ'(GAMMA)) = (H, AX B, 'Γ'(GAMMA)), where H : (AX 'Γ'(GAMMA)) X (BX 'Γ'(GAMMA)) $\rightarrow$ P(C X 'Γ'(GAMMA) X C X 'Γ'(GAMMA)), such that H ((a,b), £) = J(a,£) X G(b,£), for some a $\in$ A, b $\in$ B , £ $\in$ 'Γ'(GAMMA).

Also J(a,£) X G(b,£) = { ($(h_i,£_i)$, $(h_j,£_j)$) / $(h_i,£_i)$ $\in$ J(a,£) and $(h_j,£_j)$ $\in$ G(b,£) }.

Illustration.3 Suppose two 'Γ'(GAMMA)- soft-sets, (J, L, Γ) and (G, M, Γ) over a Universal set, C is characterized as
J(a,£) = { $(h_1,£_1)$, $(h_2,£_1)$ } and G(b,£) = { $(h_2,£_1)$, $(h_3,£_2)$ }. The Cartesian product of two 'Γ'(GAMMA)- soft sets is J(a,£) X G(b,£) = { ($(h_1,£_1)$, $(h_2,£_1)$), ($(h_1,£_1)$, $(h_3,£_2)$), ($(h_2,£_1)$, $(h_2,£_1)$), ($(h_2,£_1)$, $(h_3,£_2)$) }.

Γ – Soft Relation : Assume that two Γ- soft sets (J, L, Γ) and (G, M, Γ) above a universal set, C
In this manner the relation between above two Γ- soft sets, is indicated by (R,D, Γ) and is just mean by R_Γ and which is Γ- soft subset of (J, L, Γ) X (G, M, Γ)
i.e., R_Γ ((a,b), £) = H((a,b), £)

Illustration 3 Suppose taht (F, A, Γ) = { ($F(a_1, £_1)$, $F(a_2, £_2)$}, and (G, B, Γ) = { ($G(b_1, £_1)$, $G(b_2, £_2)$} be the two 'Γ'(GAMMA)- soft sets above a Universal set, C.
Wherever,
$F(a_1, £_1)$ = { $(v_1, £_1)$, $(v_3, £_1)$ }
$F(a_2, £_2)$ = { $(v_3, £_2)$, $(v_4, £_2)$ }
$G(b_1, £_1)$= { $(v_1, £_1)$, $(v_2, £_1)$ }
$G(b_2, £_2)$= { $(v_3, £_2)$, $(v_2, £_2)$ }
Therefore the relation, R_Γ ((a,b), £) is given by R_Γ ((a,b), £) = ($J(a_1, £_1)$ X ($G(b_1, £_1)$)
= { ($(v_1, £_1)$, $(v_1, £_1)$), ($(v_1, £_1)$, $(v_2, £_1)$), ($(v_2, £_1)$, $(v_1, £_1)$), ($(v_2, £_1)$, $(v_3, £_1)$) }.

'Γ'(GAMMA)- soft matrix: Assume that C be the universal set, the sets of constraints E and Γ with reference to C and A $\subseteq$ E. let (f_A, E, Γ) be a soft set above C. Therefore the sub set, R_Γ of C X Γ X E X Γis defined as R_Γ = { ((u, £),(e, £)): $u \in$ $f_A(e)$, e $\in$ A, £ $\in$ Γ } is named as the relation of the soft set, (f_A, E, Γ).

Characteristic function: The characteristic function, $\aleph_{R_\Gamma}$ of R_Γ is defined by $\aleph_{R_\Gamma}((u,\gamma),(e,\gamma))$
= { 1, ((u, £),(e, £)), ((u, £),(e, £)) $\in R_\Gamma$
={ 0, ((u, £),(e, £)), ((u, £),(e, £)) $\notin R_\Gamma$,where $\aleph_{R_\Gamma}$: U X Γ X E X Γ $\rightarrow$ {0.1}.

Illustration 4 Assume that U be the universal set and let E and 'Γ'(GAMMA) be the parameters sets with reference to the universal set, U and A $\subseteq$ E. let (f_A, E, Γ) be a soft set over U, where U={ m_1, m_2, m_3 }, E = { c_1, c_2, c_3 }, 'Γ'(GAMMA) = { $£_1, £_2$ }.
Let A = { e_1, e_2 } be the subset of E. The Γ- soft set is { $f_A(e_1, £_1)$, $f_A(e_2, £_1)$, $f_A(e_1, £_2)$, $f_A(e_2, £_2)$ }.
Let the Γ- soft relation, R_Γ = { ($(m_1,£_1)$, $(e_1, £_1)$), ($(m_2,£_1)$, $(e_1, £_1)$), ($(m_1,£_2)$, $(e_1, £_2)$), ($(m_3,£_2)$, $(e_1, £_2)$), ($(m_2,£_1)$, $(e_2, £_1)$), ($(m_3,£_2)$, $(e_2, £_2)$) }.
Therefore the Γ- soft matrix is defined by

Brand	$£_1$			$£_2$		
	c_1	c_2	c_3	c_1	c_2	c_3
m_1	0	0	0	0	0	0
m_2	0	0	0	1	0	0
m_3	0	0	1	1	0	0
m_4	0	0	0	0	0	0
m_5	0	0	0	0	0	1

The matrix can also be represented by

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

DISCUSSION

Operations on Γ- soft Matrices:

Union of 'Γ'(GAMMA)- soft matrices: Let M = [a_{ij}], N = [b_{ij}] be two 'Γ'(GAMMA)- soft matrices the union of these two matrices is represented by $M \cup_\Gamma N$ and is termed as $M \cup_\Gamma N$ = max. { a_{ij}, b_{ij} }.

Intersection of 'Γ'(GAMMA)- soft matrices: Let M = [a_{ij}], N = [b_{ij}] be two 'Γ'(GAMMA)- soft matrices the union of these two matrices is denoted by $M \cap_\Gamma N$ and is defined as $M \cap_\Gamma N$ = min.{ $a_{ij,}$ b_{ij} }.

Complement of 'Γ'(GAMMA)- soft matrix: Complement of 'Γ'(GAMMA)- soft matrix, M is indicated by M^c and is characterized by M^c = 1- a_{ij}.

Product of 'Γ'(GAMMA)- soft Matrices:

'AND' Product : Suppose that M = [a_{ij}], N = [b_{ik}] be two 'Γ'(GAMMA)- soft matrices the 'AND' product of two 'Γ'(GAMMA)- soft matrices is indicated by MΛN, where Λ : M X N_{mxn} $\rightarrow$ M X $N_{mxn^2}$is characterized as [a_{ij}] Λ [b_{ij}] = c_{ip}, in which

c_{ip}= min{ a_{ij} , b_{ik} }and p = n (j-1) +k, where n shows the number of columns in the matrices.

'OR' Product : Suppose that M = [a_{ij}], N = [b_{ik}] be two Γ- soft matrices the 'OR' product of two Γ- soft matrices is denoted by MVN, where V : M X N_{mxn} $\rightarrow$ M X $N_{mxn}{}^2$is characterized as [a_{ij}] V [b_{ij}] = c_{ip}, in which c_{ip}= max{ a_{ij} , b_{ik} }and p = n (j-1) +k, where n is the numeral columns in the matrices.

AND-NOT Product : Let M = [a_{ij}], N = [b_{ik}] be two 'Γ'(GAMMA)-soft matrices the AND-NOT product of two 'Γ'(GAMMA)- soft matrices is denoted by M~ΛN, where ~Λ : M X N_{mxn} $\rightarrow$ M X $N_{mxn}{}^2$is defined as [a_{ij}] ~Λ [b_{ij}] = c_{ip}, in which c_{ip}= min{ a_{ij} , 1-b_{ik} }and p = n (j-1) +k, where n is the numeral of columns in the matrices.

OR-NOT Product : Let M = [a_{ij}], N = [b_{ik}] be two 'Γ'(GAMMA)-soft matrices the AND-NOT product of two 'Γ'(GAMMA)- soft matrices is denoted by M~VN, where ~V : M X N_{mxn} $\rightarrow$ M X $N_{mxn}{}^2$is defined as [a_{ij}] ~V [b_{ij}] = c_{ip}, in which c_{ip}= max{ a_{ij} , 1-b_{ik}}and p = n (j-1) +k, where n is the number of columns in the matrices.

APPLICATION

Parents function a significant guidance in their children's profession progress profession decision-making. Now a days it is difficult to the parent to choose a institute for their wards. The parent has to take right decision to choose good institute for their wards. On this context we try to construct a model using Γ-soft matrices with some suitable parameters.

Consider s set of institutions {m_1, m_2, m_3, m_4, m_5 } where m_1 indicates institutions with good infrastructure and good faculty, m_2 indicates institutions with some faculty are good and poor infrastructure, h_3 indicates institutions with no proper identification, h_4 indicates institutions with good faculty but no facilities, h_5 indicates institutions with facilities and poor in students strength. The parameter set E = { c_1, c_2, c_3 } , where e_1 is institutions with qualified faculty and sufficient number of faculty, e_2 is institutions with no qualified faculty, e_3 is institutions with insufficient qualified faculty and other parameter set Γ = { $£_1$, $£_2$ } represents two agencies.

A parent Mr. X has to select right institute to his ward based on the information given by the agencies. The two agencies give their report on their own parameters.

Let the two agencies $£_1$ and $£_2$ consider their parameters sets as A = {c_1, c_3} and B= {c_2,c_3} respectively.

Let (P, A, Γ) and (Q, B, Γ) be two Γ- soft sets constructed by two agencies, which are defined as follows.

(P, A, Γ) = {((c_1, $£_1$), { (m_1, $£_1$), (m_3, $£_1$) }), ((c_1, $£_2$), (m_1, $£_2$)), ((c_3, $£_2$), (m_1, $£_2$)), ((c_3, $£_2$), (m_5, $£_2$)) }

(Q,B, Γ) = {((c_2, $£_1$), {(m_2, $£_1$), (m_3, $£_1$), (m_4, $£_1$)}), ((c_2, $£_2$), (m_1, $£_2$)), ((c_3, $£_1$), {(m_3, $£_1$), (m_4, $£_1$)}, ((c_3, $£_2$), (m_5, $£_2$)}.

The Γ- soft matrix of Γ- soft set, (P,A, Γ) is

Table 1

Brand	$£_1$			$£_2$		
	c_1	c_2	c_3	c_1	c_2	c_3
m_1	1	0	0	1	0	1
m_2	0	0	0	0	0	0
m_3	0	0	0	0	0	0
m_4	0	0	0	0	0	0
m_5	0	0	0	0	0	1

We can observe graphically the Table-1 between hi values and (e_i, $£_i$) values from the following figure.

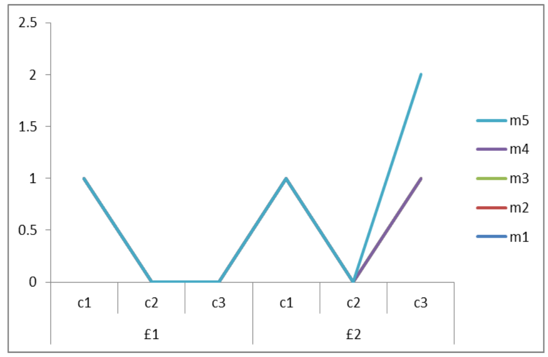

Fig. 1

The Matrix is

$$[a_{ij}] = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The Γ- soft matrix of Γ- soft set, (Q,B, Γ) is

Table 2

Brand	$£_1$			$£_2$		
	c_1	c_2	c_3	c_1	c_2	c_3
m_1	0	0	0	0	1	0
m_2	0	0	0	0	0	0
m_3	0	0	1	0	0	0
m_4	0	0	1	0	0	0
m_5	0	0	0	0	0	1

We can observe graphically the Table-2 between m_i values and (c_i, $£_i$) values from the following figure.

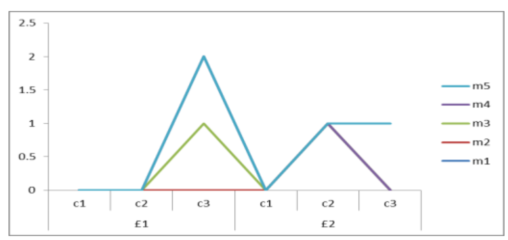

Fig. 2

The Matrix is

$$[b_{ik}] = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The AND product of a_{ij} and b_{ik} is given by

$$\begin{array}{c} \overleftrightarrow{\quad £_1 \quad} \qquad \overleftrightarrow{\quad £_2 \quad} \\ \begin{bmatrix} 000010 & 000000 & 000000 & 000010 & 000000 & 000010 \\ 000000 & 000000 & 000000 & 000000 & 000000 & 000000 \\ 010000 & 000000 & 000000 & 000000 & 000000 & 000000 \\ 000000 & 000000 & 000000 & 000000 & 000000 & 000000 \\ 000000 & 000000 & 000000 & 000000 & 000000 & 000001 \end{bmatrix} \end{array}$$

Algorithm

i) Consider the Γ- soft set with required parameters
ii) Construct the Γ- soft matrix from the Γ- soft set
iii) Calculate the product matrix for the Γ- soft matrices
iv) Find the count of product matrix
v) Construct the approach matrix
vi) Define the Optimum set to take the decision of the problem

Count of product matrix:

The count of product matrix is denoted by G_{in} and is defined as $G_{in} = \sum_i c_{ip}$ corresponding to the parameters $£_1$ and $£_2$.

∴ The count of the product matrix

$$G_{in} = \begin{array}{c} \overleftrightarrow{\ £_1\ } \quad \overleftrightarrow{\ £_2\ } \\ \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \end{array}$$

Approach Matrix

The Approach matrix is constructed by taking article names h1, h2, h3, h4, h5 as rows and the sum of elements in each row corresponding to the parameters £1 and £2 as columns.

	$£_1$	$£_2$
m_1	1	2
m_2	0	0
m_3	1	0
m_4	0	0
m_5	0	1
	$\sum £_1 = 2$	$\sum £_2 = 3$

Analysis: According to the report given by the Agencies-1&2 the parent has not choose the institutions without good faculty and good infrastructure. Even though the institutions have good infrastructure without good faculty the parent is not advise to choose that institutes.

Optimum set = $\left\{ \sum £_1, \sum £_2 \right\}$ min.

Decision: Based on the Optimum set the parent has to take advise from Agency-1 and parent has to choose the institute recommended by Agency-1.

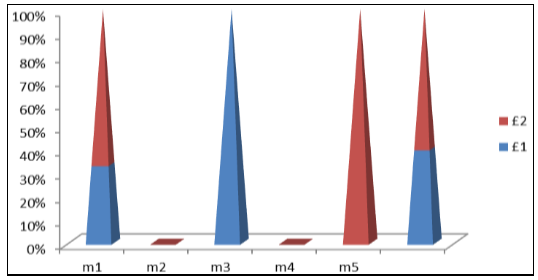

Fig. 3

From Figure-3 we can view the decision very clearly, i.e., we have to take the minimum value of.

CONCLUSION

In this paper we have discussed about the definitions like Γ- Soft set, Γ- Soft set matrix, Γ- Soft Characteristic function etc with suitable examples. Also, we explained by defining an algorithm to take a right decision between two agencies with an example.

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