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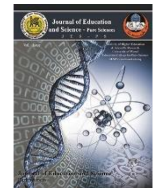

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On ℵ𝑐-Method of e-Abacus Diagram

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Abstract

When a specific method is chosen for a solution, representing or encoding a mathematical model, others seek to make this method ambiguous through what we can call (multiple encoding) to conceal the solution and make it more secret. This is exactly what we did in this research, as we placed a special movement exclusively on the columns of the first main e-abacus diagram, which we called (ℵ𝒄) on the condition that the first and last columns of the original diagram are not affected at all, due to our actual need for them in representing the diagram later. In addition, the mechanism was implemented in the form of a graph, and a computer program was also created to solve the problem more quickly. It is expected that the application of this technology will have industrial potential aimed at improving production in terms of quality and quantity.

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1. Introduction

Let n be a nonnegative integer. The composition $\vartheta = (\vartheta_1, \vartheta_2, \dots, \vartheta_z) = (\omega_1{}^{\sigma_1}, \omega_2{}^{\sigma_2}, \dots, \omega_s{}^{\sigma_s})$ (where σ_j represents the number of times $\omega_j$appeared, j=1, 2, …, s) of n is a sequence of non-negative integers such that $|\vartheta| = \sum_{r=1}^{z} \vartheta_r = \sum_{j=1}^{s} \omega_j{}^{\gamma_j} = n$. The composition is called a partition of n if $\vartheta_r \geq \vartheta_{r+1}, \forall\, r \geq 1$. For $1 \leq i \leq b$ then $\beta_i = \vartheta_i + b - i$. The set $\{\beta_1, \beta_2, \cdots, \beta_b\}$ is said to be the set of β - number for ∂, see [1]. Let e be a positive integer number greater than or equal to 2, we can represent numbers by a diagram called *e*-abacus diagram, see [2], as shown in Table 1:

Table 1. *e*-Abacus Diagram

runner – 1	**runner -2**	**…**	**runner – *e***
0	1	…	*e* – 1
e	*e* + 1	…	2*e* -1
2*e*	2*e* + 1	…	3*e* -1
⋮	⋮	⋮	⋮

where every β will be represented by the symbol (•) and the rest of the sites will be left blank. For example, if $\vartheta = (6^3, 5, 4^2, 3, 2^2)$ and $e = 5$, the resulting diagram will be as shown in Figure 1:

		•	•	
•		•	•	
•		•	•	•

Figure 1. e-Abacus Diagram for the partition $\vartheta = (6^3, 5, 4^2, 3, 2^2)$ when $e = 5$

2. Mechanism Road ($\aleph c$):

It is well known that for any partition, there is a main e-abacus diagram depending on the values of e [3]. These diagrams are possible for each one of them to carry out the task alone, isolated from the rest, in the new method, but we will rely entirely on the first diagram, the following steps explain this approach in detail:

1. We will rely on using a representation of each letter of the English language to try to control it more, as there are 5 columns and the same number of rows [4].
2. As we mentioned previously, we will not make any changes at all, neither to the first nor the last column.

Based on what was mentioned above, the changes will be in the second, third and fourth columns, but according to a certain method. In ($\aleph c^1$), in addition to the values of the first and last columns mentioned in point 2, second column will also remain unchanged, and the exchange will be between third and fourth columns. This exchange involves swapping the values of the first location of the third column with the last location of the fourth column of the e-abacus diagram, and similarly swapping the last location of the third column with the first location of the fourth column. Alternatively, in ($\aleph c^2$), the third column will remain unchanged and the swapping will be between the first value of the second column and the last value of the forth column, and between the last value of the second column and the first value of the fourth column. Finally, in ($\aleph c^3$), the fourth column values will be unchanged and the exchange will be between third and fourth columns. Figure 2 is an example that illustrates all of the above in the previous steps on the letter A.

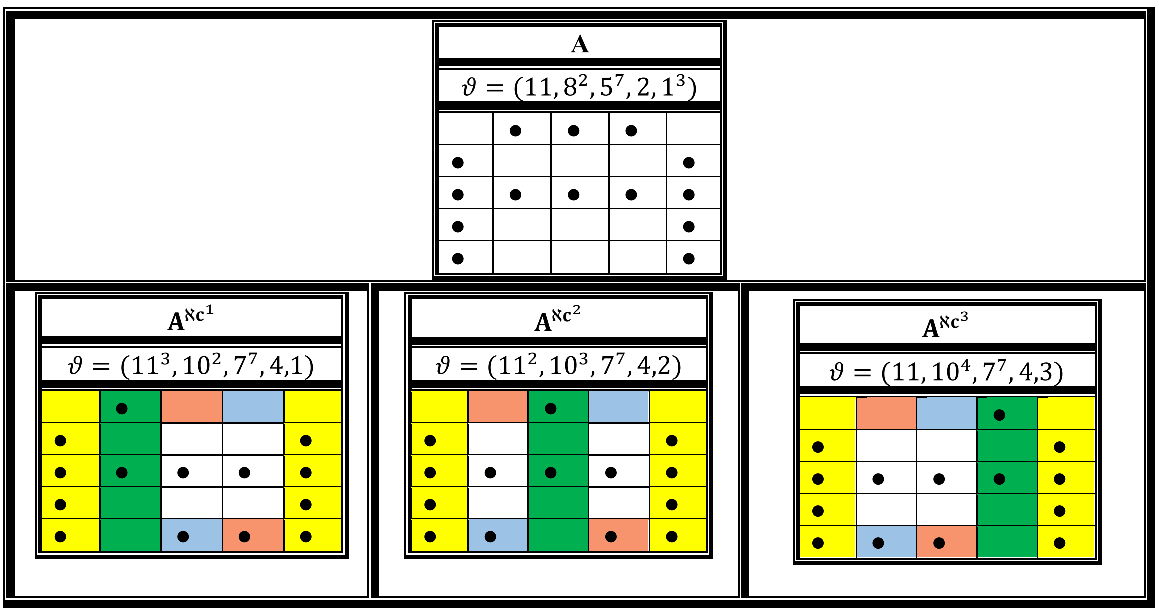

Figure 2 shows the movements $\aleph c^1$, $\aleph c^2$, and $\aleph c^3$ on the letter A.

2.1 Note: The representation of any letter of the English language if ($\aleph c$) is applied will be only 3 cases.

Proof: We will find ($\aleph c$) for each letter according to the following table:

Table 2. Illustrates all possible cases when applying ($\aleph c$) to all letters of the English language.

Letter	Partition for each letter	$\aleph c^1$	$\aleph c^2$	$\aleph c^3$
B	$(11^3,10,8,6^3,5,3,1^3)$	$(11^3,10,8,6^3,5,3,1^3)$	$(11^3,10,8,6^3,5,3,1^3)$	$(11^3,10,8,6^3,5,3,1^3)$
C	$(13^3,12,9,5^2,2,1^3)$	$(13^3,12,9,5^2,2,1^3)$	$(13^3,12,9,5^2,2,1^3)$	$(13^3,12,9,5^2,2,1^3)$
D	$(12^3,11,9,8,6,5,3,1^3)$	$(12^3,11,9,8,6,5,3,1^3)$	$(12^3,11,9,8,6,5,3,1^3)$	$(12^3,11,9,8,6,5,3,1^3)$
E	$(12^4,8,6^3,2,1^4)$	$(12^4,8,6^3,2,1^4)$	$(12^4,8,6^3,2,1^4)$	$(12^4,8,6^3,2,1^4)$
F	$(12,8,6^3,2,1^4)$	$(14^3,10,8^3,4,3,1)$	$(14,13,9,7^3,3,2^3)$	$(13^2,9,7^3,3,2^3)$
G	$(11^3,10,7^4,6,1^3)$	$(11^3,10,7^4,6,1^3)$	$(11^3,10,7^4,6,1^3)$	$(11^3,10,7^4,6,1^3)$
H	$(13,11,10,8,7^4,6,4,3,$	$(13,11,10,8,7^4,6,4,3,1)$	$(13^2,10,8,7^4,6,4,3^2)$	$(13,12,10,8,7^4,6,4,3,2)$
I	$(15^3,12,8,4,1^3)$	$(15^3,12,8,4,1^3)$	$(15^3,12,8,4,1^3)$	$(15^3,12,8,4,1^3)$
J	$(14,11,10,8,4,1^3)$	$(16^3,13,12,10,6,1)$	$(16,15,12,11,9,5,2^2)$	$(15^2,12,11,9,5,2^2)$
K	$(15,13,11,10,7^2,5,4,3,1)$	$(15,13,11,10,7^2,5,4,3,1)$	$(15^2,11,10,7^2,5,4,3^2)$	$(15,14,11,10,7^2,5,4,3,2)$
L	$(17^4,13,9,5,1)$	$(17,15,11,7,3,1^3)$	$(17^3,12,8,4,2,1)$	$(17^3,12,8,4,1^2)$
M	$(12,9^2,8,7^2,6,5^2,4,3,2,1)$	$(12,11,10^2,9,8^2,7,6^2,5,4,1)$	$(12^2,11^3,10,9^2,8,7^2)$	$(12,11,10^2,9,8^2,7,6^2,5,4,3)$
N	$(11,9,8^2,7,6^4,5,4^2,3$	$(11,9,8^2,7,6^4,5,4^2,3,1)$	$(11^2,8^2,7,6^4,5,4^2,3^2)$	$(11,10,8^2,7,6^4,5,4^2,3,2)$
O	$(12^3,11,8^2,5^2,2,1^3)$	$(12^3,11,8^2,5^2,2,1^3)$	$(12^3,11,8^2,5^2,2,1^3)$	$(12^3,11,8^2,5^2,2,1^3)$
P	$(11^3,8,6^3,5,3,1^3)$	$(12^4,9,7^3,6,4,2,1)$	$(12^4,9,7^3,6,4,2^2)$	$(11^3,8,6^3,5,3,1^3)$
Q	$(11^4,10^2,8^2,5^2,2,1^3)$	$(11^4,10^2,8^2,5^2,2,1^3)$	$(11^4,10^2,8^2,5^2,2,1^3)$	$(11^4,10^2,8^2,5^2,2,1^3)$
R	$(13,11,10,8,6^3,5,3,1^3$	$(13^4,12,10,8^3,7,5,1)$	$(13^2,12,11,9,7^3,6,4,2^2)$	$(13,12^2,11,9,7^3,6,4,2^2)$
S	$(13^3,12,7^2,2,1^3)$	$(14^4,13,8^2,3,2,1)$	$(14^4,13,8^2,3,2^2)$	$(13^3,12,7^2,2,1^3)$
T	$(14,10,6,2,1^5)$	$(15^2,11,7,3,2^3,1)$	$(15^3,12,8,4,3^2,2)$	$(14^2,11,7,3,2^3,1)$
U	$(14^2,12,10,9,7,6,4,3,1$	$(10,8,7,5,4,2,1^4)$	$(14^2,12,10,9,7,6,4,3,1)$	$(14^2,12,10,9,7,6,4,3,1)$
V	$(16,13,12,11,8^2,5)$	$(12,11,10,7^2,4,3)$	$(16,13,12,11,8^2,5)$	$(12,11,10,7^2,4,1)$
W	$(14,13,12,11,10^2,9,8^2,5)$	$(12,11,10,9^2,8,7^2,4,2)$	$(10,9,8^2,7,6^2,3,2,1)$	$(14,11,10,9^2,8,7^2,4,2)$
X	$(13,10,9,8,5,2,1)$	$(12,9,8,7,4,1)$	$(13,10,9,8,5)$	$(12,9,8,7,4,1)$
Y	$(16,12,9^3,8,5)$	$(11,8^3,7,4,3)$	$(16,12,9^3,8,5)$	$(11,8^3,7,4,1)$
Z	$(13^5,10,7,4,1^4)$	$(13^5,10,7,4,1^4)$	$(13^5,10,7,4,1^4)$	$(13^5,10,7,4,1^4)$

2.2 Note: For any English word consisting exclusively of two letters, the number of possibilities for applying ($\aleph c$) is 9.

Proof: From Note 1, each letter has three possibilities. If we say that there is a second letter and it also has, according to the same rule, three possibilities, so that each one of them takes a possibility from what came before for the first letter, we will have 9 possibilities. Figure 3 shows all possible cases involving the two letters (**AF**).

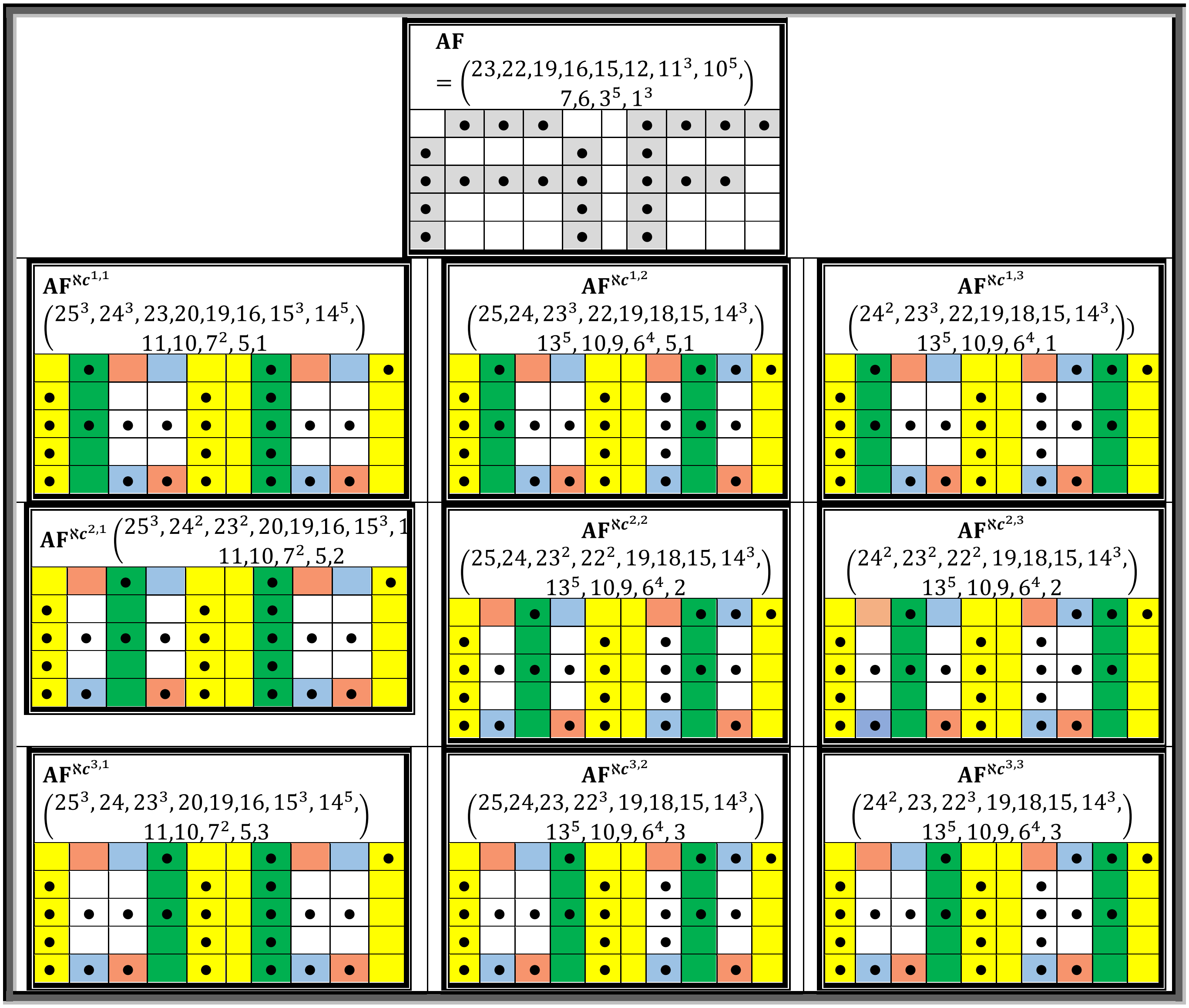

Figure 3. Illustrate all cases of the word (AF)

2.3 Note: It can be generalized that for any English word consisting of α letters, the number of possible cases when applying ($\aleph c$)will be $\mathbf{3^{\alpha}}$**.**

Data security can also be enhanced by applying the graph method, as discussed in [5]. The abacus diagram is transformed into an alternative graph that can be used as a secret code for any letter or word. Columns are designated by the symbol (c), while rows are represented by (w). Each node (●) is depicted as an edge (w,c), where the colors used in the graph reflect all possible states, including $\aleph c^1$, $\aleph c^2$ and $\aleph c^3$, as exemplified in Figure 3 for the word (AF), and Figure 4 shows the graph of the same word.

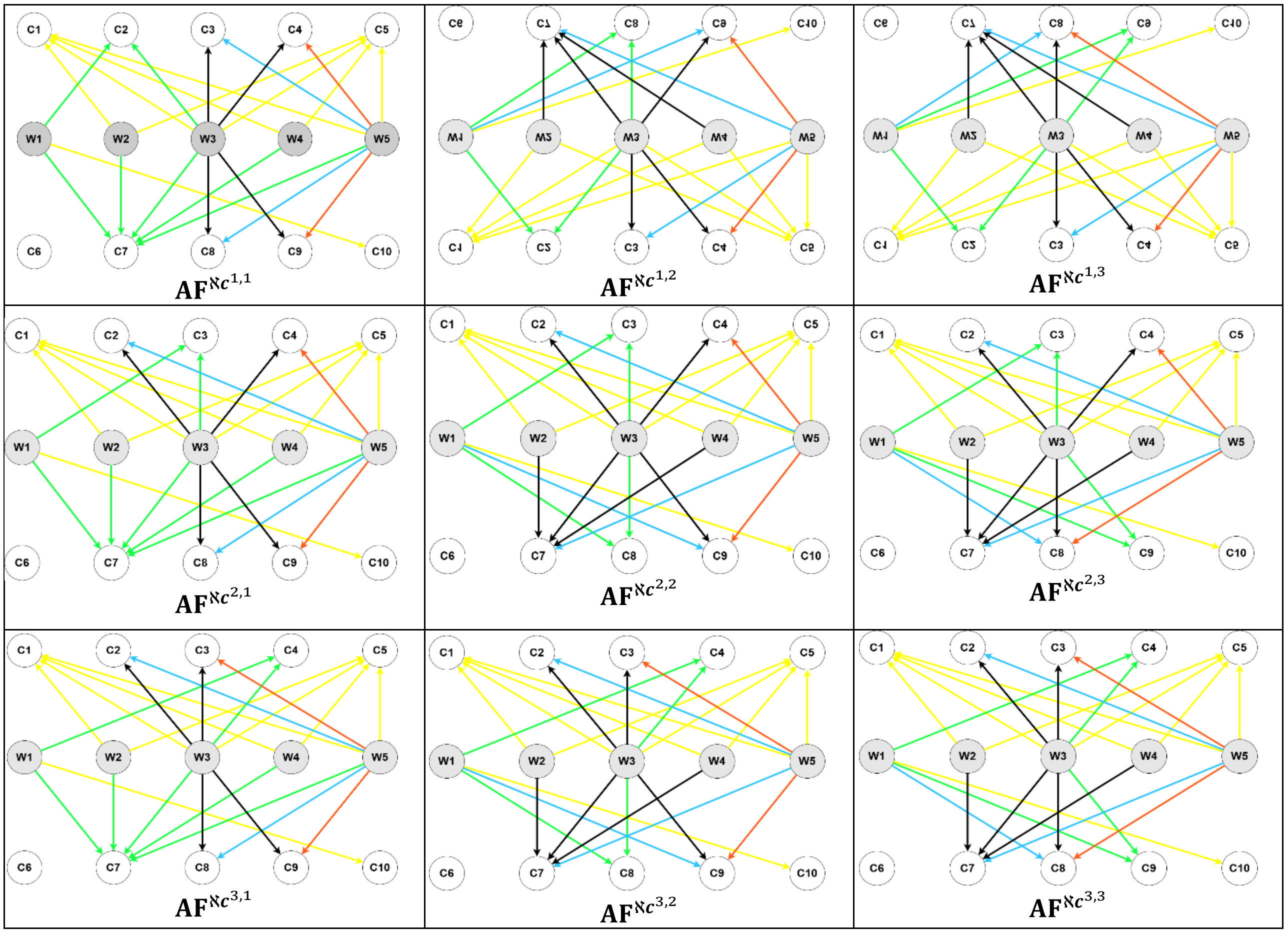

Figure 4. The graph of the word (AF)

3. Program

To draw diagrams and ensure the accuracy of the results, we used Microsoft Excel with custom-built macros written in Visual Basic for Applications (VBA). The Excel workbook consists of six worksheets. The first worksheet is called "Input". As the name suggests, this sheet is used for entering the partition numbers (ϑ) and the value of e (which is 5 in our case). Furthermore, this "Input" worksheet also allows entering a complete word with the corresponding transposition of every letter in that word.

The next worksheet is called "Array". This shows the original diagram of the entered data. As discussed in the introduction, the diagram consists of 5x5 cells where each cell is either a node or a space. In addition to drawing the original diagram, the VBA code also rewrites the partition numbers of the diagram.

The next three worksheets are "$\aleph \boldsymbol{c}^1$", "$\aleph \boldsymbol{c}^2$" and "$\aleph \boldsymbol{c}^3$". These worksheets show the diagram and partition numbers of the original diagram after applying $\aleph \boldsymbol{c}^1$, $\aleph \boldsymbol{c}^2$ and $\aleph \boldsymbol{c}^3$ transpositions respectively.

The final worksheet displays the entire word if entered in the "Input" worksheet. Like other diagram worksheets, this worksheet also contains the partition numbers of the final word. Figure 5 illustrates the work of the program when the partition numbers of a letter are entered. These numbers are shown in part (a) of the figure. Part (b) of Figure 5 illustrates the original diagram representing entered partition numbers. Finally, parts (c, d and e) of the figure show the diagrams after applying "$\aleph \boldsymbol{c}^1$", "$\aleph \boldsymbol{c}^2$" and "$\aleph \boldsymbol{c}^3$". transpositions respectively. Figure 6 demonstrates a whole word by entering the letters and the corresponding transposition number of each letter (1, 2 or 3). Part (a) of this figure shows the entered input data, whereas part (b) displays the resulting diagram.

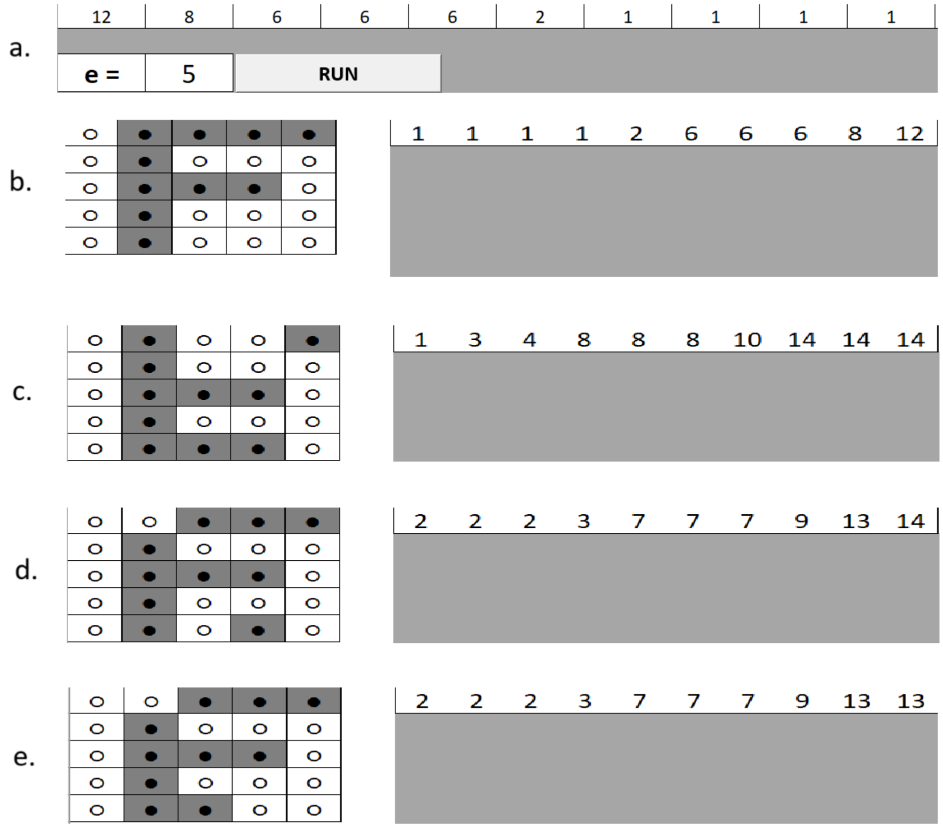

Figure 5. Illustrates the three movements of any letter.

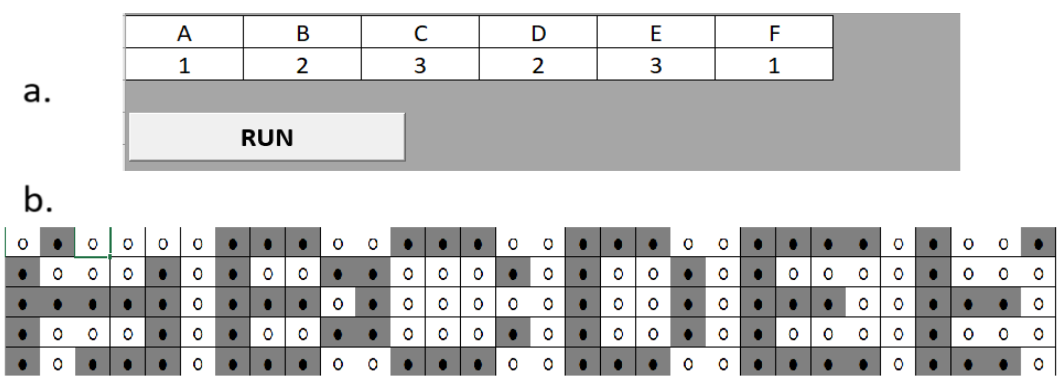

Figure 6. Illustrates a word with the three movements for each letter

4. Results And Discussion

1. This method will increase the difficulty of identifying the origin of the letter as long as there are several choices for each letter.
2. It is completely possible to implement the ideas mentioned in [6], These ideas involve adding columns or rows or make special movements to increase the difficulty of the task even more.
3. Using theory will be completely useful in this topic in that there are always 5 rows versus 5 x columns, where x is the number of letters of any word, and here it will be like the effect of each row on the changes taking place, especially the first and fifth, while the rest of the rows will be almost similar. There is a research team that focuses on rows only, and its results will

appear soon, but working on columns (in our opinion) is always better because it is more controllable in terms of possible changes [7].

4. This method will be effective in industrial applications. See, for example, the possibility of using the ideas contained in [8].

5. Conclusion

1. On the GCYD-method in e-abacus diagram [9], this resource could quite possibly play a prominent role in the possibility of combining graph theory with Young diagrams.
2. This technique can be used with letters of another language, and here [10] is used as a case for this technique. It is also possible to use the separation process mentioned in [11] and apply this new method to bring about very large and broad changes.
3. It is not unlikely that there is compatibility between this new method and all the relationships mentioned in Suer and Yesil [12].

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7. Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication

8. Funding

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حول طريقة $\aleph c$ لمخطط العداد من النمط e

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الخلاصة:

عندما يتم اختيار طريقة معينة لحل ما، لتمثيل أو ترميز نموذج رياضي، يسعى الآخرون إلى جعل هذه الطريقة غامضة من خلال ما يمكن أن نسميه (الترميز فوق الترميز) من أجل إخفاء الحل وجعله أكثر سرية. وهذا بالضبط ما فعلناه في هذا البحث، حيث وضعنا حركة خاصة حصريًا على أعمدة الرسم التخطيطي الرئيسي الأول للمعداد الإلكتروني، والتي أطلقنا عليها ($\aleph c$) بشرط ألا يتأثر العمودان الأول والأخير من الرسم التخطيطي الأصلي على الإطلاق، نظرًا لحاجتنا الفعلية إليهما في تمثيل الرسم التخطيطي لاحقًا. بالإضافة إلى ذلك، تم تنفيذ الآلية على شكل رسم بياني، كما تم إنشاء برنامج حاسوبي لحل المشكلة بشكل أسرع. ومن المتوقع أن يكون لتطبيق هذه التقنية إمكانات صناعية تهدف إلى تحسين الإنتاج من حيث الجودة والكمية.