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The effect of the 2nd path movement on the encoding of English letters in the framework of the Partition Theory

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ABSTRACT

With the increase interest in unconventional encoding methods, the need to study models that employ the kinematic dimension in letter formation. Partition Theory is one effective tool for representing letters within organized geometric structures. Among these models, the concept of "Path Two" stands out as a new approach to rethinking how letters are building visually and kinetically. This research aims to explore the effect of second-path motion on the encoding of English letters within the framework of partition theory. In this research, we will depend on a word consisting of two English letters, and the movement of the second path will be up to nine movements only, without the need to complete it to the end of the path because the movement will be similar to other movement but in the opposite direction. Each movement has its own rule. The movement of the second path of the two-letter word will make the word more ambiguous and difficult to read. and so, this research looks forward to contribute to the use of the second path in obfuscating the optical encoding of letters, which leads to giving the system an additional level of visual security or perceptual camouflage in coding systems.



Introduction

Since the advent of the e-Abacus diagram, this diagram was a good idea for G. James [3]. It took importance and study for a group of researchers, most notably the English M. Fayers. Several years later, Mahmood, A.S. represented the English letters with researcher Orank [5], [6]. After that, Mahmood, AS, with the researcher Shareef, R.J, the movement of the second, third paths and their effect on the encoding of English letters are studied within the framework of the partitioning theory with letters (5×5) by 7 movements [8]. Here we study the possibility of encoding a word consisting of two English letters in the theory of Partition, consisting of 5 rows and 10 columns, of the rank (5 x 10) with 9 movements. It is worth noting that the development of these models, although far from explicit statistical models, shares the need for precise analytical tools and methodologies based on prior information, as is the case with Lindley's method using prior information [10],[11]. This conceptual overlap opens the way for the employment of similar methods in various analytical fields, including partition theory and character encoding. This type of encoding enhances the theoretical understanding of the relationships between motor configurations and the symbolic structures of letters. It can also be a basis for expanding the scope of research in multiple fields such as visual encoding and non-traditional symbolic systems.

Aim of the study

This research aims to explore the effect of second-path motion on the encoding of English letters within the framework of partition theory.

Methodology

Partition

Let r be a positive integer. The partition $\mu = (\mu_1, \mu_2, \dots, \mu_n)$ for r is a sequence of given that $|\mu| = \sum_{j=1}^n \mu_j = r$ for each $j \geq 1$, $\mu_j \geq \mu_{j+1}$.

β -numbers

For any partition μ of r , for any positive integer number b greater or equal to the number of parts μ . The numbers of β are defined according to the following rule $\beta_i = \mu_i + b - i$ for $1 \leq i \leq b$. The set $\{\beta_1, \beta_2, \dots, \beta_b\}$ (β -numbers) of μ . [3],[7].

e-Abacus diagram

Let e be a positive integer such that $e \geq 2$. We can represent the β numbers in a diagram known as an e-abacus (Table 1). In this diagram, each β number is represented by a node (), while the rest are represented by a space () that occupies its position in (Table 1).

Table 1. e-Abacus diagram

Run.1	Run.2	...	Run. e
0	1	...	$e - 1$
e	$e + 1$	...	$2e - 1$
$2e$	$2e + 1$	...	$3e - 1$
$\vdots$	$\vdots$	$\vdots$	$\vdots$

Paths

The formula in [8] was used to determine the path shapes of each English letter, in this research only the state of the 2nd-path will be discussed.

Now if we had a two-letter word, would we try to encode on each letter separately or would we use the encoding on a two-letter word, [9][5]. It was necessary to develop a mechanism to encode the two-letter word based on the movement pattern of the tracks.

Act every path towards any word.

It is clear that there are three paths:

1. External path (1-Path): It is the first path that will remain unchanged. Allowing us to read the part before making any changes. [4]

2. Middle path (2-Path): It is the second path that takes the following locations:

$$\begin{array}{ccccccc} a_{22} & a_{23} & a_{24} & \cdots & a_{28} & a_{29} & \\ a_{32} & & & & & & a_{39} \\ a_{42} & a_{43} & a_{44} & \cdots & a_{48} & a_{49} & \end{array}$$

3. Internal Path (3-Path): It is the third and final path that will take the following locations:

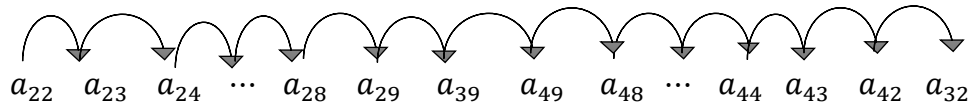
$$a_{33} \ a_{34} \ \cdots \ a_{38}$$

If we consider P_τ to represent the motion of the paths τ -Path where $\tau=1,2,3$, we get $[P_1; P_2; P_3]$ where:

$$P_1 = P_3 = 0 \text{ , } P_2 = 0,1, \dots, 9$$

$path_2 = 1$ for any two letters

In the case of a two-letter word, its movement will be according to design (1).



Design1. The movement when $P_2 = 1$

General rule (4.2.1):

When selecting a partition and any two-letter word, when $e = 10$ and the values of β_i are equal to the positions $a_{\eta\sigma}$ when $[0; P_2; 0] = [0; 1; 0]$ will be:

$$a_{\eta\sigma} \rightarrow \begin{cases} a_{\eta(\sigma+1)} & \text{if } \eta = 2 \text{ (or } 4) \wedge \sigma = 2, \dots, 8 \text{ (or } 3, \dots, 9) \text{ respectively,} \\ a_{(\eta+1)\sigma} & \text{if } \eta = 2, 3 \text{ (or } 3, 4) \wedge \sigma = 9 \text{ (or } 2) \text{ respectively.} \end{cases}$$

Results and discussion

The Proof:

Since $P_2 = 1$ so, the transition process takes place according to two different paths, each one of them is $P_2 = 1$ since it has opposite directions

The first path (conventional direction) will take

$$a_{2\sigma} \rightarrow a_{2(\sigma+1)} \quad \text{when } 2 \leq \sigma \leq 8$$

While the opposite direction of the same path will be

$$a_{4\sigma} \rightarrow a_{4(\sigma-1)}, \quad \text{when } 3 \leq \sigma \leq 9$$

The second path (conventional direction) will take

$$a_{\eta 9} \rightarrow a_{(\eta+1)9} \quad \text{when } \eta = 2, 3 \text{ respectively}$$

While the opposite direction of the second path will be

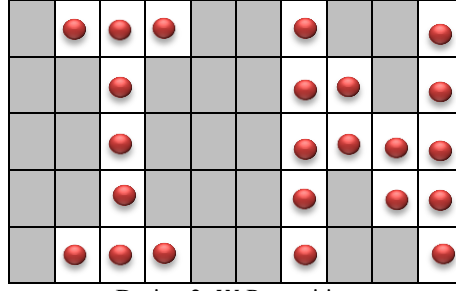
$$a_{\eta 2} \rightarrow a_{(\eta-1)2}, \quad \text{when } \eta = 3, 4 \text{ respectively} \blacksquare$$

Example: if design (2) Preposition IN

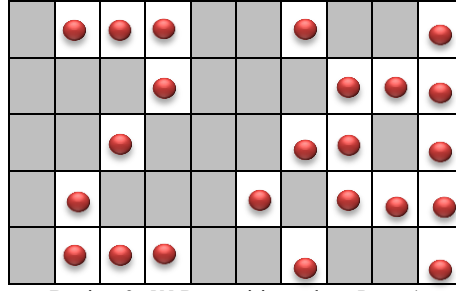
$$IN = (27, 25, 23^3, 22^2, 21, 18, 16^4, 13, 11, 10^2, 7, 5, 3, 1^3)$$

And we get design (3) when

$$IN^{[0;1;0]} = (27, 25, 23^3, 22^3, 21, 18, 17, 16^2, 13, 11^3, 8, 5, 3, 1^3)$$



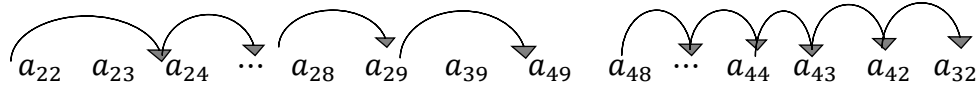
Design 2. IN Preposition



Design 3. IN Preposition when $P_2 = 1$

$path_2 = 2$ for any two letters

if the word is made up of two letters, its movement depends on the design (4).



Design 4. The movement when $P_2 = 1$

General rule (4.2.2)

Here, we select the partition and any two-letter word when $e = 10$ and the values of β_i are equal to the positions $a_{\eta\sigma}$ when $(0, P_2, 0)$ will be:

I. If $P_2 = 2$ So:

$$a_{\eta\sigma} \rightarrow \begin{cases} a_{\eta(\sigma \mp 2)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 2, \dots, 7 \text{ (or } 4, \dots, 9) \text{ respectively,} \\ a_{(\eta+1)(\sigma \mp 1)} & \text{If } \eta = 2 \text{ (or } 3) \wedge \sigma = 8 \text{ (or } 9) \text{ respectively,} \\ a_{(\eta-1)(\sigma \pm 1)} & \text{If } \eta = 4 \text{ (or } 3) \wedge \sigma = 3 \text{ (or } 2) \text{ respectively,} \\ a_{(\eta \mp 1)\sigma} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 9 \text{ (or } 2), \text{ respectively.} \end{cases}$$

II. If $P_2 = 3$ So:

$$a_{\eta\sigma} \rightarrow \begin{cases} a_{\eta(\sigma \mp 3)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 2, \dots, 6 \text{ (or } 5, \dots, 9) \text{ respectively,} \\ a_{(\eta+1)(\sigma \mp 2)} & \text{If } \eta = 2 \text{ (or } 3) \wedge \sigma = 7 \text{ (or } 9) \text{ respectively,} \\ a_{(\eta-1)(\sigma \pm 2)} & \text{If } \eta = 4 \text{ (or } 3) \wedge \sigma = 4 \text{ (or } 2) \text{ respectively,} \\ a_{(\eta \mp 2)(\sigma \mp 1)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 8 \text{ (or } 3) \text{ respectively,} \\ a_{(\eta \mp 2)(\sigma \pm 1)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 9 \text{ (or } 2) \text{ respectively.} \end{cases}$$

III. If $P_2 = 4$ So:

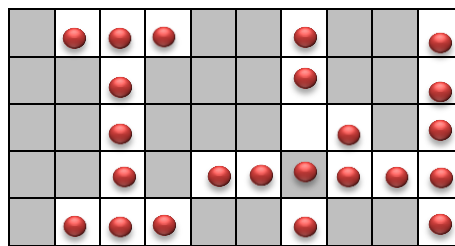
$$a_{\eta\sigma} \rightarrow \begin{cases} a_{\eta(\sigma\mp 4)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 2, \dots, 5 \text{ (or } 6, \dots, 9) \text{ respectively ,} \\ a_{(\eta+1)(\sigma\mp 3)} & \text{If } \eta = 2 \text{ (or } 3) \wedge \sigma = 6 \text{ (or } 9) \text{ respectively ,} \\ a_{(\eta-1)(\sigma\pm 3)} & \text{If } \eta = 4 \text{ (or } 3) \wedge \sigma = 5 \text{ (or } 2) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 2)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 7 \text{ (or } 4) \text{ respectively ,} \\ a_{(\eta\mp 2)\sigma} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 8 \text{ (or } 3) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 2)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 9 \text{ (or } 2) \text{ respectively .} \end{cases}$$

IV. If $P_2 = 5$ So:

$$a_{\eta\sigma} \rightarrow \begin{cases} a_{\eta(\sigma\mp 5)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 2, 3, 4 \text{ (or } 7, 8, 9) \text{ respectively ,} \\ a_{(\eta+1)(\sigma\mp 4)} & \text{If } \eta = 2 \text{ (or } 3) \wedge \sigma = 5 \text{ (or } 9) \text{ respectively ,} \\ a_{(\eta-1)(\sigma\pm 4)} & \text{If } \eta = 4 \text{ (or } 3) \wedge \sigma = 6 \text{ (or } 2) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 3)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 6 \text{ (or } 5) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 1)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 7 \text{ (or } 4) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 1)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 8 \text{ (or } 3) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 3)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 9 \text{ (or } 2) \text{ respectively .} \end{cases}$$

For example, the preposition design (5)

$$IN^{[0;4;0]} = (27, 25, 23^3, 22^2, 21^2, 20, 17^4, 14, 12, 9, 6, 5, 3, 1^3)$$



design (5) Preposition IN when $P_2 = 4$

V. If $P_2 = 6$ So:

$$a_{\eta\sigma} \rightarrow \begin{cases} a_{\eta(\sigma\mp 6)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 2, 3, \text{ (or } 8, 9) \text{ respectively ,} \\ a_{(\eta+1)(\sigma\mp 5)} & \text{If } \eta = 2 \text{ (or } 3) \wedge \sigma = 4 \text{ (or } 9) \text{ respectively ,} \\ a_{(\eta-1)(\sigma\pm 5)} & \text{If } \eta = 4 \text{ (or } 3) \wedge \sigma = 7 \text{ (or } 2) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 4)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 5 \text{ (or } 6) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 2)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 6 \text{ (or } 5) \text{ respectively ,} \\ a_{(\eta\mp 2)\sigma} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 7 \text{ (or } 4) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 2)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 8 \text{ (or } 3) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 4)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 9 \text{ (or } 2) \text{ respectively .} \end{cases}$$

VI. If $P_2 = 7$ So:

$$a_{\eta\sigma} \rightarrow \begin{cases} a_{\eta(\sigma\mp 7)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 2 \text{ (or } 9) \text{ respectively ,} \\ a_{(\eta+1)(\sigma\mp 6)} & \text{If } \eta = 2 \text{ (or } 3) \wedge \sigma = 3 \text{ (or } 9) \text{ respectively ,} \\ a_{(\eta-1)(\sigma\pm 6)} & \text{If } \eta = 4 \text{ (or } 3) \wedge \sigma = 8 \text{ (or } 2) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 5)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 4 \text{ (or } 7) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 3)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 5 \text{ (or } 6) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\mp 1)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 6 \text{ (or } 5) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 1)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 7 \text{ (or } 4) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 3)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 8 \text{ (or } 3) \text{ respectively ,} \\ a_{(\eta\mp 2)(\sigma\pm 5)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 9 \text{ (or } 2) \text{ respectively .} \end{cases}$$

VII. If $P_2 = 8$ So:

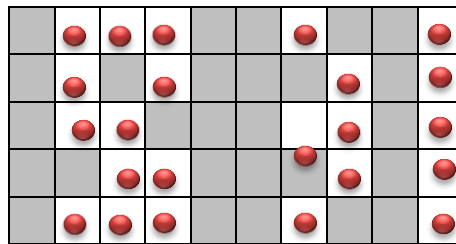
$$a_{\eta\sigma} \rightarrow \begin{cases} a_{(\eta\pm 1)(\sigma+7)} & \text{If } \eta = 2(\text{or } 3) \wedge \sigma = 2 \text{ respectively ,} \\ a_{(\eta\pm 2)(\sigma+6)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 3 \text{ (or } 2)\text{respectively ,} \\ a_{(\eta\pm 2)(\sigma+4)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 4 \text{ (or } 3)\text{respectively ,} \\ a_{(\eta\pm 2)(\sigma+2)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 5 \text{ (or } 4)\text{respectively ,} \\ a_{(\eta\pm 2)\sigma} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 6 \text{ (or } 5)\text{respectively ,} \\ a_{(\eta\pm 2)(\sigma-2)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 7 \text{ (or } 6)\text{respectively ,} \\ a_{(\eta\pm 2)(\sigma-4)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 8 \text{ (or } 7)\text{respectively ,} \\ a_{(\eta\pm 2)(\sigma-6)} & \text{If } \eta = 2 \text{ (or } 4) \wedge \sigma = 9 \text{ (or } 8)\text{respectively ,} \\ a_{(\eta\pm 1)(\sigma-7)} & \text{If } \eta = 3 \text{ (or } 4) \wedge \sigma = 9\text{respectively .} \end{cases}$$

VIII. If $P_2 = 9$ So:

$$a_{\eta\sigma} \rightarrow \begin{cases} a_{(\eta+2)(\sigma\pm 7)} & \text{If } \eta = 2 \wedge \sigma = 2(\text{or } 9) \text{ respectively ,} \\ a_{(\eta+2)(\sigma\pm 5)} & \text{If } \eta = 2 \wedge \sigma = 3 \text{ (or } 8)\text{respectively ,} \\ a_{(\eta+2)(\sigma\pm 3)} & \text{If } \eta = 2 \wedge \sigma = 4 \text{ (or } 7)\text{respectively ,} \\ a_{(\eta+2)(\sigma\pm 1)} & \text{If } \eta = 2 \wedge \sigma = 5 \text{ (or } 6)\text{respectively ,} \\ a_{\eta(\sigma\mp 7)} & \text{If } \eta = 3 \wedge \sigma = 9(\text{or } 2)\text{respectively ,} \\ a_{(\eta-2)(\sigma\pm 7)} & \text{If } \eta = 4 \wedge \sigma = 2 \text{ (or } 9)\text{respectively ,} \\ a_{(\eta-2)(\sigma\pm 5)} & \text{If } \eta = 4 \wedge \sigma = 3 \text{ (or } 8)\text{respectively ,} \\ a_{(\eta-2)(\sigma\pm 3)} & \text{If } \eta = 4 \wedge \sigma = 4 \text{ (or } 7)\text{respectively ,} \\ a_{(\eta-2)(\sigma\pm 1)} & \text{If } \eta = 4 \wedge \sigma = 5 \text{ (or } 6)\text{respectively .} \end{cases}$$

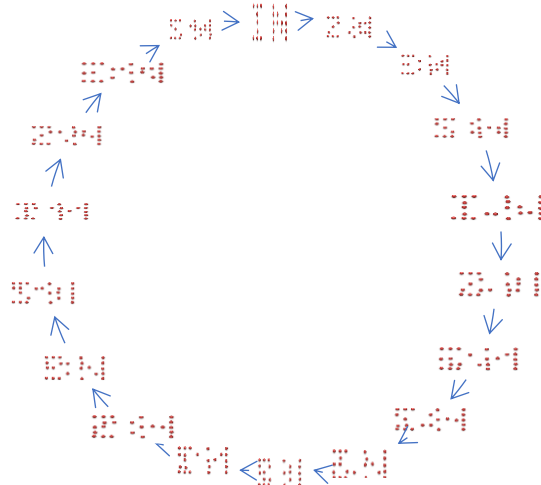
An example of this is the preposition of design (6)

$$IN^{[0;9;0]} = (27, 25, 23^3, 22^2, 19^2, 18, 17, 16^2, 13^2, 12, 10, 7, 5, 3, 1^3)$$



Design 6. Preposition IN when $P_2 = 9$

This diagram illustrates the changes that result from the movement of the second track of the preposition IN from $P_2 = 0$ until $P_2 = 17$



Conclusions

This method can be used with the characters of other languages even if these languages do not use the same characters as this method. The mentioned method can be used with Tiling where the colors and shapes are different.

References

- [1] George E. Andrews, and Kimmo Eriksson, Integer Partition, Cambridge University Press,UK,2004.
- [2] George E. Andrews, Partition identities, Advances in math.,(1972), 10-51.
- [3] James, G.D (1978) Some Combinatorial Results Involving Young Diagrams. Mathematical Proceedings of the Cambridge Philosophical Society, Vol.83,1-10.
- [4] Mahmood, A.B. and Mahmood, A.S. (2019) Secret-Text by e-Abacus Diagram II. Iraqi Journal of Science, 60,840-864
- [5] Mahmood, A.B. and Mahmood, A.S. (2019) Secret-Word by e-Abacus Diagram I. Iraqi Journal of Science, 60,638-646.
- [6] Mahmood, A.S. (2011) On the Intersection of Young's Diagrams Core. Journal of Education Science, 24, 149-157.
- [7] Mathas, A. (1999) Iwahori-Hecke Algebras and Schur Algebras of the Symmetric Group. . University Lecture Series, Vol. 15.
- [8] Shareef, R.J. and Mahmood, A.S. (2019) The Movement of Orbits and Effect on the on the Encoding of the letters in Partition Theory. Open Access Library Journal, 6, 1-7.
- [9] Shareef, R.J. and Mahmood, A.S. (2020) The Movement of Orbits and Effect on the on the Encoding of the letters in Partition TheoryII. Open Access Library Journal, 7, 1-7.
- [10] Hussain, E.A. (2021) Lindely's method to estimate the parameters of the univariate truncated t Regression Model using informative prior information. NTU Journal of Pure Sciences Vol.1 No.1 P (44-54).
- [11] Hussain, E.A. Ahmad, N.S. and Saied, H.A. (2022) Using Maximum Likelihood Method to Estimate Parameters of the Linear Regression T Truncated Model. NTU Journal of Pure Sciences Vol.1 No.4 P(26-34).