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№ 8690

A Combinatorical Analysis in Representation of Single Decimal Sybmol with Its Structures.

Frank Appiah

August 21, 2022

A COMBINATORICAL ANALYSIS IN REPRESENTATION OF SINGLE DECIMAL SYBMOL WITH ITS STRUCTURES.

FRANK APPIAH[1].

appiahnsiahfrank@gmail.com.

Extended Abstract⁺. This teaches single decimal symbols from 0 to 9 and its representation in graphical ways. A universal set of numbers are generated from the graph representation with the concept of diagonalization sums[5]. In this means, there are three different ways of counting the representation of 1 to 9 in a graphic depiction as illustrated. Enumeration of numbers are generated in this work. Operational principles from arithmetic fields including addition, multiplication, division and subtraction are applied to the enumeration of numbers. New numbers are created from the operational principles.

Keywords. graph theory; decimal symbols; graph representation; sets; combinatorics; analysis.

Year of Research: 2020 **Year of Publication: 2020**

1 *AFFILIATE. TAKORADI TECHNICAL UNIVERSITY, SECONKDI-TAKORADI, WESTERN REGION, GHANA .

1 INTRODUCTION

Number is a digit from 0 to 9 and its different series representation with order or repeation. A number is a mathematical concept. There is only one number thirteen, yet the number thirteen can be represented in many different ways. The resultant is no

[1] This person is a fellow member staff of King's College London, Department of Computer Science, 2020.

other way affected in the mathematical operation of yielding. Adding nine and four gives the result thirteen regardless of representation used for four, nine and thirteen. The arithmetic effort in computing the resultant is a profound impact needed to change the representation. As a matter of fact, the representation of furthermore yielding of thirteen will need algorithms to see that happen.

It is shown also how to have a Roman Numeral representation of 13. This is an algorithm and it is needed in having a representation of number thirteen in less effort than an arithmetic fields of operation namely addition, multiplication, subtraction and division. Roman numeral representation is simple than arithmetical representations. The much conventional decimal representation will require an algorithm of concatenation of both one(1) and three(3) to yeild thirteen(13). The representation of numbers by their logarithm would likely be efficient than their field yeilds. Addition and substraction is less difficult and common than multiplication and division. Scientific notations are important in the representation of large or extremely large numbers. This is done in magnitude for the graceful handling. In building an efficient means to representation the number thirteen we have the following:

Figure 1: 13 Representations

For the purpose of computer, Arithmetic Logic Unit will perform the operation of basic arithmetic representation simply with less effort. In string representation in computer can just be viewing the list of various representation as shown above and may be quering the category or type of representation. This number 13 is primitively explained from the visual representation as shown below in Figure 2.

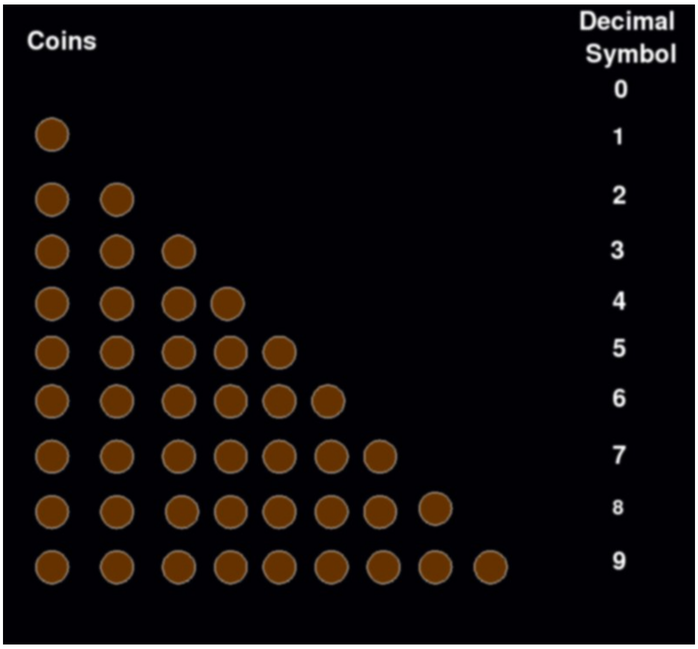

Figure 2: (0-9) Visual Number Representation

Several dot of coins are drawn to represent each digit from zero(0) to nine(9). The existence of a dot represents a number except zero. There is no dot of coin for a zero(0) number. Each count of dot coins is a number in both decimal and binary format or symbol. This is a visual number notation in number representation. The arrangement forms a triangular shape of dot of coins.

2 GRAPH REPRESENTATION

Thirteen is a number deduced from the digit representation os 0 to 9 digit representation in visual form. This deduction is made graphical with series of drawings. First is the division of representation into 5 parts. Depicted as shown below in Figure 3:

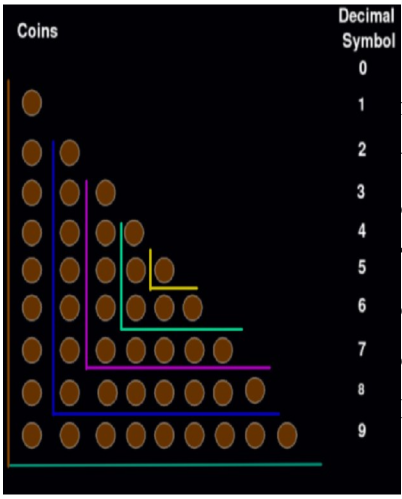

Figure 3: Division Representation

The parts are color coded as lightblue from far-left vertical, then yellow vertical, then green vertical division, violet vertical division and finally blue vertical division. The next step is to count(C) the number of dotcoins in both vertical and horizontal divisions.

Depictedly as shown below in Figure 4:

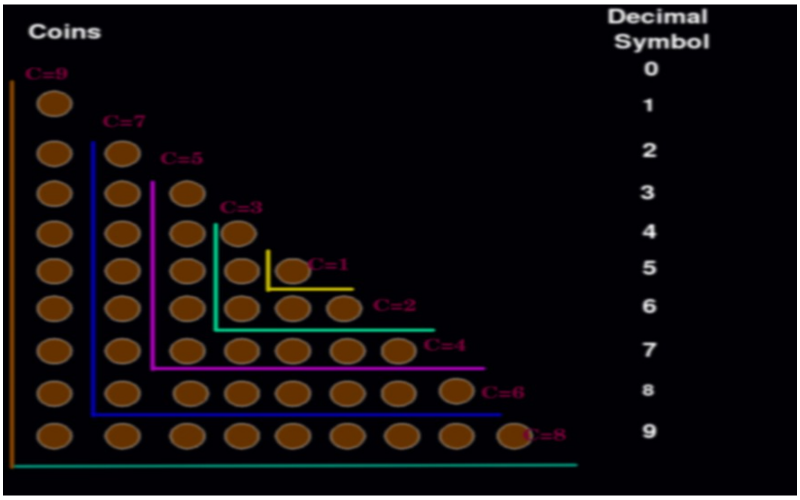

Figure 4: 5-Division Representation Counts

The total count for each vertical and horizontal divisions are shown pictorially below:

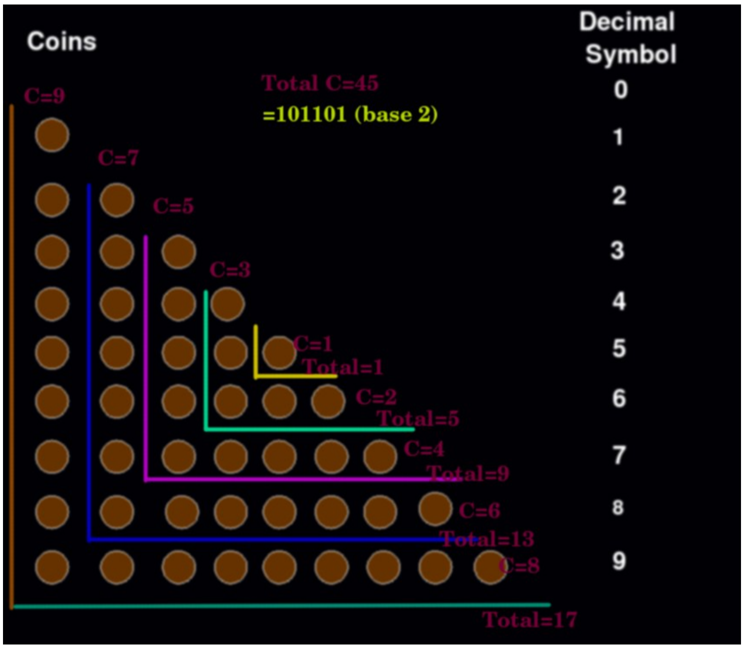

Figure 5: 5-Division Representation Total Counts

There are five total vert-horiz divisions : total=17, total=13, total=9, total=5 and total=1. The universal set of dotcoins= {1, 5, 9, 13, 17}. Subsets of dotcoins will be:

2 Members: {1,5}, {1,9}, {1, 13}, {1,17}.

3 Members:{1,5,9}, {1,5,13}, {1,5,17}, {5,9,13}, {5,13,17}, {9,13,17}

4 Members:{1,5,9,13}, {1,9,13,17}

5 Members:{1,5,9,13,17}.

The member set is a group of data sets for the 5-division representation. The set is ordered and the reverse is still a dataset for 5-division representation if each set created has a member in the 5 member set.

The total vertical or horizontal number representation is

$$\begin{aligned}&=9+8+7+6+5+4+3+2+1+0\\&=30+12+3\\&=45.\end{aligned}$$.------(1)

The total C is

$$\begin{aligned}&=17+13+9+5+1\\&=30+10+5\\&=45.\end{aligned}$$.-------------------------(2)

(1) and (2) applies the addition principle of combinatorics.

Considering the factorization of 45 gives the following formulae:

max n	**Formula**
9	5n
8	4n + 4
7	6n + 3
6	7n + 3
5	9n
4	11n + 1
3	15n
2	20n + 5
1	45n

4 NUMBER ENUMERATION and PRINCIPLES.

With the given table of formulae, it is possible to generate new numbers from the decimal symbols (0 to 9). Each formula will be used to create a different set of numbers. From the numbers created, arithmetic principles of addition, multiplication, substraction and division are applied in the enumeration of numbers.

Formula 1. $45n = 45xn$

n	***45n***
0	0
1	45
2	90
3	135
4	180
5	225
6	270
7	315
8	360
9	405

For n=0, Result(R)= 0*45=0. For n=1, R=1*45=45.

For n=2, R=2*45=90. For n=3, R=3*45=135.

For n=4, R=4*45=180. For n=5, R=5*45=225.

For n=6, R=6*45=270. For n=7, R=7*45=315.

For n=8, R=8*45=360. For n=9, R=9*45=405.

PRINCIPLE 1.

Addition: 0 + 45 + 90 + 135 + 180 + 225 + 270 + 315 + 360 + 405=2025
Substraction: 0 - 45 - 90 - 135 - 180 - 225 - 270 - 315 - 360 – 405= -2025
Multiplication: 0 * 45 * 90 * 135 * 180 * 225 * 270 * 315 * 360 * 405= 0
Division: 0 / 45 / 90 / 135 / 180 / 225 / 270 / 315 / 360 / 405= 0.

Formula 2. $20n+5=20xn+5$

n	20n+5
0	5
1	25
2	45
3	65
4	85
5	105
6	125
7	145
8	165
9	185

For n=0, Result(R)= 20(0)+5=5. For n=1, R=20(1)*5=25. For n=2, R=20(2)+5=45.

For n=3, R=20(3)+5=65. For n=4, R=20(4)+5=85. For n=5, R=20(5)+5=105.

For n=6, R=20(6)+5=125. For n=7, R=20(7)+5=145. For n=8, R=20(8)+5=165.

For n=9, R=20(9)+5=185.

PRINCIPLE 2.

Addition: 5 + 25 + 45 + 65 + 85 + 105 + 125 + 145 + 165 + 185= 950
Substraction: 5 - 25 - 45 - 65 - 85 - 105 - 125 - 145 - 165 – 185= -945
Multiplication: 5 * 25 * 45 * 65 * 85 * 105 * 125 * 145 * 165 *185=18054181164455078125
Division: 5 / 25 / 45 / 65 / 85 / 105 / 125 / 145 / 165 / 185= 0

Formula 3. $15n=15xn$

n	*15n*
0	0
1	15
2	30
3	45
4	60

n	*15n*
5	75
6	80
7	105
8	120
9	135

For n=0, Result(R)= 0*15=0. For n=1, R=1*15=15.

For n=2, R=2*15=30. For n=3, R=3*15=45.

For n=4, R=4*15=60. For n=5, R=5*15=75.

For n=6, R=6*15= 80. For n=7, R=7*15=105.

For n=8, R=8*15=120. For n=9, R=9*15=135.

PRINCIPLE 3.

Addition: 0 + 15 + 30 + 45 + 60 + 75 + 80 + 105 + 120 +135 = 665
Substraction: 0 - 15 - 30 - 45 - 60 - 75 - 80 - 105 - 120 – 135= -665
Multiplication: 0 * 15 * 30 * 45 * 60 * 75 * 80 * 105 * 120 *135= 0
Division: 0 / 15 / 30 / 45 / 60 / 75 / 80 / 105 / 120 / 135 = 0

Formula 4. $11n+1=11xn+1$

n	*11n+1*
0	1
1	12
2	23
3	34
4	45
5	56
6	67
7	78

n	*11n+1*
8	89
9	100

For n=0, Result(R)= 11(0)+1=1. For n=1, R=11(1)+1=12. For n=2, R=11(2)+1=23.

For n=3, R=11(3)+1=34. For n=4, R=11(4)+1=45. For n=5, R=11(5)+1=56.

For n=6, R=11(6)+1=67. For n=7, R=11(7)+1=78. For n=8, R=11(8)+1=89.

For n=9, R=11(9)+1=100.

PRINCIPLE 4.

Addition: 1 + 12 + 23 + 34 + 45 + 56 + 67 + 78 + 89 + 100= 505
Substraction: 1 - 12 - 23 - 34 - 45 - 56 - 67 - 78 - 89 - 100= -504
Multiplication:1 * 12 * 23 * 34 * 45 * 56 * 67 * 78 * 89 * 100= 1099886703552000
Division: 1 / 12 / 23 / 34 / 45 / 56 / 67 / 78 / 89 / 100 = 0

Formula 5. 9n=9xn

n	*9n*
0	0
1	9
2	18
3	27
4	36
5	45
6	54
7	63
8	72
9	81

For n=0, Result(R)= 0*9=0. For n=1, R=1*9=9.

For n=2, R=2*9=18. For n=3, R=3*9=27.

For n=4, R=4*9=36. For n=5, R=5*9=45.

For n=6, R=6*9=54. For n=7, R=7*9=63.

For n=8, R=8*9=72. For n=9, R=9*9=81.

PRINCIPLE 5.

Addition: 0 + 9 + 18 + 27 + 36 + 45 + 54 + 63 + 72 + 81 = 405
Substraction: 0 - 9 - 18 - 27 - 36 - 45 - 54 - 63 - 72 - 81 = -405
Multiplication:0 * 9 * 18 * 27 * 36 * 45 * 54 * 63 * 72 * 81 = 0
Division: 0 / 9 / 18 / 27 / 36 / 45 / 54 / 63 / 72 / 81 = 0

Formula 6. $7n+3=7xn+3$

n	**7n+3**
0	**3**
1	**10**
2	**17**
3	**24**
4	**31**
5	**38**
6	**45**
7	**52**
8	**59**
9	**66**

For n=0, Result(R)= 7(0)+3=3 For n=1, R=7(1)+3=10. For n=2, R=7(2)+3=17.

For n=3, R=7(3)+3=24. For n=4, R=7(4)+3=31. For n=5, R=7(5)+3=38.

For n=6, R=7(6)+3=45. For n=7, R=7(7)+3=52. For n=8, R=7(8)+3=59.

For n=9, R=7(9)+3=66.

PRINCIPLE 6.

Addition: 3 + 10 + 17 + 24 + 31 + 38 + 45 + 52 + 59 + 66 = 345
Substraction: 3 - 10 - 17 - 24 - 31 - 38 - 45 - 52 - 59 – 66= -342
Multiplication: 3 * 10 * 17 * 24 * 31 * 38 * 45 * 52 * 59 * 66=131382799891200
Division: 3 / 10 / 17 / 24 / 31 / 38 / 45 / 52 / 59 / 66 = 0.

Formula 7. $6n+3=6*n+3$

n	6n+3
0	**3**
1	**9**
2	**15**
3	**21**
4	**27**
5	**33**
6	**39**
7	**45**
8	**51**
9	**57**

For n=0, Result(R)= 6(0)+3=3. For n=1, R=6(1)+3=9. For n=2, R=6(2)+3=15.

For n=3, R=6(3)+3=21. For n=4, R=6(4)+3=27. For n=5, R=6(5)+3=33.

For n=6, R=6(6)+3=39. For n=7, R=6(7)+3=45. For n=8, R=6(8)+3=51.

For n=9, R=6(9)+3=57.

PRINCIPLE 7.

Addition: 3 + 9 + 15 + 21 + 27 + 33 + 39 + 45 + 51 + 57 = 300
Substraction: 3 - 9 - 15 - 21 - 27 - 33 - 39 - 45 - 51 - 57 = -297
Multiplication: 3 + 9 + 15 + 21 + 27 + 33 + 39 + 45 + 51 + 57 = 38661097149675
Division: 3 / 9 / 15 / 21 / 27 / 33 / 39 / 45 / 51 / 57 = 0.

Formula 8. $4n+4=4*n+4$

n	4n+4
0	**4**
1	**8**
2	**10**
3	**16**
4	**20**

n	4n+4
5	24
6	28
7	32
8	36
9	40

For n=0, Result(R)= 4(0)+4=4. For n=1, R=4(1)+4=8. For n=2, R=4(2)+4=10.

For n=3, R=4(3)+4=16. For n=4, R=4(4)+4=20. For n=5, R=4(5)+4=24.

For n=6, R=4(6)+4=28. For n=7, R=4(7)+4=32. For n=8, R=4(8)+4=36.

For n=9, R=4(9)+4=40.

PRINCIPLE 8.

Addition: 4+8+10+16+20+24+28+32+36+40= 218
Substraction: 4-8-10-16-20-24-28-32-36-40 = -214
Multiplication: 4*8*10*16*20*24*28*32*36*40 = 3170893824000
Division: 4/8/10/16/20/24/28/32/36/40 = 0.

Formula 9. $5\text{n} = 5 * n$

n	5n
0	0
1	5
2	10
3	15
4	20
5	25
6	30
7	35
8	40
9	45

For n=0, Result(R)= 0*5=0. For n=1, R=1*5=5.

For n=2, R=2*5=10. For n=3, R=3*5=15.

For n=4, R=4*5=20. For n=5, R=5*5=25.

For n=6, R=6*5=30. For n=7, R=7*5=35.

For n=8, R=8*5=40. For n=9, R=9*5=45.

PRINCIPLE 9.

Addition: 0 + 5 + 10 + 15 + 20 + 25 + 30 + 35 + 40 + 45 = 225
Substraction: 0 - 5 - 10 - 15 - 20 - 25 - 30 - 35 - 40 - 45 = -225
Multiplication: 0 * 5 * 10 * 15 * 20 * 25 * 30 * 35 * 40 * 45 = 0
Division: 0 / 5 / 10 / 15 / 20 / 25 / 30 / 35 / 40 / 45 = 0.

5 CONCLUSION

The visual representation completed the vertical and horizontal division of counts. This is a combinatorics[4] solution with focus on arithmetic principles of operation with enumeration numbers. From the four principles of operational arithmetic, this work could generate about 36 different numbers from the enumeration of numbers.

Appiah number sequence(ANS) is now : *-2025, -945, -665, -504, -405, -342, -297, -225 , -214*, *0, 1, 3, 4, 5, 8, 9,* ***10****, 12, 15, 16, 17, 18,* **20***, 21, 23, 24, 25,* **27***, 28, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40, 45, 51, 52, 54, 56, 57, 59, 60, 63, 65, 66, 67, 72, 75, 78, 81, 85, 89, 90, 100, 105, 120, 125, 135, 145, 165, 180, 185, 218, 225, 270, 300, 315, 345, 360, 405, 505, 665, 950, 2025, 1099886703552000, 131382799891200, 3170893824000, 38661097149675.*

The enumeration of size for ANS is *82*. *Appiah Missing Sequence(AMS)* is a sequence of number missing in 10-count of numbers in the sequence. AMS is now: *2, 6, 7, 11, 13, 14, 19, 22, 26, 29, 37,.. and more.* There were three missing numbers(*2,6,7*) in the first 10-count numbers. Then four missing numbers(*11, 13, 14, 19*) in the second 10-count numbers. The three missing numbers in the third 10-

count numbers are (*22, 26, 29*). The ways of generating countable integers is given by a generating function.

The generating function for first 10-count missing numbers is given by:

$$1 + x^2 + x^6 + x^7 \ .$$

There are spectrum of different applications in subject of computer sicence and engineering.These number sequences can be used in cryptography[1] as a hash function generator[2]. It can also be used in distributed systems[3] in sense of parallel computer performance setup. Numbers can be referring to a parallel computer in a distributed system. This is similar to cluster numbering in computing. The maximum number does not necessary means a total computer count of *38661097149675* but just a machine identifier.

Compliance with Ethical Standards

(In case of funding) Funding: This research is funded by Ministry of Information under grant and centred at Data Organization and Storage Research. This information is programmed in C++ and the project is dubbed Offline Data Organization and Storage (ODOS): Reduced Data Set Computer (RDSC).

Conflict of Interest:

Author, Dr. Frank Appiah declares that he has no conflict of interest.

REFERENCES

1. Stallings W. (1999), Cryptography and Network Security: Principles and Practice, Prentice Hall. 2nd Edition.
2. Pfleeger Charles P. and Pfleeger Shari L.(2003), Security in Computing. Prentice Hall.
3. Coulouris G., Dollimore J. and Kindberg T. (2005). Distributed System. Addison Wesley. Fourth Edition.
4. Alan Tucker, Applied Combinatorics, Wiley, Six Edition.
5. Frank Appah, Appiah Diagonalization Method, Registrar Department of Ghana, 2016.