

Mathematical Beauty of 2022

Inder J. Taneja¹

W E L C O M E - 2022
Beauty of Numbers - 2022

Single Digit Day:
February 22, 22: 22.2.22

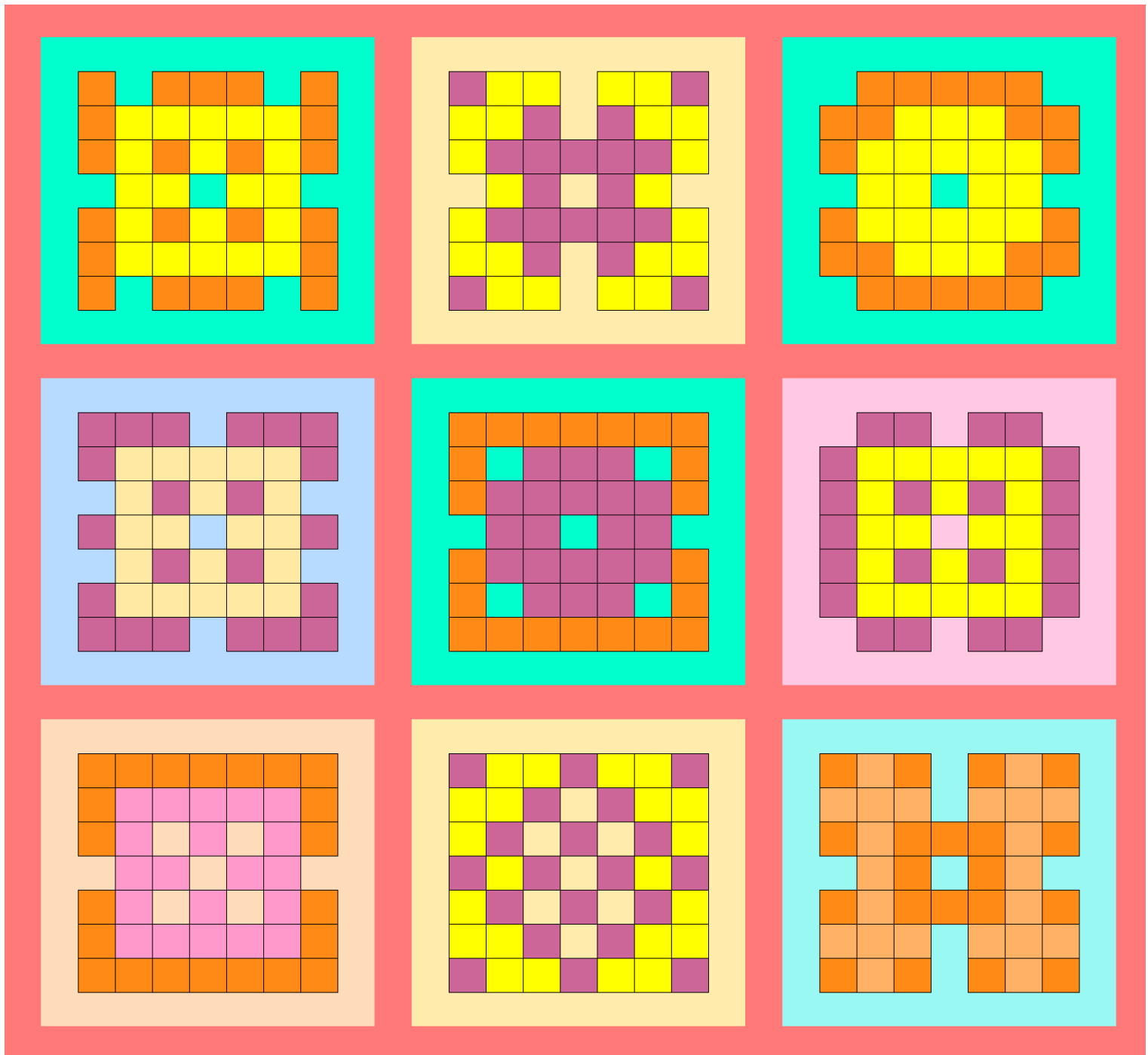
Single Digit Day With Time:
22h, 22m, 22s, February 22, 22:
22.22.22.22.2.22 or 222222222222

□ **Upside-Down Magic Square of Order 4 with 22 and 2022** □

		4444	4444	4444	4444	
	0220	2022	0000	2202	4444	
4444	0002	2200	0222	2020	4444	
4444	2222	0020	2002	0200	4444	
4444	2000	0202	2220	0022	4444	
	4444	4444	4444	4444	4444	

¹Formerly, Professor of Mathematics, Federal University of Santa Catarina, Florianópolis, SC, Brazil (1978-2012).
E-mail: ijtaneja@gmail.com;
Web-sites: <https://inderjtaneja.com>; <https://numbers-magic.com>;
Twitter: @IJTANEJA; **Instagram:** @crazynumbers.

★ **Nine Colored Patterns With 20-22 On a Board of 7×7** ★



◆ **Upside-Down and Mirror Looking With 0, 1 and 8 Summing 2022** ◆

$$8+|+|+|00|+|00|+|+|+8$$

$$|+|+8|+|8+88+8|8+8+8|8+88+8|+|8+|+|$$

Abstract

This work brings representations of 2022 in different ways. These representations are of crazy-type, running numbers, single digit, single letter, Triangular, Fibonacci, palindromic-type, prime numbers, embedded, repeated digits, colored patterns, magic squares, etc. Interesting, this year there will be a day with 11 times repetition of single digit. It will happens on: 22h, 22m, 22s, February 22, 22, i.e., 22.22.22.22.2.22.

Contents

1 Crazy Representations	6
1.1 Basic Operations	6
1.2 Factorial and Square-Root	6
1.3 1 to 10 Numbers: Increasing and Decreasing	6
1.4 Pyramid-Type	7
1.5 Block of 10 Starting With 2022: Increasing and Decreasing	7
2 Single Digit Representations	8
2.1 Single Digit	8
2.2 Patterns in Single Digit	8
3 Single Letter Representations	10
3.1 Patterns in Single Letter	11
4 Running Equality Expressions	12
5 Selfie Representations	12
5.1 Digit's Order and Reverse Order of Digits	12
5.2 Numbers With 2022: Digit's Order	12
6 Semi-Selfie Expressions	13
6.1 Semi-Selfies With 22	13
7 Same Digits Power and Bases: Flexible Power	14
7.1 Pyramid-Type Representations of 22 and 2022	14
7.2 Block Representations With 2022	14

8 Narcissistic-Type Representations	15
9 Selfie Fractions	16
9.1 Patterns in Selfie Fractions	19
10 Same Digits Equality Expressions	20
10.1 Powers and Sums	20
10.2 Factorial-Powers	20
10.3 Multiplication	21
11 Power Representations	23
11.1 Powers 2, 3 and 4	23
11.2 Powers of 2	24
12 Numbers From 1 to 100 in Terms of Digits of 2022	24
12.1 Numbers From 1 to 100 in Terms of Digits of 20222022	24
12.2 Numbers From 1 to 100 in Terms of Digits of 20222202	26
13 Palindromic Days and Time	27
13.1 Palindromic Days	27
13.2 Single Digit Day	27
13.3 Palindromic Times	28
14 Upside Down and Mirror Looking	29
14.1 Upside Down	29
14.2 Upside Down and Mirror Looking	29
15 Pythagorean Triples and Patterns	30
15.1 Pythagorean Triples	30
15.2 Patterns in Pythagorean Triples	30
15.3 Pandigital Type Patterns With 22 and 2022	31
15.4 More Pythagorean Triples With 2022	34
15.5 Magic Squares Generated by Pythagorean Triple	34
15.6 Magic Squares	34
15.6.1 Magic Square of Order 3×3	35
16 Fibonacci and Triangular Type Representations	35
16.1 Fibonacci Sequences	35
16.1.1 Blocks of 10 With 2022	35
16.2 Triangular Number	36
16.2.1 Blocks of 10 With 2022	36

17 Fixed Digits Repetitions Prime Patterns	37
17.1 Repetitions With 2022	37
17.1.1 Length 6	37
17.1.2 Length 7	38
17.2 Prime Numbers With 22 and 2022	38
17.2.1 Length 8	38
17.2.2 Length 7	40
18 Embedded Prime Numbers Patterns	46
18.1 Palindromic Prime Numbers Embedded With 2022	46
18.2 Non Palindromic Prime Numbers Embedded With 2022	47
19 Magic Square Type Embedded Palprimes	49
19.1 Magic Square Type Properties	50
19.2 Magic Square Type Palprimes With Embedded Properties	51
20 Palindromic-Type Expressions and Patterns	51
20.1 Reverse Square	51
20.2 Palindromic-Type Square Expressions	52
20.3 Palindromic-Type Expressions	53
20.4 Palindromic-Type Patterns	54
21 Magic Squares	56
21.1 Upside-Down Two Digits Magic Square With 22 and 2022	56
21.2 Bordered and Block-Bordered Magic Square of Order 11 With Magic Sum 22	57
21.2.1 First Type: Bordered Magic Square of Order 11 With Magic Sum 22	57
21.2.2 Second Type: Block-Bordered Magic Square of Order 11 With Magic Sum 22	58
21.3 Magic Squares of Order 12 With Magic Sum 2022	58
21.3.1 First Type: Blocks of Order 3	59
21.3.2 Second Type: Blocks of Order 4	60
21.3.3 Third Type: Blocks of Order 6	61
21.4 Bordered and Block-Bordered Magic Squares of Order 12	62
21.4.1 First Type: Bordered Magic Square	62
21.4.2 Second Type: Block Bordered Magic Square	63
22 2022 In Magic Squares of Order 4	64
23 Colored Pattern Designs With 20-22	66
23.1 Colored Patterns With 20-22 On a Board of 7×7	66
23.2 Colored Patterns With 20-22 On a Board of 9×9	76
24 References	78

1 Crazy Representations

Below are representations of 2022 in terms of 1 to 9 and 9 to 1. These are with **basic operations** alongwith **factorial, square-root, Fibonacci sequence, Triangular numbers**, etc

1.1 Basic Operations

$$\begin{aligned}2022 &:= -(1+2) + 3^4 \times (-5+6+7+8+9) \\ &:= -1 \times 2 + (3+4 \times 5) \times (6-7+89) \\ &:= 1234 + 5 - 6 + 789\end{aligned}$$

$$\begin{aligned}2022 &:= (9+8 \times (7 \times 6 - 5 + 4)) \times (3+2+1) \\ &:= -9 + 87 + 6^5 / 4 \times 3 / (2+1) \\ &:= 9 - 8 - 7 + 6 \times (-5 + (4+3)^{2+1}) \\ &:= 9 - 876 + (5+4) \times 321\end{aligned}$$

1.2 Factorial and Square-Root

$$2022 := (1+2) \times (3!!+4) - 5 \times (6+7+8+9)$$

$$\begin{aligned}2022 &:= (9-8+7!/(6+5+4)) \times (3+2+1) \\ &:= \sqrt{9} \times (-8+7+6!) + 5 \times (4-32+1)\end{aligned}$$

1.3 1 to 10 Numbers: Increasing and Decreasing

$$\begin{aligned}2022 &:= 10 + (9 \times 8 \times 7 - 6 + 5) \times (4 + 3 - 2 - 1) \\ &:= 1 \times 2 \times (-3 + 4^5) - 6 - 7 - 8 - 9 + 10\end{aligned}$$

1.4 Pyramid-Type

$$\begin{aligned} \mathbf{2022} &:= -1 - 2 + 3 \times (-45 + 6!) = (6!/5!)^4 + 3! + (2 + 1)!! \\ &:= 1 + 2 + 3 - 4! \times (5! + 6) + 7! = 7! - (6 + 5!) \times 4! + 3 + 2 + 1 \\ &:= 1 - 2^{3!} \times 4! + 5 \times (6! - 7) - 8 = 8 + 7! - 6!/5 - 4 \times 3!! - 2 \times 1 \end{aligned}$$

1.5 Block of 10 Starting With 2022: Increasing and Decreasing

$$\begin{aligned} \mathbf{20220} &:= -1 - 2 + (3 + 4!) \times (5 + 6! + 7 + 8 + 9) = (9 + 8 - 7 + (6! + 5!) \times 4) \times (3 + 2 + 1) \\ \mathbf{20221} &:= -1 \times 2 + (3 + 4!) \times (5 + 6! + 7 + 8 + 9) = -9 + (8 + 7! + 6 + 5) \times 4 - 3 - 2 - 1 \\ \mathbf{20222} &:= 1 - 2 + (3 + 4!) \times (5 + 6! + 7 + 8 + 9) = (-9 + 8! + 7 + 6 + 5!) / (-4 + 3 + 2 + 1) \\ \mathbf{20223} &:= ((-1 + 2) \times 3 + 4!) \times (5 + 6! + 7 + 8 + 9) = -9 + (8 \times 7! + 6!/5) / (-4 + 3 + 2 + 1) \\ \mathbf{20224} &:= -1 + 2 + (3 + 4!) \times (5 + 6! + 7 + 8 + 9) = (9 + 8! - 7 + 6 + 5!) / (-4 + 3 + 2 + 1) \\ \mathbf{20225} &:= 1 \times 2 + (3 + 4!) \times (5 + 6! + 7 + 8 + 9) = (9 + 8! + 7 - 6 + 5!) / (-4 + 3 + 2 + 1) \\ \mathbf{20226} &:= (-1 + 2 + 3!) \times (4! \times 5! + 6) + 7 + 8 + 9 = (-9 + 8 + 7) \times (-6! - 5 + 4^{(3 + 2 + 1)}) \\ \mathbf{20227} &:= 1 - 2 + (-3 - 4 + 5 + 6) \times (7! + 8 + 9) = -9 + (8 + 7! + 6 + 5) \times 4! / (3 + 2 + 1) \\ \mathbf{20228} &:= 1 \times 2^{3!} + 4 + (5! + 6!) \times (7 + 8 + 9) = (9 + 8 + 7!) \times (-6!/5! + 4 + 3 + 2 + 1) \\ \mathbf{20229} &:= -1 - 2 + 3 \times 4! + (5! + 6!) \times (7 + 8 + 9) = -9 + (8 + 7!/6 - 5) \times 4! + 3 + 2 + 1 \end{aligned}$$

2 Single Digit Representations

2.1 Single Digit

$$\begin{aligned}
 \mathbf{2022} &:= (1 + 1) \times (11 + (11 - 1)^{1+1+1}) \\
 &:= 2^{22/2} - 22 - 2 - 2 \\
 &:= 3 + 3 + (3 + 3) \times (333 + 3) \\
 &:= 4 + (4 + 4) \times (4^4 - 4) + \frac{4 + 4}{4} \\
 &:= \left(5 + \frac{5}{5}\right) \times \left(5 \times 5 + \frac{5^5 - 5}{5 + 5}\right) \\
 &:= 6 + 6 \times 6 + 66 \times (6 \times 6 - 6) \\
 &:= \left(7 - \frac{7}{7}\right) \times \left(7 \times 7 \times 7 - 7 + \frac{7}{7}\right) \\
 &:= 88 \times (8 + 8 + 8) - 88 - \frac{8 + 8}{8} \\
 &:= \frac{9 + 9}{9} \times \left(999 + \frac{99 + 9}{9}\right)
 \end{aligned}$$

2.2 Patterns in Single Digit

Below are few patterns based on the above representations:

$$\begin{aligned}
 \mathbf{2022} &:= (1 + 1) \times (11 + (11 - 1)^{1+1+1}) & \mathbf{2022} &:= 3 + 3 + (3 + 3) \times (333 + 3) \\
 \mathbf{20222} &:= (1 + 1) \times (111 + (11 - 1)^{1+1+1+1}) & \mathbf{20022} &:= 3 + 3 + (3 + 3) \times (3333 + 3) \\
 \mathbf{202222} &:= (1 + 1) \times (1111 + (11 - 1)^{1+1+1+1+1}) & \mathbf{200022} &:= 3 + 3 + (3 + 3) \times (33333 + 3) \\
 \mathbf{2022222} &:= (1 + 1) \times (11111 + (11 - 1)^{1+1+1+1+1+1}) & \mathbf{2000022} &:= 3 + 3 + (3 + 3) \times (333333 + 3)
 \end{aligned}$$

$$\begin{aligned}
 \mathbf{2022} &:= 6 + 6 \times 6 + 66 \times (6 \times 6 - 6) & \mathbf{2022} &:= \frac{9 + 9}{9} \times \left(999 + \frac{99 + 9}{9}\right) \\
 \mathbf{20022} &:= 6 + 6 \times 6 + 666 \times (6 \times 6 - 6) & \mathbf{20022} &:= \frac{9 + 9}{9} \times \left(9999 + \frac{99 + 9}{9}\right) \\
 \mathbf{200022} &:= 6 + 6 \times 6 + 6666 \times (6 \times 6 - 6) & \mathbf{200022} &:= \frac{9 + 9}{9} \times \left(99999 + \frac{99 + 9}{9}\right) \\
 \mathbf{2000022} &:= 6 + 6 \times 6 + 66666 \times (6 \times 6 - 6) & \mathbf{2000022} &:= \frac{9 + 9}{9} \times \left(999999 + \frac{99 + 9}{9}\right)
 \end{aligned}$$

The above representations are not uniform. Below are patterns with uniform representations in each digit:

$$\begin{aligned} 2022 &:= \frac{(1111 - 111 + 11) \times (1 + 1)}{1 \times 1} \\ 22022 &:= \frac{(11111 - 111 + 11) \times (1 + 1)}{1 \times 1} \\ 222022 &:= \frac{(111111 - 111 + 11) \times (1 + 1)}{1 \times 1} \\ 2222022 &:= \frac{(1111111 - 111 + 11) \times (1 + 1)}{1 \times 1} \end{aligned}$$

$$\begin{aligned} 2022 &:= \frac{(2222 - 222 + 22) \times (2 + 2)}{2 \times 2} \\ 22022 &:= \frac{(22222 - 222 + 22) \times (2 + 2)}{2 \times 2} \\ 222022 &:= \frac{(222222 - 222 + 22) \times (2 + 2)}{2 \times 2} \\ 2222022 &:= \frac{(2222222 - 222 + 22) \times (2 + 2)}{2 \times 2} \end{aligned}$$

$$\begin{aligned} 2022 &:= \frac{(3333 - 333 + 33) \times (3 + 3)}{3 \times 3} \\ 22022 &:= \frac{(33333 - 333 + 33) \times (3 + 3)}{3 \times 3} \\ 222022 &:= \frac{(333333 - 333 + 33) \times (3 + 3)}{3 \times 3} \\ 2222022 &:= \frac{(3333333 - 333 + 33) \times (3 + 3)}{3 \times 3} \end{aligned}$$

$$\begin{aligned} 2022 &:= \frac{(4444 - 444 + 44) \times (4 + 4)}{4 \times 4} \\ 22022 &:= \frac{(44444 - 444 + 44) \times (4 + 4)}{4 \times 4} \\ 222022 &:= \frac{(444444 - 444 + 44) \times (4 + 4)}{4 \times 4} \\ 2222022 &:= \frac{(4444444 - 444 + 44) \times (4 + 4)}{4 \times 4} \end{aligned}$$

$$\begin{aligned} 2022 &:= \frac{(5555 - 555 + 55) \times (5 + 5)}{5 \times 5} \\ 22022 &:= \frac{(55555 - 555 + 55) \times (5 + 5)}{5 \times 5} \\ 222022 &:= \frac{(555555 - 555 + 55) \times (5 + 5)}{5 \times 5} \\ 2222022 &:= \frac{(5555555 - 555 + 55) \times (5 + 5)}{5 \times 5} \end{aligned}$$

$$\begin{aligned} 2022 &:= \frac{(6666 - 666 + 66) \times (6 + 6)}{6 \times 6} \\ 22022 &:= \frac{(66666 - 666 + 66) \times (6 + 6)}{6 \times 6} \\ 222022 &:= \frac{(666666 - 666 + 66) \times (6 + 6)}{6 \times 6} \\ 2222022 &:= \frac{(6666666 - 666 + 66) \times (6 + 6)}{6 \times 6} \end{aligned}$$

$$\begin{aligned}
 2022 &:= \frac{(7777 - 777 + 77) \times (7 + 7)}{7 \times 7} & 2022 &:= \frac{(8888 - 888 + 88) \times (8 + 8)}{8 \times 8} \\
 22022 &:= \frac{(77777 - 777 + 77) \times (7 + 7)}{7 \times 7} & 22022 &:= \frac{(88888 - 888 + 88) \times (8 + 8)}{8 \times 8} \\
 222022 &:= \frac{(777777 - 777 + 77) \times (7 + 7)}{7 \times 7} & 222022 &:= \frac{(888888 - 888 + 88) \times (8 + 8)}{8 \times 8} \\
 2222022 &:= \frac{(7777777 - 777 + 77) \times (7 + 7)}{7 \times 7} & 2222022 &:= \frac{(8888888 - 888 + 88) \times (8 + 8)}{8 \times 8}
 \end{aligned}$$

$$\begin{aligned}
 2022 &:= \frac{(9999 - 999 + 99) \times (9 + 9)}{9 \times 9} \\
 22022 &:= \frac{(99999 - 999 + 99) \times (9 + 9)}{9 \times 9} \\
 222022 &:= \frac{(999999 - 999 + 99) \times (9 + 9)}{9 \times 9} \\
 2222022 &:= \frac{(9999999 - 999 + 99) \times (9 + 9)}{9 \times 9}
 \end{aligned}$$

3 Single Letter Representations

Below are two different representations of 2022 written in **single letter a**:

$$\begin{aligned}
 2022 &:= \frac{(aaaa - aaa + aa) \times (a + a)}{a \times a} \\
 &:= \frac{(aaaaa + aa - a) \times (a + a)}{a \times aa}
 \end{aligned}$$

where, $aaaaa = a10^4 + a10^3 + a10^2 + a10 + a$,
 $aaaa = a10^3 + a10^2 + a10 + a$,
 $aaa = a10^2 + a10 + a$,
 $aa = a10 + a$, etc.
 $a \in \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$.

3.1 Patterns in Single Letter

Below are three different patterns for 2022 written in single letter **a**:

1.

$$\begin{aligned} 2022 &:= \frac{(aaaa - aaa + aa) \times (a + a)}{a \times a} \\ 20222 &:= \frac{(aaaaa - aaaa + aaa) \times (a + a)}{a \times a} \\ 202222 &:= \frac{(aaaaaa - aaaaa + aaaa) \times (a + a)}{a \times a} \\ 2022222 &:= \frac{(aaaaaaa - aaaaaa + aaaaa) \times (a + a)}{a \times a} \end{aligned}$$

2.

$$\begin{aligned} 2022 &:= \frac{(aaaa - aaa + aa) \times (a + a)}{a \times a} \\ 20022 &:= \frac{(aaaaa - aaaa + aa) \times (a + a)}{a \times a} \\ 200022 &:= \frac{(aaaaaa - aaaaa + aa) \times (a + a)}{a \times a} \\ 2000022 &:= \frac{(aaaaaaa - aaaaaa + aa) \times (a + a)}{a \times a} \end{aligned}$$

3.

$$\begin{aligned} 2022 &:= \frac{(aaaa - aaa + aa) \times (a + a)}{a \times a} \\ 22022 &:= \frac{(aaaaa - aaa + aa) \times (a + a)}{a \times a} \\ 222022 &:= \frac{(aaaaaa - aaa + aa) \times (a + a)}{a \times a} \\ 2222022 &:= \frac{(aaaaaaa - aaa + aa) \times (a + a)}{a \times a} \end{aligned}$$

where, $aaaaa := a10^4 + a10^3 + a10^2 + a10 + a$, $aaaa := a10^3 + a10^2 + a10 + a$,
 $aaa := a10^2 + a10 + a$, $aa := a10 + a$, etc.
 $a \in \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$.

4 Running Equality Expressions

$$\begin{aligned}
 \mathbf{2022} &:= -1 - 2 \times T(T(T(3))) + T(T(T(4)) + T(5)) = 6 + T(7) \times 8 \times 9 \\
 &:= T(1 + 2) + T(T(T(3)) \times F(4)) &&= T(5) \times T(F(6) + 7) + T(F(8)) - 9 \\
 &:= 9 \times 8 \times T(7) + 6 &&= T((5 + T(T(4))) + 3) + T(2 + 1) \\
 &:= 9 \times T(8) \times 7 - T(T(6)) - T(5) &&= T(4) + T(T(T(3))) \times 2 + T(T(10))
 \end{aligned}$$

The function T is **Triangular** numbers. It is explained in more details in Section 16.

5 Selfie Representations

5.1 Digit's Order and Reverse Order of Digits

Below are three different **selfie representations** of 2022. These are in terms of **Fibonacci**, **Triangular** numbers and **binomials**. In some cases, factorials are also used.

$$\begin{aligned}
 \mathbf{2022} &:= C((T(2) + 0)!, T(2)) - 2 &&:= -2 + C((T(2) + 0)!, T(2)) \\
 &:= T(T(2)) + T(T(02) \times T(T(T(2)))) &&:= T(T(2)) + T(T(2) \times T(T(T(02)))) \\
 &:= T(T(2)) + T(-0! + 2^{T(T(2))}) &&:= T(2^{T(T(2))} - 0!) + T(T(2))
 \end{aligned}$$

The function $C(n, k)$ is well known **binomial coefficient** given by

$$C(n, k) := \frac{n!}{k! \times (n - k)!}, n \geq k$$

5.2 Numbers With 2022: Digit's Order

Below are **selfie representations** of numbers with 2022. These are in terms of **Fibonacci**, **Triangular** numbers and **factorials**.

$$\begin{aligned}
 \mathbf{20223} &:= (F(20) - (2 + 2)!) \times 3 &&= (F(20) - T(2) - T(T(T(2)))) \times 3 \\
 \mathbf{20224} &:= F((2 + 0)!)! / 2 + 2^{F(4)!} &&= (F(20) - T(T(T(2)))) \times T(2) - F(T(F(4))) \\
 \mathbf{20226} &:= (F(20) - T(T(T(2)))) \times T(2) - 6 \\
 \mathbf{20228} &:= T(T(T(2)))^{T(02)} + T(T(T(2))) + F(F(8)) \\
 \mathbf{20229} &:= F(20) \times T(2) - T(2 + 9)
 \end{aligned}$$

More details on **Fibonacci sequence** and **Triangular numbers** are given in Section 16.

6 Semi-Selfie Expressions

6.1 Semi-Selfies With 22

In this case, we don't have representations for 2022. The results below refer to number 22.

$$\begin{aligned} \blacktriangleright 22^4 &:= 234256 &= (2 + 3 + 4 + 2 + 5 + 6)^4 \\ & &= (2 - 3 + 4 + 25 - 6)^4 \\ & &= (2 - 34 - 2 + 56)^4 \\ & &= (-234 + 256)^4 \\ \\ \blacktriangleright 22^5 &:= 5153632 &= (5 + 15 - 3 + 6 - 3 + 2)^5 \\ & &= (5 - 1 - 5 - 3 - 6 + 32)^5 \\ & &= (-51 + 5 + 3 + 63 + 2)^5 \\ & &= (-51 + 5 + 36 + 32)^5 \\ \\ \blacktriangleright 22^6 &:= 113379904 &= (11 + 3 - 3 + 7 + 9 - 9 + 04)^6 \\ & &= (113 - 3 + 7 - 99 + 04)^6 \\ & &= (-11 - 33 + 79 - 9 - 04)^6 \\ & &= (-1 + 133 - 7 - 99 - 04)^6 \\ \\ \blacktriangleright 22^7 &:= 2494357888 &= (2 + 4 + 9 + 4 - 3 + 5 - 7 + 8 + 8 - 8)^7 \\ & &= (24 - 94 + 3 - 5 + 78 + 8 + 8)^7 \\ & &= (2 + 49 - 4 - 35 - 78 + 88)^7 \\ & &= (24 + 943 - 57 - 888)^7 \\ \\ \blacktriangleright 22^8 &:= 54875873536 &= (54 - 8 + 7 - 5 - 8 - 7 + 3 - 5 - 3 - 6)^8 \\ & &= (5 - 48 + 75 + 8 - 7 + 3 - 5 - 3 - 6)^8 \\ & &= (54 - 87 + 5 + 8 + 73 + 5 - 36)^8 \\ & &= (5 - 4 + 8 - 758 + 735 + 36)^8 \\ & &= (548 + 75 + 8 - 73 - 536)^8 \end{aligned}$$

7 Same Digits Power and Bases: Flexible Power

This section brings representations of 22 and 2022 and some patterns. These representations are in such a way that the bases and powers are of same digits with different permutations. As a convention it is understood that $0^0 := 1$ and $0^a := 0, a \neq 0$.

7.1 Pyramid-Type Representations of 22 and 2022

Below are **pyramid-type** representations of 22 and 2022. In each case there are permutations of bases and powers are of same digits.

$$\begin{aligned} \mathbf{22} &:= -1^1 - 2^2 + 3^3 \\ &:= 0^1 - 1^0 - 2^2 + 3^3 \\ &:= 0^2 + 1^3 + 2^4 + 3^0 + 4^1 \\ &:= 0^4 - 1^5 + 2^3 + 3^2 + 4^0 + 5^1 \\ &:= 0^2 + 1^6 + 2^5 - 3^4 + 4^3 + 5^1 + 6^0 \\ &:= 0^5 + 1^7 - 2^6 - 3^4 + 4^1 + 5^3 + 6^2 + 7^0 \\ &:= 0^1 + 1^4 + 2^8 + 3^5 - 4^7 + 5^6 + 6^3 + 7^0 + 8^2 \\ &:= 0^6 - 1^9 + 2^8 - 3^7 + 4^5 + 5^4 + 6^3 + 7^1 + 8^0 + 9^2 \end{aligned}$$

$$\begin{aligned} \mathbf{2022} &:= 1^3 + 3^6 - 4^1 + 6^4 \\ &:= 1^2 - 2^3 + 3^6 + 4^1 + 6^4 \\ &:= -0^0 + 1^3 - 2^5 + 3^6 + 4^1 + 5^2 + 6^4 \\ &:= 0^4 + 1^7 + 2^1 + 3^6 + 4^5 + 5^0 + 6^3 + 7^2 \\ &:= 0^7 - 1^8 - 2^4 + 3^6 + 4^5 + 5^1 + 6^3 + 7^0 + 8^2 \\ &:= 0^6 + 1^9 + 2^8 - 3^7 + 4^4 + 5^5 + 6^0 + 7^2 + 8^3 + 9^1 \end{aligned}$$

7.2 Block Representations With 2022

$$\begin{aligned} \mathbf{20220} &:= 0^3 - 1^0 - 2^5 + 3^7 + 4^1 + 5^6 + 6^2 + 7^4 \\ \mathbf{20221} &:= 0^3 - 1^5 + 2^2 + 3^7 + 4^1 + 5^6 + 6^0 + 7^4 \\ \mathbf{20222} &:= 0^3 + 1^0 - 2^5 + 3^7 + 4^1 + 5^6 + 6^2 + 7^4 \\ \mathbf{20223} &:= 0^3 + 1^5 + 2^2 + 3^7 + 4^1 + 5^6 + 6^0 + 7^4 \end{aligned}$$

$$\mathbf{20224} := 0^1 + 1^6 - 2^2 + 3^7 - 4^3 + 5^0 + 6^4 + 7^5$$

$$\mathbf{20225} := 0^3 + 1^5 + 2^2 + 3^7 + 4^0 + 5^6 + 6^1 + 7^4$$

$$\mathbf{20226} := 0^5 - 1^0 - 2^3 + 3^7 + 4^2 + 5^6 + 6^1 + 7^4$$

$$\mathbf{20227} := 0^2 + 1^5 + 2^3 + 3^7 + 4^1 + 5^6 + 6^0 + 7^4$$

$$\mathbf{20228} := 0^5 + 1^0 - 2^3 + 3^7 + 4^2 + 5^6 + 6^1 + 7^4$$

$$\mathbf{20229} := 0^2 + 1^5 + 2^3 + 3^7 + 4^0 + 5^6 + 6^1 + 7^4$$

$$\mathbf{1\ 2022} := -0^0 + 1^1 + 2^4 + 3^2 + 4^6 + 5^3 + 6^5$$

$$\mathbf{2\ 2022} := 0^4 + 1^7 - 2^1 - 3^8 - 4^6 - 5^3 + 6^2 + 7^0 + 8^5$$

$$\mathbf{3\ 2022} := 0^3 + 1^4 - 2^5 + 3^0 + 4^7 + 5^6 + 6^2 + 7^1$$

$$\mathbf{4\ 2022} := 0^1 + 1^3 - 2^5 - 3^7 - 4^2 + 5^0 + 6^6 - 7^4$$

$$\mathbf{5\ 2022} := 0^2 - 1^0 - 2^4 + 3^7 + 4^3 + 5^5 + 6^6 + 7^1$$

$$\mathbf{6\ 2022} := 0^4 + 1^0 + 2^1 + 3^6 - 4^3 + 5^7 + 6^2 - 7^5$$

$$\mathbf{7\ 2022} := 0^3 + 1^0 - 2^2 - 3^6 + 4^1 + 5^7 - 6^5 + 7^4$$

$$\mathbf{8\ 2022} := 0^1 - 1^4 + 2^3 - 3^5 + 4^6 + 5^7 + 6^2 + 7^0$$

$$\mathbf{9\ 2022} := 0^0 + 1^8 + 2^9 + 3^6 + 4^1 + 5^7 + 6^5 + 7^2 + 8^4 + 9^3$$

8 Narcissistic-Type Representations

$$\mathbf{22} := \frac{2^1 + 2^6}{2^0 + 2^1}$$

$$\mathbf{221} := \frac{-2^4 + 2^{13} + 1^0}{2^2 + 2^5 + 1^0}$$

$$\mathbf{222} := \frac{-2^1 - 2^5 + 2^8}{-2^0 + 2^0 + 2^0}$$

$$:= -2^1 - 2^5 + 2^8$$

$$\mathbf{223} := \frac{2^6 + 2^{10} + 3^3}{2^0 + 2^0 + 3^1}$$

$$:= -2^2 - 2^4 + 3^5$$

$$\mathbf{224} := \frac{2^7 + 2^9 + 4^4}{2^0 + 2^1 + 4^0}$$

$$:= -2^4 - 2^4 + 4^4$$

$$:= 2^5 + 2^7 + 4^3$$

$$\mathbf{225} := \frac{2^2 + 2^{12} + 5^4}{2^2 + 2^4 + 5^0}$$

$$:= -2^5 + 2^8 + 5^0$$

$$\mathbf{226} := \frac{2^8 + 2^8 + 6^4}{2^0 + 2^0 + 6^1}$$

$$:= 2^1 + 2^3 + 6^3$$

$$\mathbf{227} := \frac{2^5 + 2^6 + 7^4}{2^1 + 2^1 + 7^1}$$

$$\mathbf{228} := \frac{2^2 + 2^2 + 8^4}{2^0 + 2^4 + 8^0}$$

$$\mathbf{229} := \frac{2^2 + 2^{11} + 9^1}{2^2 + 2^2 + 9^0}$$

9 Selfie Fractions

Below are few **selfie fractions** with 2022.

$$\frac{337}{2022} := \frac{3^3 + 7}{202 + 2}$$

$$\frac{2022}{2359} := \frac{20 + 22}{2^3 \times 5 + 9}$$

$$\frac{2022}{3707} := \frac{2 + 022}{37 + 07}$$

$$\frac{2022}{4381} := \frac{2 + 022}{43 + 8 + 1}$$

$$\frac{1348}{2022} := \frac{1 + 3 + 4 + 8}{2 + 022}$$

$$:= \frac{(13 + 4) \times 8}{202 + 2}$$

$$\frac{1685}{2022} := \frac{1 + 6 + 8 + 5}{2 + 022}$$

$$:= \frac{1^{68} \times 5}{2 + 022}$$

$$\frac{2022}{4718} := \frac{2 + 022}{47 + 1 + 8}$$

$$\frac{2022}{5392} := \frac{2 + 022}{(5 + 3 \times 9) \times 2}$$

$$\frac{2022}{5729} := \frac{2 + 022}{57 + 2 + 9}$$

$$\frac{2022}{9436} := \frac{2 + 022}{94 + 3 \times 6}$$

$$\frac{2022}{11458} := \frac{2 + 022}{1 + (1 + 4) \times 5 + 8}$$

$$\frac{2022}{7414} := \frac{20 + 22}{(7 + 4) \times 14}$$

$$:= \frac{2 + 022}{74 + 14}$$

$$\frac{2022}{10784} := \frac{2 + 022}{1^{07} \times 8 \times 4}$$

$$:= \frac{20 + 22}{1 \times 07 \times 8 \times 4}$$

$$\frac{2022}{13817} := \frac{2 + 02^2}{1 \times 3 \times 8 + 17}$$

$$\frac{2022}{14828} := \frac{2 + 022}{148 + 28}$$

$$\frac{2022}{15839} := \frac{2 + 02^2}{1^5 \times (8 + 39)}$$

$$\frac{2022}{17524} := \frac{2 + 02^2}{1 + 7 \times 5 + 2^4}$$

$$:= \frac{2 + 022}{(1 + 7 + 5) \times 2^4}$$

$$\frac{2022}{18535} := \frac{2 + 02^2}{1 \times 8 \times 5 + 3 \times 5}$$

$$:= \frac{2 + 022}{(1 + 8 \times 5 + 3) \times 5}$$

$$\frac{1011}{2022} := \frac{1 + 0 \times 11}{2 + 0 \times 22} = \frac{1 + 01^1}{2^{0 \times 2 + 2}} = \frac{1 + 01 + 1}{2 + 02^2} = \frac{101 + 1}{202 + 2} = \frac{1 + 011}{2 + 022} = \frac{10 + 11}{20 + 22}$$

$$\frac{2022}{5055} := \frac{2 + 0 \times 22}{5 + 0 \times 55} = \frac{2 + 02^2}{5 + 05 + 5} = \frac{202 + 2}{505 + 5} = \frac{20 + 22}{50 + 55} = \frac{2 + 022}{5 + 055} = \frac{2^{0 \times 2 + 2}}{5 + 0 \times 5 + 5}$$

$$\frac{2022}{6066} := \frac{2 + 0 \times 22}{6 + 0 \times 66} = \frac{2 + 02^2}{6 + 06 + 6} = \frac{202 + 2}{606 + 6} = \frac{20 + 22}{60 + 66} = \frac{2 + 022}{6 + 066} = \frac{2^{0 \times 2 + 2}}{6 + 0 \times 6 + 6}$$

$$\frac{2022}{9099} := \frac{2+0 \times 22}{9+0 \times 99} = \frac{2+02^2}{9+09+9} = \frac{202+2}{909+9} = \frac{20+22}{90+99} = \frac{2+022}{9+099} = \frac{2^{0 \times 2+2}}{9+0 \times 9+9}$$

$$\begin{aligned} \frac{2022}{7077} &:= \frac{2+0 \times 22}{7+0 \times 77} = \frac{2+02^2}{7+07+7} = \frac{202+2}{707+7} = \frac{20+22}{70+77} \\ &:= \frac{2^{02 \times 2}}{7+07 \times 7} = \frac{2+022}{7+077} = \frac{2^{0 \times 2+2}}{7+0 \times 7+7} \end{aligned}$$

$$\begin{aligned} \frac{2022}{3033} &:= \frac{2+0 \times 22}{3+0 \times 33} = \frac{2+02^2}{3+03+3} = \frac{2 \times 02^2}{3+03 \times 3} = \frac{202+2}{303+3} \\ &:= \frac{20+22}{30+33} = \frac{2+022}{3+033} = \frac{2^{0 \times 2+2}}{3+0 \times 3+3} \end{aligned}$$

$$\begin{aligned} \frac{2022}{4044} &:= \frac{2+0 \times 22}{4+0 \times 44} = \frac{2+02^2}{4+04+4} = \frac{2 \times 02^2}{4 \times (0 \times 4+4)} = \frac{202+2}{404+4} \\ &= \frac{20+22}{40+44} = \frac{2^{02 \times 2}}{4 \times (04+4)} = \frac{2+022}{4+044} = \frac{2^{0 \times 2+2}}{4+0 \times 4+4} \end{aligned}$$

$$\begin{aligned} \frac{2022}{8088} &:= \frac{2+0 \times 22}{8+0 \times 88} = \frac{2+02^2}{8+08+8} = \frac{202+2}{808+8} = \frac{20+22}{80+88} = \frac{2^{02 \times 2}}{8 \times (0 \times 8+8)} \\ &:= \frac{2+022}{8+088} = \frac{2^{0 \times 2+2}}{8+0 \times 8+8} \end{aligned}$$

$$\begin{aligned} \frac{2022}{13143} &:= \frac{2+0 \times 22}{1+3 \times (1^4+3)} = \frac{2+02^2}{1 \times 3 \times (1+4 \times 3)} = \frac{2 \times 02^2}{1+3 \times (14+3)} = \frac{2^{02 \times 2}}{13 \times (1+4+3)} \\ &:= \frac{2+022}{13 \times 1 \times 4 \times 3} = \frac{2^{0 \times 2+2}}{13+1+4 \times 3} \end{aligned}$$

$$\begin{aligned} \frac{2022}{14154} &:= \frac{2+0 \times 22}{1 \times 4+1+5+4} = \frac{2 \times 02^2}{14 \times 1^5 \times 4} = \frac{20+22}{14 \times (1+5 \times 4)} = \frac{2+022}{14+154} \\ &:= \frac{2^{0 \times 2+2}}{1 \times 4+(1+5) \times 4} \end{aligned}$$

$$\begin{aligned} \frac{2022}{16176} &:= \frac{2+0 \times 22}{16^{176}} = \frac{2+02^2}{1 \times 6+1 \times 7 \times 6} = \frac{2 \times 02^2}{16+(1+7) \times 6} = \frac{202+2}{16 \times (17 \times 6)} \\ &:= \frac{20+22}{(1+6+1) \times 7 \times 6} = \frac{2+022}{16+176} \end{aligned}$$

$$\begin{aligned} \frac{2022}{18198} &:= \frac{20 \times 2^2}{(1 \times 81 + 9) \times 8} = \frac{2 + 0 \times 22}{1 + 8 + 1^9 + 8} = \frac{2 \times 02^2}{1 \times 8 \times (1^9 + 8)} = \frac{2^{02 \times 2}}{1 \times 8 \times (1 + 9 + 8)} \\ &:= \frac{2 + 022}{1 \times 8 \times (19 + 8)} = \frac{2^{0 \times 2 + 2}}{1 + 8 + 19 + 8} \end{aligned}$$

$$\begin{aligned} \frac{2022}{11121} &:= \frac{2 + 0 \times 22}{11^{1^21}} = \frac{2 + 02^2}{1 + 11 + 21} = \frac{2 \times 02^2}{11 \times 1 + 2 + 1} = \frac{202 + 2}{1 + 1121} \\ &:= \frac{20 + 22}{1 \times 11 \times 21} = \frac{2 \times 022}{11 \times 1 + 21} = \frac{2 + 022}{11 + 121} = \frac{2^{0 \times 2 + 2}}{1 \times 1 \times 1 + 21} \end{aligned}$$

$$\begin{aligned} \frac{6011}{12022} &:= \frac{6 \times 0 \times 1 + 1}{1 \times 2 + 0 \times 22} = \frac{6 + 0 \times 11}{(1 + 2) \times 02^2} = \frac{6 + 01 \times 1}{12 + 0 \times 2 + 2} = \frac{6 + 01 + 1}{1 \times 2^{02 \times 2}} \\ &:= \frac{60 + 11}{120 + 22} = \frac{6 \times 01 + 1}{1 \times 2 + 022} = \frac{6 + 011}{12 + 022} = \frac{601 + 1}{1202 + 2} = \frac{60 + 1 + 1}{120 + 2^2} \end{aligned}$$

$$\begin{aligned} \frac{2022}{12132} &:= \frac{2 + 0 \times 22}{1 \times 2 + 1 + 3^2} = \frac{2 + 02^2}{1 + 2 + 1 + 32} = \frac{2 \times 02^2}{(1 \times 21 + 3) \times 2} = \frac{2 \times 022}{1 \times 2 \times 132} \\ &:= \frac{2^{02 \times 2}}{(1 + 2^1) \times 32} = \frac{2 + 022}{((1 + 2 + 1) \times 3)^2} = \frac{2^{0 \times 2 + 2}}{(1 + 2 + 1) \times 3 \times 2} \end{aligned}$$

$$\begin{aligned} \frac{2022}{15165} &:= \frac{2 + 0 \times 22}{15^{1^65}} = \frac{2 + 02^2}{15 + 1 \times 6 \times 5} = \frac{2 \times 02^2}{1 \times 5 \times (1 + 6 + 5)} = \frac{202 + 2}{1 \times 51 \times 6 \times 5} \\ &:= \frac{20 + 22}{15 \times (16 + 5)} = \frac{2 \times 022}{1 \times 5 \times (1 + 65)} = \frac{2 + 022}{1 + 5 \times (1 + 6) \times 5} = \frac{2^{0 \times 2 + 2}}{1 \times 5 \times (1^6 + 5)} \end{aligned}$$

$$\frac{2022}{16513} := \frac{2 + 02^2}{1 + 6 \times (5 + 1 \times 3)} = \frac{20 + 22}{(1^6 + 5 + 1)^3} = \frac{2 + 022}{1 + 65 \times 1 \times 3}$$

$$\frac{2022}{17187} := \frac{2 + 0 \times 22}{17^{1^{87}}} = \frac{2^{02 \times 2}}{17 \times (1^8 + 7)} = \frac{2 + 022}{17 + 187}$$

9.1 Patterns in Selfie Fractions

$$\frac{2022}{11121} := \frac{20+22}{1 \times 11 \times 21}$$

$$\frac{2022}{111210} := \frac{20+22}{1 \times 11 \times 210}$$

$$\frac{2022}{1112100} := \frac{20+22}{1 \times 11 \times 2100}$$

$$\frac{2022}{11121000} := \frac{20+22}{1 \times 11 \times 21000}$$

$$\frac{2022}{14154} := \frac{2 \times 02^2}{14 \times 1^5 \times 4}$$

$$\frac{2022}{141540} := \frac{2 \times 02^2}{14 \times 1^5 \times 40}$$

$$\frac{2022}{1415400} := \frac{2 \times 02^2}{14 \times 1^5 \times 400}$$

$$\frac{2022}{14154000} := \frac{2 \times 02^2}{14 \times 1^5 \times 4000}$$

$$\frac{2022}{15165} := \frac{202+2}{1 \times 51 \times 6 \times 5}$$

$$\frac{2022}{151650} := \frac{202+2}{1 \times 51 \times 6 \times 50}$$

$$\frac{2022}{1516500} := \frac{202+2}{1 \times 51 \times 6 \times 500}$$

$$\frac{2022}{15165000} := \frac{202+2}{1 \times 51 \times 6 \times 5000}$$

$$\frac{2022}{18535} := \frac{2+022}{(1+8 \times 5+3) \times 5}$$

$$\frac{2022}{185350} := \frac{2+022}{(1+8 \times 5+3) \times 50}$$

$$\frac{2022}{1853500} := \frac{2+022}{(1+8 \times 5+3) \times 500}$$

$$\frac{2022}{18535000} := \frac{2+022}{(1+8 \times 5+3) \times 5000}$$

$$\frac{2022}{10784} := \frac{20+22}{1 \times 07 \times 8 \times 4} = \frac{2+02^2}{1^{07} \times 8 \times 4}$$

$$\frac{2022}{107840} := \frac{20+22}{1 \times 07 \times 8 \times 40} = \frac{2+02^2}{1^{07} \times 8 \times 40}$$

$$\frac{2022}{1078400} := \frac{20+22}{1 \times 07 \times 8 \times 400} = \frac{2+02^2}{1^{07} \times 8 \times 400}$$

$$\frac{2022}{10784000} := \frac{20+22}{1 \times 07 \times 8 \times 4000} = \frac{2+02^2}{1^{07} \times 8 \times 4000}$$

$$\frac{2022}{16176} := \frac{202+2}{16 \times 17 \times 6} = \frac{20+22}{(1+6+1) \times 7 \times 6}$$

$$\frac{2022}{161760} := \frac{202+2}{16 \times 17 \times 60} = \frac{20+22}{(1+6+1) \times 7 \times 60}$$

$$\frac{2022}{1617600} := \frac{202+2}{16 \times 17 \times 600} = \frac{20+22}{(1+6+1) \times 7 \times 600}$$

$$\frac{2022}{16176000} := \frac{202+2}{16 \times 17 \times 6000} = \frac{20+22}{(1+6+1) \times 7 \times 6000}$$

$$\begin{aligned}
 \frac{2022}{12132} &:= \frac{2 \times 022}{1 \times 2 \times 132} = \frac{2 \times 02^2}{(1 \times 21 + 3) \times 2} = \frac{2^{02 \times 2}}{(1 + 2 \times 1) \times 32} = \frac{2^{0 \times 2 + 2}}{(1 + 2 + 1) \times 3 \times 2} \\
 \frac{2022}{121320} &:= \frac{2 \times 022}{1 \times 2 \times 1320} = \frac{2 \times 02^2}{(1 \times 21 + 3) \times 20} = \frac{2^{02 \times 2}}{(1 + 2 \times 1) \times 320} = \frac{2^{0 \times 2 + 2}}{(1 + 2 + 1) \times 3 \times 20} \\
 \frac{2022}{1213200} &:= \frac{2 \times 022}{1 \times 2 \times 13200} = \frac{2 \times 02^2}{(1 \times 21 + 3) \times 200} = \frac{2^{02 \times 2}}{(1 + 2 \times 1) \times 3200} = \frac{2^{0 \times 2 + 2}}{(1 + 2 + 1) \times 3 \times 200} \\
 \frac{2022}{12132000} &:= \frac{2 \times 022}{1 \times 2 \times 132000} = \frac{2 \times 02^2}{(1 \times 21 + 3) \times 2000} = \frac{2^{02 \times 2}}{(1 + 2 \times 1) \times 32000} = \frac{2^{0 \times 2 + 2}}{(1 + 2 + 1) \times 3 \times 2000}
 \end{aligned}$$

10 Same Digits Equality Expressions

Below are equality expressions written in such a way that both sides we have same digits. These are based on power, factorial or just on multiplications.

10.1 Powers and Sums

$$\begin{aligned}
 22 &:= 1^0 - 1^4 - 2^1 + 2^3 + 2^4 = 10 - 14 - 21 + 23 + 24 \\
 2022 &:= 1^9 + 44^2 + 72^0 + 84^1 = 19 + 442 + 720 + 841
 \end{aligned}$$

$$\begin{aligned}
 891 &:= 87^1 - 200^2 + 202^2 = 871 - 2002 + 2022 \\
 1499 &:= -18^0 - 34^3 + 202^2 = -180 - 343 + 2022 \\
 2211 &:= -197^2 + 216^1 + 202^2 = -1972 + 2161 + 2022
 \end{aligned}$$

10.2 Factorial-Powers

Below are some **factorial-power equality expressions** with same digits for 22 and 2022.

$$\begin{aligned}
 \mathbf{22} &:= 4! + 0! - 1! - 2! &&= 4^1 + 0^0 + 1^2 + 2^4 \\
 &:= 1! \times 3! \times 4! - 2! - 5! &&= 1^5 \times 3^3 + 4^1 + 2^4 - 5^2 \\
 &:= 1! \times 4! \times 3! - 2! - 5! &&= 1^5 \times 4^2 + 3^3 - 2^4 - 5^1 \\
 &:= 3! \times 4! - 2! - 5! \times 1! &&= 3^3 + 4^1 + 2^4 - 5^2 \times 1^5 \\
 &:= -1! \times 5! + 3! \times 4! - 2! &&= 1^3 \times 5^1 - 3^5 + 4^4 + 2^2 \\
 &:= -2! + 3! \times 4! - 5! \times 1! &&= 2^1 \times 3^4 - 4^2 - 5^3 + 1^5 \\
 &:= -5! - 2! + 4! \times 1! \times 3! &&= 5^4 - (2^1 + 4^3 + 1^5) \times 3^2 \\
 &:= -5! - 2! \times 1! + 3! \times 4! &&= (5^1 - 2^5 + 1^3) \times 3^2 + 4^4
 \end{aligned}$$

$$\begin{aligned}
 \mathbf{2022} &:= -5! + (2! + 1!) \times (6! - 3!) = 5^1 + 2^6 + (1^5 + 6^3) \times 3^2 \\
 &:= -5! + (6! - 3!) \times (1! + 2!) = (5^1 + 6^3) \times 3^2 + 1^6 + 2^5 \\
 &:= (2! + 1!) \times (6! - 3!) - 5! = 2^6 + (1^5 + 6^3) \times 3^2 + 5^1 \\
 &:= (-3! + 6!) \times (1! + 2!) - 5! = 3^2 \times (6^3 + 1^5) + 2^6 + 5^1 \\
 &:= (6! - 3!) \times (2! + 1!) - 5! = (6^2 + 3^3) \times 2^5 + 1^6 + 5^1
 \end{aligned}$$

10.3 Multiplication

$$\mathbf{2022} \times 11 = 1011 \times 22$$

$$\mathbf{2022} \times 22 = \mathbf{2022} \times 22$$

$$\mathbf{2022} \times 33 = 3033 \times 22$$

$$\mathbf{2022} \times 44 = 4044 \times 22$$

$$\mathbf{2022} \times 55 = 5055 \times 22$$

$$\mathbf{2022} \times 66 = 6066 \times 22$$

$$\mathbf{2022} \times 77 = 7077 \times 22$$

$$\mathbf{2022} \times 88 = 8088 \times 22$$

$$\mathbf{2022} \times 99 = 9099 \times 22$$

$$\mathbf{2022} \times 111 = 1011 \times 222$$

$$\mathbf{2022} \times 222 = \mathbf{2022} \times 222$$

$$\mathbf{2022} \times 333 = 3033 \times 222$$

$$\mathbf{2022} \times 444 = 4044 \times 222$$

$$\mathbf{2022} \times 555 = 5055 \times 222$$

$$\mathbf{2022} \times 666 = 6066 \times 222$$

$$\mathbf{2022} \times 777 = 7077 \times 222$$

$$\mathbf{2022} \times 888 = 8088 \times 222$$

$$\mathbf{2022} \times 999 = 9099 \times 222$$

$$2022 \times 1111 = 1011 \times 2222$$

$$2022 \times 2222 = 2022 \times 2222$$

$$2022 \times 3333 = 3033 \times 2222$$

$$2022 \times 4444 = 4044 \times 2222$$

$$2022 \times 5555 = 5055 \times 2222$$

$$2022 \times 6666 = 6066 \times 2222$$

$$2022 \times 7777 = 7077 \times 2222$$

$$2022 \times 8888 = 8088 \times 2222$$

$$2022 \times 9999 = 9099 \times 2222$$

$$2022 \times 1101 = 1011 \times 2202$$

$$2022 \times 2202 = 2022 \times 2202$$

$$2022 \times 3303 = 3033 \times 2202$$

$$2022 \times 4404 = 4044 \times 2202$$

$$2022 \times 5505 = 5055 \times 2202$$

$$2022 \times 6606 = 6066 \times 2202$$

$$2022 \times 7707 = 7077 \times 2202$$

$$2022 \times 8808 = 8088 \times 2202$$

$$2022 \times 9909 = 9099 \times 2202$$

$$11 \times 202202 = 101 \times 2022 = 1001 \times 2222$$

$$22 \times 202202 = 202 \times 2022 = 2002 \times 2222$$

$$33 \times 202202 = 303 \times 2022 = 3003 \times 2222$$

$$44 \times 202202 = 404 \times 2022 = 4004 \times 2222$$

$$55 \times 202202 = 505 \times 2022 = 5005 \times 2222$$

$$66 \times 202202 = 606 \times 2022 = 6006 \times 2222$$

$$77 \times 202202 = 707 \times 2022 = 7007 \times 2222$$

$$88 \times 202202 = 808 \times 2022 = 8008 \times 2222$$

$$99 \times 202202 = 909 \times 2022 = 9009 \times 2222$$

$$2022044 \times 4402022 = 2422004 \times 4002242$$

$$2022766 \times 6672022 = 3022684 \times 4862203$$

$$20223143 \times 34132022 = 24223013 \times 31032242$$

$$20224044 \times 44042022 = 24224004 \times 40042242$$

$$20222884 \times 48822022 = 26862004 \times 40026862$$

$$\begin{aligned}
 \mathbf{20220760} &:= 2056 \times 9835 = 3598 \times 5620 \\
 \mathbf{20221244} &:= 2441 \times 8284 = 4142 \times 4882 \\
 \mathbf{20221510} &:= 2698 \times 7495 = 2998 \times 6745 \\
 \mathbf{20221776} &:= 2334 \times 8664 = 4332 \times 4668 \\
 \mathbf{20222580} &:= 2670 \times 7574 = 2705 \times 7476 \\
 \mathbf{20224152} &:= 2418 \times 8364 = 4182 \times 4836 \\
 \mathbf{20224400} &:= 3472 \times 5825 = 3728 \times 5425 \\
 \mathbf{20227380} &:= 3044 \times 6645 = 4430 \times 4566 \\
 \mathbf{20228985} &:= 2155 \times 9387 = 3879 \times 5215 \\
 \mathbf{20229552} &:= 2256 \times 8967 = 2562 \times 7896
 \end{aligned}$$

11 Power Representations

11.1 Powers 2, 3 and 4

$$\mathbf{22} := 2^1 + 2^2 + 4^2$$

$$\mathbf{22^2} := 4^2 + 12^2 + 18^2$$

$$\begin{array}{lll}
 \mathbf{2022} := 2^2 + 13^2 + 43^2 & := 1^2 + 6^2 + 7^2 + 44^2 & := 1^2 + 14^2 + 23^2 + 36^2 \\
 := 5^2 + 29^2 + 34^2 & := 1^2 + 6^2 + 31^2 + 32^2 & := 1^2 + 16^2 + 26^2 + 33^2 \\
 := 7^2 + 23^2 + 38^2 & := 1^2 + 7^2 + 26^2 + 36^2 & := 1^2 + 17^2 + 24^2 + 34^2 \\
 := 11^2 + 26^2 + 35^2 & := 1^2 + 9^2 + 28^2 + 34^2 & := 1^2 + 22^2 + 24^2 + 31^2 \\
 := 13^2 + 22^2 + 37^2 & := 1^2 + 10^2 + 20^2 + 39^2 & := 1^2 + 2^2 + 21^2 + 26^2 + 30^2 \\
 := 1^2 + 2^2 + 9^2 + 44^2 & := 1^2 + 10^2 + 25^2 + 36^2 & \\
 := 1^2 + 4^2 + 18^2 + 41^2 & := 1^2 + 12^2 + 14^2 + 41^2 & \\
 := 1^2 + 4^2 + 22^2 + 39^2 & := 1^2 + 14^2 + 15^2 + 40^2 &
 \end{array}$$

$$\begin{aligned}
 \mathbf{2022} &:= 11^3 + 7^3 + 6^3 + 5^3 + 2^3 - 1^3 \\
 &:= 11^3 + 7^3 + 7^3 + 1^3 + 1^3 + 1^3 + 1^3 + 1^3 \\
 &:= 13^3 - 5^3 - 4^3 + 3^3 - 2^3 - 2^3 + 1^3 + 1^3 + 1^3
 \end{aligned}$$

$$\mathbf{2022} := 6^4 + 5^4 + 3^4 + 2^4 + 1^4 + 1^4 + 1^4 + 1^4$$

In case of powers as 3 and 4, we used repeated numbers such as 1^3 and 1^4 . Moreover in one example negative values are also considered.

11.2 Powers of 2

$$\begin{aligned} \mathbf{2022} &:= 2^{11} - 2^5 + 2^2 + 2^1 \\ &:= 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^2 + 2^1 \\ &:= 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^4 - 2^3 - 2^2 + 2^1 \end{aligned}$$

Below is block os 10 numbers as power 3 starting from 2022

$$\begin{aligned} \mathbf{20220} &:= 2^3 + 5^3 + 8^3 + 11^3 + 13^3 + 14^3 + 15^3 + 16^3 + 18^3 \\ \mathbf{20221} &:= 2^3 + 5^3 + 13^3 + 14^3 + 15^3 + 17^3 + 19^3 \\ \mathbf{20222} &:= 10^3 + 11^3 + 14^3 + 15^3 + 17^3 + 19^3 \\ \mathbf{20223} &:= 1^3 + 10^3 + 11^3 + 14^3 + 15^3 + 17^3 + 19^3 \\ \mathbf{20224} &:= 4^3 + 6^3 + 12^3 + 15^3 + 16^3 + 17^3 + 18^3 \\ \mathbf{20225} &:= 8^3 + 9^3 + 13^3 + 16^3 + 18^3 + 19^3 \\ \mathbf{20226} &:= 4^3 + 15^3 + 16^3 + 18^3 + 19^3 \\ \mathbf{20227} &:= 1^3 + 4^3 + 15^3 + 16^3 + 18^3 + 19^3 \\ \mathbf{20228} &:= 1^3 + 3^3 + 6^3 + 10^3 + 13^3 + 16^3 + 18^3 + 19^3 \\ \mathbf{20229} &:= 5^3 + 8^3 + 10^3 + 12^3 + 14^3 + 15^3 + 17^3 + 18^3 \end{aligned}$$

12 Numbers From 1 to 100 in Terms of Digits of 2022

12.1 Numbers From 1 to 100 in Terms of Digits of 2022022

Below are numbers from 1 to 99 written in terms of digits of **2022** used twice, i.e., **2022022**. The reverse order **2022022** is also considered. There are lot of **extra brackets** in the reverse order. These can be removed after simplifications.

$\mathbf{1} := 2022/2022$	$= 2202/2202$	$\mathbf{5} := (20 - 22)^2 + 02/2$	$= 220/(22 \times (2 + 0 \times 2))$
$\mathbf{2} := 2 + 0 \times 222022$	$= 220222 \times 0 + 2$	$\mathbf{6} := 20 + 22 - (20 - 2) \times 2$	$= 2 + 2 - 0 \times 2220 + 2$
$\mathbf{3} := 20 - 22 + 20/(2 + 2)$	$= 2 + (2 + 0 \times 2220)/2$	$\mathbf{7} := (20/2 - 2 + 20)/(2 + 2)$	$= (2 \times (20 - 2) - 22)/02$
$\mathbf{4} := 202 - 220 + 22$	$= 2 + 2 + 0 \times 22202$	$\mathbf{8} := 20 - 2 - 220/22$	$= 220/22 + 2 \times 0 - 2$

9 := (20 + 222 × 0 - 2)/2	= 2 + 20 - 2 - 22/02	49 := 20 × 2 - 2 + (20 + 2)/2	= 2 × 20 - 2 + 22/02
10 := 2 × 0 × 2 + 220/22	= (2 - 202 + 220)/2	50 := 20 × 2 + 220/22	= 220/22 + 20 × 2
11 := 20 × (2 - 2) + (20 + 2)/2	= (22 + 0 × 2220)/2	51 := 20 + 22 + (20 - 2)/2	= (22 + 0 × 2)/2 + 20 × 2
12 := 20 + 2 - 220/22	= 220/22 - 2 × 0 + 2	52 := (20/(2 + 2) + 20) × 2 + 2	= 2 × 20 + 22 - 20/2
13 := 20/2 - 2 + 20/(2 × 2)	= 2 + (-20 + 22 + 20)/2	53 := 20 + 22/2 + 022	= 2 + 20 × 2 + 22/02
14 := 2 + 02 + 220/22	= 2 + 20/(22 - 20) + 2	54 := 20/2 + 22 + 022	= 22 + 022 + 20/2
15 := 20 + 2 - 2 - 20/(2 × 2)	= (220/22 + 20)/2	55 := (20 + 2)/2 + 2 × 022	= 22/02 + 22 × 02
16 := 20 + 222 × 0 - 2 - 2	= 2 ^{2+0×2220+2}	56 := 20 + 2 - 2 + (20 - 2) × 2	= 22 - 02 + 2 × (20 - 2)
17 := 20 - 22/(20 + 2) - 2	= 22 × 0 - 2/2 + 20 - 2	57 := (20 - 2) × 2 + 20 + 2/2	= 2 × 20 - 2/2 + 20 - 2
18 := 20 × (22 - 20) - 22	= 2 - 202 + 220 - 2	58 := 20 × 2 + 2 × 20 - 22	= 2 × 20 - 22 + 20 × 2
19 := 20 + 222 × 0 - 2/2	= 2 × 20 - (22 + 20)/2	59 := 20 × (2 + 2) - 20 - 2/2	= (2 × 20 - 2)/2 + 20 × 2
20 := 20/2 + 220/22	= 22 + 0 × 2220 - 2	60 := 20 - 2 - 2 + (20 + 2) × 2	= (220/22 + 20) × 2
21 := 20 + 22 - 20 - 2/2	= 2 + 20 - 22/(20 + 2)	61 := 20 + 22 + 20 - 2/2	= 2 × 20 + (22 + 20)/2
22 := 20222 × 0 + 22	= 22 + 0 × 22202	62 := 20 × (22 - 20) + 22	= 2 × (20 + 22 + 20)/2
23 := 20 + 2 + 22/022	= 2 + 20 + 22/(20 + 2)	63 := 20 + 22 + 20 + 2/2	= ((2 - 20)/2) ² - 20 + 2
24 := 2 - 0 × 2220 + 22	= 22 + 0 × 2220 + 2	64 := 20 - 22 × (20 - 22)	= 22 × 02 + 2 × 20/2
25 := 20 - 2 + 2 + 20/(2 × 2)	= 2 + 2 + (022 + 20)/2	65 := (20 + 2) × 2 + 20 + 2/2	= 2/2 + 02 ²⁺²⁺⁰²
26 := 20 + 22 - 20 + 2 + 2	= 22 + (022 - 20) ²	66 := 20 + 22 + 2 + 022	= 22 + 022 + 20 + 2
27 := (20 - 2) × 2 - (20 - 2)/2	= (2 × (20 - 2) - 2 + 20)/2	67 := 20 × 2 + 2 + 2 + 0! + 22	= 22 + 0! + 22 + 20 + 2
28 := 20 - 2 + 220/22	= 220/22 + 20 - 2	68 := (20 + 2) × 2 + 2 + 022	= 22 × 02 + 2 + 20 + 2
29 := 20/(2 + 2) + 2 + 022	= (2 - 20)/2 - 2 + 20 × 2	69 := 20 × (2 + 2) - (20 + 2)/2	= 2 × 20 × 2 - 22/02
30 := 20 × 2 - 220/22	= 2 + 20 × 2 - 2 - 20/2	70 := 20 + 2 + 2 × (2 + 022)	= 22 × (02 + 2) - 20 + 2
31 := 20 + 22/2 + 0 × 22	= (2 × 20 + 2)/2 + 20/2	71 := (20 × 2) × 2 - (20 - 2)/2	= (2 - 20)/2 + 2 × 20 × 2
32 := 20 + 2 + 220/22	= 220/22 + 20 + 2	72 := (2 + 02) × (2 × 20 - 22)	= (2 - 20 + 22) × (20 - 2)
33 := 2 + 022 + (20 - 2)/2	= 2 + (20 + 22 + 20)/2	73 := 2 × 02 × (-2 + 20) + 2/2	= 2 × (20 - 2) × 2 + 2/02
34 := (20 - 2) × 2 + 20 - 22	= 22 + 022 - 20/2	74 := 20 × 2 × 2 - 2 × 02 - 2	= 2 × (20 - 2) - 2 + 20 × 2
35 := (20 + 2)/2 + 20 + 2 + 2	= 22/02 + 22 + 02	75 := (20 × 2 - 2) × 2 - 02/2	= 2 × (20 × 2 - 2) - 2/02
36 := (20 + 222 × 0 - 2) × 2	= 2 - 20/2 + 22 × 02	76 := (20 × (22 - 20) - 2) × 2	= (2 × 20 - 22 + 20) × 2
37 := 20 + 22 - 20/(2 + 2)	= (2 × 20 - 2)/2 + 20 - 2	77 := 20 × 2 × 2 - 2 - 02/2	= 2 × 20 × 2 - 2/2 - 02
38 := (20 - 2) × 2 - 20 + 22	= 2 - (202 - 220) × 2	78 := 20 + 22 + (20 - 2) × 2	= 2 × 20 × (22 - 20) - 2
39 := 20 + (22 + 20)/2 - 2	= 2 + 20 - 2/2 + 20 - 2	79 := 20 × 2 × 2 + 2/02 - 2	= 2 × 20 × 2 + 2/2 - 02
40 := 20 + 22 + 20 - 22	= (2 - 202 + 220) × 2	80 := 20 + 22 + 20 × 2 - 2	= 2 × (20 + 222 × 0) × 2
41 := (20 + 22 + 20 × 2)/2	= (2 × 20 + 22 + 20)/2	81 := (20 - 2)/2 × (20 - 2)/2	= 2 + 20 × 2 × 2 - 2/02
42 := 20 - 222 × 0 + 22	= 2 + (20 + 222 × 0) × 2	82 := 20 × 2 × 2 - 20 + 22	= 2 × 20 × (22 - 20) + 2
43 := (20 + 22)/2 + 022	= 2 + 20 + (22 + 20)/2	83 := 2 + 02 × 2 × 20 + 2/2	= 2 × (20 + 22) - 2/02
44 := 20 + 22 - 20 + 22	= 22 × 02 + 22 × 0 × 2	84 := 20 + 22 + 20 + 22	= 2 × 20 + 22 + 20 + 2
45 := (20 - 2) × 2 + (20 - 2)/2	= 2/2 + 0 + 22 + 20 + 2	85 := 20/(2 × 2) + 20 × 2 × 2	= 2/2 + (022 + 20) × 2
46 := 2 - 022 × (20 - 22)	= 2 + (-20 + 22 + 20) × 2	86 := 20 + 22 × 2 + 022	= 22 × 02 + 2 × 20 + 2
47 := 20 + 22 + 20/(2 + 2)	= 2 + 2/02 + 22 × 02	87 := (2 + 02) × 22 - 02/2	= 22 × (02 + 2) - 2/02
48 := 2 × (022 - 20 + 22)	= 2 × (20 + 22 - 20) + 2	88 := (20 + 22 - 20) × (2 + 2)	= 22 × (022 - 20) × 2

$$\begin{aligned}
 \mathbf{89} &:= (20-2)/2 + 20 \times 2 \times 2 &= 2/2 + (02+2) \times (20+2) & \mathbf{96} &:= 20-2-2+20 \times 2 \times 2 &= (2 \times 20) \times 2 - (2-20) - 2 \\
 \mathbf{90} &:= 2 + (022+20+2) \times 2 &= (22/02-2) \times 20/2 & \mathbf{97} &:= (2+0!)^2 \times (2+20)/2 - 2 &= (2+20+2) \times (2+2) + (0 \times 2)! \\
 \mathbf{91} &:= 20/2 + ((2-20)/2)^2 &= 2 \times 20 \times 2 + 22/02 & \mathbf{98} &:= ((20-2)/2 + 20 \times 2) \times 2 &= 2+2 \times (022+2) \times 02 \\
 \mathbf{92} &:= 2+02+22 \times (02+2) &= 2+20/(2 \times 2) \times (20-2) & \mathbf{99} &:= 20-2/2+20 \times 2 \times 2 &= ((2-20)/2)^2 + 20-2 \\
 \mathbf{93} &:= 2 \times (0!+22) \times 2 + 0!^{22} &= (2+2) \times (022+2) - 0! - 2 & \mathbf{100} &:= 202 - (2+202)/2 &= 220/22 \times 20/2 \\
 \mathbf{94} &:= 20-2+(-2+20 \times 2) \times 2 &= 22 + (02+2) \times (20-2) & & & \\
 \mathbf{95} &:= (20-2/2) \times 20/(2+2) &= (2+20+2) \times (2+2) - (0 \times 2)! & & &
 \end{aligned}$$

The extension to higher numbers shall be given in another work.

12.2 Numbers From 1 to 100 in Terms of Digits of 20222202

Instead considering twice 2022 and 2202, below are numbers 1 to 100 where we have used **palindromic-type** digits of **20222202**. In this case we don't need to calculate reverse order.

$$\begin{aligned}
 \mathbf{1} &:= 20/(222-202) & \mathbf{26} &:= 20+2+22-20+2 & \mathbf{51} &:= 20+(22+2 \times 20)/2 \\
 \mathbf{2} &:= 2+0 \times 222202 & \mathbf{27} &:= (20/2+22 \times 2)/02 & \mathbf{52} &:= 20 \times 2+22-20/2 \\
 \mathbf{3} &:= 2+(0 \times 222202)! & \mathbf{28} &:= 20+(22+2-20) \times 2 & \mathbf{53} &:= 20+22/2+20+2 \\
 \mathbf{4} &:= 2-0 \times 22220+2 & \mathbf{29} &:= 20+2/2-2+20/2 & \mathbf{54} &:= 20+22+2+20/2 \\
 \mathbf{5} &:= 2+(0 \times 22220)!+2 & \mathbf{30} &:= (20+22-2+20)/2 & \mathbf{55} &:= (20+2)/2+22 \times 02 \\
 \mathbf{6} &:= 2 \times (0 \times 22220)!+2 & \mathbf{31} &:= 20-22/2+20+2 & \mathbf{56} &:= 20-2 \times (22-20 \times 2) \\
 \mathbf{7} &:= (20+22)/(2+2 \times 02) & \mathbf{32} &:= (20-22) \times (2-20+2) & \mathbf{57} &:= 20-2-2/2+20 \times 2 \\
 \mathbf{8} &:= 20/2+222 \times 0-2 & \mathbf{33} &:= 2 \times 0+22/2+20+2 & \mathbf{58} &:= 20+22-2+20-2 \\
 \mathbf{9} &:= (20-2+222 \times 0)/2 & \mathbf{34} &:= 20-22+2 \times (20-2) & \mathbf{59} &:= 20+2/2-2+20 \times 2 \\
 \mathbf{10} &:= (20+2222 \times 0)/2 & \mathbf{35} &:= 20-2-2/2+20-2 & \mathbf{60} &:= 20-2-2+22 \times 02 \\
 \mathbf{11} &:= (20-2)/(22-20)+2 & \mathbf{36} &:= (20-2+222 \times 0) \times 2 & \mathbf{61} &:= 20 \times 2+(22+20)/2 \\
 \mathbf{12} &:= 20/2-222 \times 0+2 & \mathbf{37} &:= 20-(2/2)^2+20-2 & \mathbf{62} &:= 20+22-2+20+2 \\
 \mathbf{13} &:= 20+2/2+2-20/2 & \mathbf{38} &:= 20-(22/2-20) \times 2 & \mathbf{63} &:= 20+22 \times 2-2/02 \\
 \mathbf{14} &:= 20-22-(2-20)-2 & \mathbf{39} &:= 20-2+(22+20)/2 & \mathbf{64} &:= 20+(22+22 \times 0) \times 2 \\
 \mathbf{15} &:= 20+(2-22)/(2 \times 02) & \mathbf{40} &:= 20+222-202 & \mathbf{65} &:= 20+22 \times 2+2/02 \\
 \mathbf{16} &:= 20-2+222 \times 0-2 & \mathbf{41} &:= 20+22/2+20/2 & \mathbf{66} &:= 20+22+2+20+2 \\
 \mathbf{17} &:= (20-22)/2+20-2 & \mathbf{42} &:= 2+0 \times 222+20 \times 2 & \mathbf{67} &:= 2+0!+22+2 \times 20+2 \\
 \mathbf{18} &:= 20+2222 \times 0-2 & \mathbf{43} &:= (20+22)/2+20+2 & \mathbf{68} &:= (20/2+22+2) \times 02 \\
 \mathbf{19} &:= 20 \times 2-(22+20)/2 & \mathbf{44} &:= 20+22+22 \times 0+2 & \mathbf{69} &:= (2-02/2+22) \times (0!+2) \\
 \mathbf{20} &:= 20-2+222 \times 0+2 & \mathbf{45} &:= 2+0!+2+22+20-2 & \mathbf{70} &:= (20/(2 \times 2)+2) \times 20/2 \\
 \mathbf{21} &:= 20+22/2-20/2 & \mathbf{46} &:= 20+2+22+2+0 \times 2 & \mathbf{71} &:= ((20-2)/2)^2-20/2 \\
 \mathbf{22} &:= 20+2222 \times 0+2 & \mathbf{47} &:= 2+0!^{22}+22 \times 02 & \mathbf{72} &:= 20 \times 2+22+20/2 \\
 \mathbf{23} &:= 2+0!+222-202 & \mathbf{48} &:= 20+2+22+2 \times 02 & \mathbf{73} &:= (20 \times 2-2) \times 2-2+0!-2 \\
 \mathbf{24} &:= (20-22-22) \times (0!-2) & \mathbf{49} &:= 20+22/2+20-2 & \mathbf{74} &:= 20 \times 2-2-(2-20) \times 2 \\
 \mathbf{25} &:= 20-(2-22)/(2 \times 02) & \mathbf{50} &:= 20/2+22+20-2 & \mathbf{75} &:= (20-2)/2+22 \times (0!+2)
 \end{aligned}$$

76 := $(20 \times 2 - 22 + 20) \times 2$	85 := $20 / (2 \times 2) + 2 \times 20 \times 2$	94 := $20 - 2 - 2 \times (2 - 20 \times 2)$
77 := $(2 \times 0)! - 2 - 2 + 2 \times 20 \times 2$	86 := $20 + 22 + 2 \times (20 + 2)$	95 := $(20 + 2 + 2) \times (2 + 2) - 0!^2$
78 := $20 + 22 + 2 \times (20 - 2)$	87 := $(2 + 0!) \times (22/2 + 20 - 2)$	96 := $(20 + 2 + 2) \times (2 + 2 + 0 \times 2)$
79 := $20 \times 2 \times 2 + 2/2 - 02$	88 := $(20 + 2) \times (22 - 20 + 2)$	97 := $(20 + 2 + 2) \times (2 + 2) + 0!^2$
80 := $20 + 22 + 2 \times 20 - 2$	89 := $(20 - 2)/2 + 2 \times 20 \times 2$	98 := $(20 \times 2 - 2) \times 2 + 20 + 2$
81 := $((20 - 2)/(22 - 20))^2$	90 := $(20 - 22/2) \times 20/2$	99 := $2 + 0! + 2 \times (22 + 2) \times 02$
82 := $2 + 0 + 02 \times (22 + 20 - 2)$	91 := $((20 - 2)/2)^2 + 20/2$	100 := $(202 - 22 + 20)/2$
83 := $(20 + 22) \times 2 - 2 + 0!^2$	92 := $20/2 + 2 + 2 \times 20 \times 2$	
84 := $20 + 2 + 22 + 20 \times 2$	93 := $(2 + 02) \times (22 + 2) - 0! - 2$	

The extension to higher numbers shall be given in another work.

13 Palindromic Days and Time

13.1 Palindromic Days

- Palindromic day on January 22 : 22.1.22 \Rightarrow 22122
- Palindromic day on February 22 : 22.2.22 \Rightarrow 22222
- Palindromic day on March 22 : 22.3.22 \Rightarrow 22322
- Palindromic day on April 22 : 22.4.22 \Rightarrow 22422
- Palindromic day on May 22 : 22.5.22 \Rightarrow 22522
- Palindromic day on June 22 : 22.6.22 \Rightarrow 22622
- Palindromic day on July 22 : 22.7.22 \Rightarrow 22722
- Palindromic day on August 22 : 22.8.22 \Rightarrow 22822
- Palindromic day on September 22 : 22.9.22 \Rightarrow 22922
- Palindromic day on November 22 : 22.11.22 \Rightarrow 221122

Also,

- Palindromic day on February 22 : 22.02.2022 \Rightarrow 22022022

13.2 Single Digit Day

- Single Digit day on February 22 : 22.2.22 \Rightarrow 22222.

13.3 Palindromic Times

- 22h 02m 0s 2022 \Rightarrow 220202022
- 22h 02m 1s 2022 \Rightarrow 220212022
- 22h 02m 2s 2022 \Rightarrow 220222022
- 22h 02m 3s 2022 \Rightarrow 220232022
- 22h 02m 4s 2022 \Rightarrow 220242022
- 22h 02m 5s 2022 \Rightarrow 220252022
- 22h 02m 6s 2022 \Rightarrow 220262022
- 22h 02m 7s 2022 \Rightarrow 220272022
- 22h 02m 8s 2022 \Rightarrow 220282022
- 22h 02m 9s 2022 \Rightarrow 220292022

- 22h 02m 00s 2022 \Rightarrow 2202002022
- 22h 02m 11s 2022 \Rightarrow 2202112022
- 22h 02m 22s 2022 \Rightarrow 2202222022
- 22h 02m 33s 2022 \Rightarrow 2202332022
- 22h 02m 44s 2022 \Rightarrow 2202442022
- 22h 02m 55s 2022 \Rightarrow 2202552022

It will happen every day in 2022. Still, we will have a single 11 digit palindrome just with number 2:

- 22h 22m 22s February 22: 22.22.22.22.2.22 \Rightarrow **22222222222**.

14 Upside Down and Mirror Looking

14.1 Upside Down

$$\begin{aligned}
 2022 &:= 69 + 619 + 619 + 619 + 96 \\
 &:= 6 + 9 + 69 + 609 + 609 + 609 + 96 + 9 + 6 \\
 &:= 9 + 1001 + 1 + 1 + 1 + 1 + 1 + 1001 + 6 \\
 &:= 1 + 1 + 6 + 9 + 619 + (1 + 1) * (6 + 9 + 69 + 609)
 \end{aligned}$$

See below **upside-down** numbers written with special fonts:

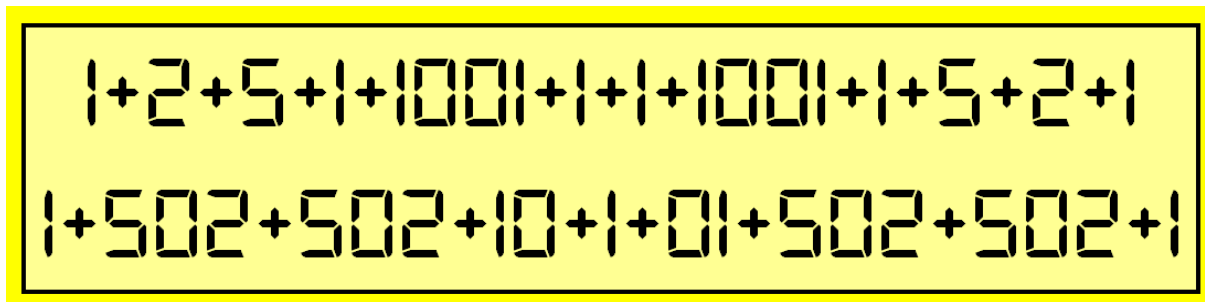
$$\begin{aligned}
 &69+619+619+619+96 \\
 &1+1+9+1001+1+1001+6+1+1 \\
 &6+9+69+609+609+609+96+9+6 \\
 &1+6+6+9+69+609+619+609+69+6+9+9+1
 \end{aligned}$$

14.2 Upside Down and Mirror Looking

$$\begin{aligned}
 2022 &:= 818 + 81 + 18 + 88 + 1 + 1 + 8 + 1 + 1 + 88 + 18 + 81 + 818 \\
 &:= 8 + 1 + 1 + 1001 + 1001 + 1 + 1 + 8 \\
 &:= 1 + 502 + 502 + 10 + 1 + 01 + 502 + 502 + 1 \\
 &:= 2 + 1 + 5 + 1 + 1001 + 1 + 1 + 1001 + 1 + 5 + 1 + 2
 \end{aligned}$$

See below **upside-down** and **mirror looking** numbers written in **digital fonts**:

$$\begin{aligned}
 &8+1+1+1001+1001+1+1+8 \\
 &1+1+8+1+8+88+8+8+8+8+88+8+1+8+1+1
 \end{aligned}$$



15 Pythagorean Triples and Patterns

15.1 Pythagorean Triples

$$\begin{aligned}
 1050^2 + 1728^2 &:= 2022^2 \\
 2022^2 + 2696^2 &:= 3370^2 \\
 2022^2 + 340704^2 &:= 340710^2 \\
 2022^2 + 113560^2 &:= 113578^2 \\
 2022^2 + 1022120^2 &:= 1022122^2
 \end{aligned}$$

15.2 Patterns in Pythagorean Triples

$$\begin{aligned}
 120^2 + 22^2 &= 122^2 &:= 14884^2 \\
 10200^2 + 202^2 &= 10202^2 &:= 104080804^2 \\
 1002000^2 + 2002^2 &= 1002002^2 &:= 1004008008004^2 \\
 100020000^2 + 20002^2 &= 100020002^2 &:= 10004000800080004^2
 \end{aligned}$$

$$\begin{aligned}
 20220^2 + 100089^2 &:= 102111^2 \\
 202220^2 + 1000989^2 &:= 1021211^2 \\
 2022220^2 + 10009989^2 &:= 10212211^2 \\
 20222220^2 + 100099989^2 &:= 102122211^2
 \end{aligned}$$

$$\begin{aligned}
 820224^2 + 848000^2 &:= 1179776^2 \\
 99820224^2 + 8480000^2 &:= 100179776^2 \\
 9999820224^2 + 84800000^2 &:= 10000179776^2 \\
 999999820224^2 + 848000000^2 &:= 1000000179776^2
 \end{aligned}$$

15.3 Pandigital Type Patterns With 22 and 2022

$$\begin{aligned}
 120^2 + 22^2 &= 122^2 \\
 12320^2 + 222^2 &= 12322^2 \\
 1234320^2 + 2222^2 &= 1234322^2 \\
 123454320^2 + 22222^2 &= 123454322^2 \\
 12345654320^2 + 222222^2 &= 12345654322^2 \\
 1234567654320^2 + 2222222^2 &= 1234567654322^2 \\
 123456787654320^2 + 22222222^2 &= 123456787654322^2 \\
 12345678987654320^2 + 222222222^2 &= 12345678987654322^2 \\
 1234567900987654320^2 + 2222222222^2 &= 1234567900987654322^2 \quad (1)
 \end{aligned}$$

$$\begin{aligned}
 0820224^2 + 848000^2 &:= 1179776^2 \\
 120820224^2 + 9328000^2 &:= 121179776^2 \\
 12320820224^2 + 94128000^2 &:= 12321179776^2 \\
 1234320820224^2 + 942128000^2 &:= 1234321179776^2 \\
 123454320820224^2 + 9422128000^2 &:= 123454321179776^2 \\
 12345654320820224^2 + 94222128000^2 &:= 12345654321179776^2 \\
 1234567654320820224^2 + 942222128000^2 &:= 1234567654321179776^2 \\
 123456787654320820224^2 + 9422222128000^2 &:= 123456787654321179776^2 \\
 12345678987654320820224^2 + 94222222128000^2 &:= 12345678987654321179776^2
 \end{aligned}$$

$$\begin{aligned}
 01719^2 + 18200^2 &:= 18281^2 \\
 1201719^2 + 200200^2 &:= 1218281^2 \\
 123201719^2 + 2020200^2 &:= 123218281^2 \\
 12343201719^2 + 20220200^2 &:= 12343218281^2 \\
 1234543201719^2 + 202220200^2 &:= 1234543218281^2 \\
 123456543201719^2 + 2022220200^2 &:= 123456543218281^2 \\
 12345676543201719^2 + 20222220200^2 &:= 12345676543218281^2 \\
 1234567876543201719^2 + 202222220200^2 &:= 1234567876543218281^2 \\
 123456789876543201719^2 + 2022222220200^2 &:= 123456789876543218281^2
 \end{aligned}$$

$$\begin{aligned}0991719^2 + 182000^2 &:= 1008281^2 \\120991719^2 + 2002000^2 &:= 121008281^2 \\12320991719^2 + 20202000^2 &:= 12321008281^2 \\1234320991719^2 + 202202000^2 &:= 1234321008281^2 \\123454320991719^2 + 2022202000^2 &:= 123454321008281^2 \\12345654320991719^2 + 20222202000^2 &:= 12345654321008281^2 \\1234567654320991719^2 + 202222202000^2 &:= 1234567654321008281^2 \\123456787654320991719^2 + 2022222202000^2 &:= 123456787654321008281^2 \\12345678987654320991719^2 + 20222222202000^2 &:= 12345678987654321008281^2\end{aligned}$$

$$\begin{aligned}0707319^2 + 1082000^2 &:= 1292681^2 \\120707319^2 + 11902000^2 &:= 121292681^2 \\12320707319^2 + 120102000^2 &:= 12321292681^2 \\1234320707319^2 + 1202102000^2 &:= 1234321292681^2 \\123454320707319^2 + 12022102000^2 &:= 123454321292681^2 \\12345654320707319^2 + 120222102000^2 &:= 12345654321292681^2 \\1234567654320707319^2 + 1202222102000^2 &:= 1234567654321292681^2 \\123456787654320707319^2 + 12022222102000^2 &:= 123456787654321292681^2 \\12345678987654320707319^2 + 120222222102000^2 &:= 12345678987654321292681^2\end{aligned}$$

$$\begin{aligned}0188199^2 + 1802000^2 &:= 1811801^2 \\120188199^2 + 19822000^2 &:= 121811801^2 \\12320188199^2 + 200022000^2 &:= 12321811801^2 \\1234320188199^2 + 2002022000^2 &:= 1234321811801^2 \\123454320188199^2 + 20022022000^2 &:= 123454321811801^2 \\12345654320188199^2 + 200222022000^2 &:= 12345654321811801^2 \\1234567654320188199^2 + 2002222022000^2 &:= 1234567654321811801^2 \\123456787654320188199^2 + 20022222022000^2 &:= 123456787654321811801^2 \\12345678987654320188199^2 + 200222222022000^2 &:= 12345678987654321811801^2\end{aligned}$$

$$\begin{aligned}0171900^2 + 1820000^2 &:= 1828100^2 \\ \mathbf{12}0171900^2 + 20020000^2 &:= \mathbf{12}1828100^2 \\ \mathbf{1232}0171900^2 + 202020000^2 &:= \mathbf{1232}1828100^2 \\ \mathbf{123432}0171900^2 + \mathbf{2022}020000^2 &:= \mathbf{123432}1828100^2 \\ \mathbf{12345432}0171900^2 + \mathbf{20222}020000^2 &:= \mathbf{12345432}1828100^2 \\ \mathbf{1234565432}0171900^2 + \mathbf{202222}020000^2 &:= \mathbf{1234565432}1828100^2 \\ \mathbf{123456765432}0171900^2 + \mathbf{2022222}020000^2 &:= \mathbf{123456765432}1828100^2 \\ \mathbf{12345678765432}0171900^2 + \mathbf{20222222}020000^2 &:= \mathbf{12345678765432}1828100^2 \\ \mathbf{1234567898765432}0171900^2 + \mathbf{202222222}020000^2 &:= \mathbf{1234567898765432}1828100^2\end{aligned}$$

$$\begin{aligned}0017919^2 + 1982000^2 &:= 1982081^2 \\ \mathbf{12}0017919^2 + 21802000^2 &:= \mathbf{12}1982081^2 \\ \mathbf{1232}0017919^2 + 220002000^2 &:= \mathbf{1232}1982081^2 \\ \mathbf{123432}0017919^2 + 2202002000^2 &:= \mathbf{123432}1982081^2 \\ \mathbf{12345432}0017919^2 + \mathbf{2022}002000^2 &:= \mathbf{12345432}1982081^2 \\ \mathbf{1234565432}0017919^2 + \mathbf{20222}002000^2 &:= \mathbf{1234565432}1982081^2 \\ \mathbf{123456765432}0017919^2 + \mathbf{202222}002000^2 &:= \mathbf{123456765432}1982081^2 \\ \mathbf{12345678765432}0017919^2 + \mathbf{2022222}002000^2 &:= \mathbf{12345678765432}1982081^2 \\ \mathbf{1234567898765432}0017919^2 + \mathbf{20222222}002000^2 &:= \mathbf{1234567898765432}1982081^2\end{aligned}$$

$$\begin{aligned}08\mathbf{2022}4^2 + 848000^2 &:= 1179776^2 \\ \mathbf{1020}08\mathbf{2022}4^2 + 85648000^2 &:= \mathbf{1020}1179776^2 \\ \mathbf{10203020}08\mathbf{2022}4^2 + 8565648000^2 &:= \mathbf{10203020}1179776^2 \\ \mathbf{102030403020}08\mathbf{2022}4^2 + 856565648000^2 &:= \mathbf{102030403020}1179776^2 \\ \mathbf{1020304050403020}08\mathbf{2022}4^2 + 85656565648000^2 &:= \mathbf{1020304050403020}1179776^2 \\ \mathbf{10203040506050403020}08\mathbf{2022}4^2 + 8565656565648000^2 &:= \mathbf{10203040506050403020}1179776^2 \\ \mathbf{102030405060706050403020}08\mathbf{2022}4^2 + 856565656565648000^2 &:= \mathbf{102030405060706050403020}1179776^2 \\ \mathbf{1020304050607080706050403020}08\mathbf{2022}4^2 + 85656565656565648000^2 &:= \mathbf{1020304050607080706050403020}1179776^2 \\ \mathbf{10203040506070809080706050403020}08\mathbf{2022}4^2 + 8565656565656565648000^2 &:= \mathbf{10203040506070809080706050403020}1179776^2\end{aligned}$$

15.4 More Pythagorean Triples With 2022

More Pythagorean triples with $20220 := 2020 \times 10$:

$20220^2 + 3707^2 := 20557^2$	$20220^2 + 567665^2 := 568025^2$
$20220^2 + 8425^2 := 21905^2$	$20220^2 + 681264^2 := 681564^2$
$20220^2 + 21231^2 := 29319^2$	$20220^2 + 1135600^2 := 1135780^2$
$20220^2 + 30667^2 := 36733^2$	$20220^2 + 1362753^2 := 1362903^2$
$20220^2 + 48528^2 := 52572^2$	$20220^2 + 1703475^2 := 1703595^2$
$20220^2 + 58975^2 := 62345^2$	$20220^2 + 2044192^2 := 2044292^2$
$20220^2 + 74477^2 := 77173^2$	$20220^2 + 2271335^2 := 2271425^2$
$20220^2 + 100089^2 := 102111^2$	$20220^2 + 3407040^2 := 3407100^2$
$20220^2 + 112669^2 := 114469^2$	$20220^2 + 5678432^2 := 5678468^2$
$20220^2 + 150976^2 := 152324^2$	$20220^2 + 6814125^2 := 6814155^2$
$20220^2 + 226688^2 := 227588^2$	$20220^2 + 10221200^2 := 10221220^2$
$20220^2 + 302963^2 := 303637^2$	$20220^2 + 17035344^2 := 17035356^2$
$20220^2 + 340407^2 := 341007^2$	
$20220^2 + 454051^2 := 454501^2$	

15.5 Magic Squares Generated by Pythagorean Triple

Below few examples of Pythagorean triples generating magic squares, where the number 1729 is one of the entries of magic squares.

1. $(135, 1008, 1017) \Rightarrow 1017 - 1008 = 3^2$, $S_{3 \times 3} := 6075$, $T_9 := 135^2$,
 $E := \{2017, 2019, \dots, 2031, 2033\}$ or $E := \{2021, 2022, \dots, 2028, 2029\}$
2. $(615, 21008, 21017) \Rightarrow 21017 - 21008 = 3^2$, $S_{3 \times 3} := 126075$, $T_9 := 615^2$,
 $E := \{42017, 42019, \dots, 42031, 42033\}$ or $E := \{42021, 42022, \dots, 42028, 42029\}$
3. $(636, 101123, 101125) \Rightarrow 101125 - 636 = 317^2$, $S_{317 \times 317} := 32258237$, $T_{100489} := 101123^2$,
 $E := \{1273, 1275, \dots, 202247, 202249\}$ or $E := \{51517, 51518, \dots, 152004, 152005\}$

15.6 Magic Squares

Based on triples given above, below are magic squares of orders 3 referring the first and second items.

15.6.1 Magic Square of Order 3×3

			6075
2024	2029	2022	6075
2023	2025	2027	6075
2028	2021	2026	6075
6075	6075	6075	6075

			126075
42024	42029	42022	126075
42023	42025	42027	126075
42028	42021	42026	126075
126075	126075	126075	126075

16 Fibonacci and Triangular Type Representations

16.1 Fibonacci Sequences

$$F(0) = F(1) = 1, F(n) = F(n-1) + F(n-2), n \geq 2,$$

$$0, 1, 1, 2, 3, 5, 8, 13, ..$$

Then,

$$\mathbf{22} := F(2) + F(8)$$

$$\mathbf{2022} := F(2) + F(7) + F(9) + F(14) + F(17)$$

16.1.1 Blocks of 10 With 2022

$$\mathbf{20220} := F(2) + F(7) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20221} := F(3) + F(7) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20222} := F(4) + F(7) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20223} := F(2) + F(4) + F(7) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20224} := F(5) + F(7) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20225} := F(2) + F(5) + F(7) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20226} := F(3) + F(5) + F(7) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20227} := F(8) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20228} := F(2) + F(8) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{20229} := F(3) + F(8) + F(10) + F(13) + F(15) + F(17) + F(22)$$

$$\mathbf{12022} := F(11) + F(16) + F(21)$$

$$\mathbf{22022} := F(3) + F(5) + F(9) + F(11) + F(19) + F(22)$$

$$\mathbf{32022} := F(2) + F(5) + F(8) + F(12) + F(15) + F(18) + F(23)$$

$$\mathbf{42022} := F(7) + F(10) + F(12) + F(15) + F(17) + F(21) + F(23)$$

$$\mathbf{52022} := F(3) + F(5) + F(7) + F(11) + F(14) + F(16) + F(19) + F(24)$$

$$\mathbf{62022} := F(2) + F(5) + F(12) + F(14) + F(19) + F(21) + F(24)$$

$$\mathbf{72022} := F(7) + F(9) + F(12) + F(16) + F(20) + F(22) + F(24)$$

$$\mathbf{82022} := F(2) + F(4) + F(6) + F(8) + F(10) + F(12) + F(20) + F(25)$$

$$\mathbf{92022} := F(2) + F(5) + F(9) + F(13) + F(17) + F(19) + F(21) + F(25)$$

16.2 Triangular Number

$$T(n) := \frac{n \times (n+1)}{2}, n \geq 0.$$

Then,

$$\mathbf{22} := T(1) + T(6)$$

$$\mathbf{2022} := T(3) + T(63)$$

16.2.1 Blocks of 10 With 2022

$$\mathbf{20220} := T(15) + T(200)$$

$$\mathbf{20221} := T(1) + T(15) + T(200)$$

$$\mathbf{20222} := T(4) + T(86) + T(181)$$

$$\mathbf{20223} := T(84) + T(182)$$

$$\mathbf{20224} := T(118) + T(162)$$

$$\mathbf{20225} := T(25) + T(199)$$

$$\mathbf{20226} := T(1) + T(25) + T(199)$$

$$\mathbf{20227} := T(61) + T(191)$$

$$\mathbf{20228} := T(1) + T(61) + T(191)$$

$$\mathbf{20229} := T(32) + T(198)$$

$$\mathbf{02022} := T(3) + T(63)$$

$$\mathbf{12022} := T(3) + T(44) + T(148)$$

$$\mathbf{22022} := T(4) + T(23) + T(208)$$

$$\mathbf{32022} := T(6) + T(78) + T(240)$$

$$\mathbf{42022} := T(28) + T(288)$$

$$\mathbf{52022} := T(1) + T(100) + T(306)$$

$$\mathbf{62022} := T(173) + T(306)$$

$$\mathbf{72022} := T(193) + T(326)$$

$$\mathbf{82022} := T(1) + T(114) + T(388)$$

$$\mathbf{92022} := T(68) + T(423)$$

17 Fixed Digits Repetitions Prime Patterns

17.1 Repetitions With 2022

17.1.1 Length 6

1 0781

1 2022 0781

1 2022 2022 0781

1 2022 2022 2022 0781

1 2022 2022 2022 2022 0781

1 2022 2022 2022 2022 2022 0781

1 1863

1 2022 1863

1 2022 2022 1863

1 2022 2022 2022 1863

1 2022 2022 2022 2022 1863

1 2022 2022 2022 2022 2022 1863

11542 9

11542 2022 9

11542 2022 2022 9

11542 2022 2022 2022 9

11542 2022 2022 2022 2022 9

11542 2022 2022 2022 2022 2022 9

17.1.2 Length 7

2367 083	2467649
2367 2022 083	2022 2467649
2367 2022 2022 083	2022 2022 2467649
2367 2022 2022 2022 083	2022 2022 2022 2467649
2367 2022 2022 2022 2022 083	2022 2022 2022 2022 2467649
2367 2022 2022 2022 2022 2022 083	2022 2022 2022 2022 2022 2467649
2367 2022 2022 2022 2022 2022 2022 083	2022 2022 2022 2022 2022 2022 2467649

9879953	51 1417
2022 9879953	51 2022 1417
2022 2022 9879953	51 2022 2022 1417
2022 2022 2022 9879953	51 2022 2022 2022 1417
2022 2022 2022 2022 9879953	51 2022 2022 2022 2022 1417
2022 2022 2022 2022 2022 9879953	51 2022 2022 2022 2022 2022 1417
2022 2022 2022 2022 2022 2022 9879953	51 2022 2022 2022 2022 2022 2022 1417

17.2 Prime Numbers With 22 and 2022

17.2.1 Length 8

22 156307	22 378141
22 48 156307	22 30 378141
22 48 48 156307	22 30 30 378141
22 48 48 48 156307	22 30 30 30 378141
22 48 48 48 48 156307	22 30 30 30 30 378141
22 48 48 48 48 48 156307	22 30 30 30 30 30 378141
22 48 48 48 48 48 48 156307	22 30 30 30 30 30 30 378141

22 846289
22 90 846289
22 90 90 846289
22 90 90 90 846289
22 90 90 90 90 846289
22 90 90 90 90 90 846289
22 90 90 90 90 90 90 846289

22 13143
22 624 13143
22 624 624 13143
22 624 624 624 13143
22 624 624 624 624 13143
22 624 624 624 624 624 13143
22 624 624 624 624 624 624 13143

22 143547
22 873 143547
22 873 873 143547
22 873 873 873 143547
22 873 873 873 873 143547
22 873 873 873 873 873 143547
22 873 873 873 873 873 873 143547

22 264309
22 759 264309
22 759 759 264309
22 759 759 759 264309
22 759 759 759 759 264309
22 759 759 759 759 759 264309
22 759 759 759 759 759 759 264309

22 416871
22 720 416871
22 720 720 416871
22 720 720 720 416871
22 720 720 720 720 416871
22 720 720 720 720 720 416871
22 720 720 720 720 720 720 416871

22 713127
22 891 713127
22 891 891 713127
22 891 891 891 713127
22 891 891 891 891 713127
22 891 891 891 891 891 713127
22 891 891 891 891 891 891 713127

22 994143
22 234 994143
22 234 234 994143
22 234 234 234 994143
22 234 234 234 234 994143
22 234 234 234 234 234 994143
22 234 234 234 234 234 234 994143

17.2.2 Length 7

234 1
234 91820223 1
234 91820223 91820223 1
234 91820223 91820223 91820223 1
234 91820223 91820223 91820223 91820223 1
234 91820223 91820223 91820223 91820223 91820223 1
234 91820223 91820223 91820223 91820223 91820223 91820223 1

23 83
23 20220240 83
23 20220240 20220240 83
23 20220240 20220240 20220240 83
23 20220240 20220240 20220240 20220240 83
23 20220240 20220240 20220240 20220240 20220240 83
23 20220240 20220240 20220240 20220240 20220240 20220240 83

382 1
382 49202295 1
382 49202295 49202295 1
382 49202295 49202295 49202295 1
382 49202295 49202295 49202295 49202295 1
382 49202295 49202295 49202295 49202295 49202295 1
382 49202295 49202295 49202295 49202295 49202295 49202295 1

859 9

859 22022271 9

859 22022271 22022271 9

859 22022271 22022271 22022271 9

859 22022271 22022271 22022271 22022271 9

859 22022271 22022271 22022271 22022271 22022271 9

859 22022271 22022271 22022271 22022271 22022271 22022271 9

86 47

86 12022068 47

86 12022068 12022068 47

86 12022068 12022068 12022068 47

86 12022068 12022068 12022068 12022068 47

86 12022068 12022068 12022068 12022068 12022068 47

86 12022068 12022068 12022068 12022068 12022068 12022068 47

91 33

91 20229309 33

91 20229309 20229309 33

91 20229309 20229309 20229309 33

91 20229309 20229309 20229309 20229309 33

91 20229309 20229309 20229309 20229309 20229309 33

91 20229309 20229309 20229309 20229309 20229309 20229309 33

1 520227

1 5673 520227

1 5673 5673 520227

1 5673 5673 5673 520227

1 5673 5673 5673 5673 520227

1 5673 5673 5673 5673 5673 520227

1 5673 5673 5673 5673 5673 5673 520227

15 20227

15 6735 20227

15 6735 6735 20227

15 6735 6735 6735 20227

15 6735 6735 6735 6735 20227

15 6735 6735 6735 6735 6735 20227

15 6735 6735 6735 6735 6735 6735 20227

1 920223	202286 3
1 5763 920223	202286 915 3
1 5763 5763 920223	202286 915 915 3
1 5763 5763 5763 920223	202286 915 915 915 3
1 5763 5763 5763 5763 920223	202286 915 915 915 915 3
1 5763 5763 5763 5763 5763 920223	202286 915 915 915 915 915 3
1 5763 5763 5763 5763 5763 5763 920223	202286 915 915 915 915 915 915 3

202286 3	20228 93
202286 9198 3	20228 987 93
202286 9198 9198 3	20228 987 987 93
202286 9198 9198 9198 3	20228 987 987 987 93
202286 9198 9198 9198 9198 3	20228 987 987 987 987 93
202286 9198 9198 9198 9198 9198 3	20228 987 987 987 987 987 93
202286 9198 9198 9198 9198 9198 9198 3	20228 987 987 987 987 987 987 93

7202269	120220 19
720226 8853 9	120220 474 19
720226 8853 8853 9	120220 474 474 19
720226 8853 8853 8853 9	120220 474 474 474 19
720226 8853 8853 8853 8853 9	120220 474 474 474 474 19
720226 8853 8853 8853 8853 8853 9	120220 474 474 474 474 474 19
720226 8853 8853 8853 8853 8853 8853 9	120220 474 474 474 474 474 474 19

120226 97
120226 819 97
120226 819 819 97
120226 819 819 819 97
120226 819 819 819 819 97
120226 819 819 819 819 819 97
120226 819 819 819 819 819 819 97

120227 89
120227 411 89
120227 411 411 89
120227 411 411 411 89
120227 411 411 411 411 89
120227 411 411 411 411 411 89
120227 411 411 411 411 411 411 89

12202279
111 12202279
111 111 12202279
111 111 111 12202279
111 111 111 111 12202279
111 111 111 111 111 12202279
111 111 111 111 111 111 12202279

1 2202279
1 111 2202279
1 111 111 2202279
1 111 111 111 2202279
1 111 111 111 111 2202279
1 111 111 111 111 111 2202279
1 111 111 111 111 111 111 2202279

171 20227
171 855 20227
171 855 855 20227
171 855 855 855 20227
171 855 855 855 855 20227
171 855 855 855 855 855 20227
171 855 855 855 855 855 855 20227

183 20227
183 855 20227
183 855 855 20227
183 855 855 855 20227
183 855 855 855 855 20227
183 855 855 855 855 855 20227
183 855 855 855 855 855 855 20227

2 0221697	20224 661
2 531 0221697	20224 951 661
2 531 531 0221697	20224 951 951 661
2 531 531 531 0221697	20224 951 951 951 661
2 531 531 531 531 0221697	20224 951 951 951 951 661
2 531 531 531 531 531 0221697	20224 951 951 951 951 951 661
2 531 531 531 531 531 531 0221697	20224 951 951 951 951 951 951 661
20225897	20228683
678 20225897	2022 396 8683
678 678 20225897	2022 396 396 8683
678 678 678 20225897	2022 396 396 396 8683
678 678 678 678 20225897	2022 396 396 396 396 8683
678 678 678 678 678 20225897	2022 396 396 396 396 396 8683
678 678 678 678 678 678 20225897	2022 396 396 396 396 396 396 8683
2 2022167	30202241
2 906 2022167	786 30202241
2 906 906 2022167	786 786 30202241
2 906 906 906 2022167	786 786 786 30202241
2 906 906 906 906 2022167	786 786 786 786 30202241
2 906 906 906 906 906 2022167	786 786 786 786 786 30202241
2 906 906 906 906 906 906 2022167	786 786 786 786 786 786 30202241

4920224 9

4920224 405 9

4920224 405 405 9

4920224 405 405 405 9

4920224 405 405 405 405 9

4920224 405 405 405 405 405 9

4920224 405 405 405 405 405 405 9

6202283 3

6202283 588 3

6202283 588 588 3

6202283 588 588 588 3

6202283 588 588 588 588 3

6202283 588 588 588 588 588 3

6202283 588 588 588 588 588 588 3

7420 2223

7420 294 2223

7420 294 294 2223

7420 294 294 294 2223

7420 294 294 294 294 2223

7420 294 294 294 294 294 2223

7420 294 294 294 294 294 294 2223

74202 223

74202 942 223

74202 942 942 223

74202 942 942 942 223

74202 942 942 942 942 223

74202 942 942 942 942 942 223

74202 942 942 942 942 942 942 223

86202253

945 86202253

945 945 86202253

945 945 945 86202253

945 945 945 945 86202253

945 945 945 945 945 86202253

945 945 945 945 945 945 86202253

18 Embedded Prime Numbers Patterns

18.1 Palindromic Prime Numbers Embedded With 2022

1011 **2022** 1 **2202** 1101
1021011 **2022** 1 **2202** 1101201
1111011021011 **2022** 1 **2202** 1101201101111
120211111011021011 **2022** 1 **2202** 110120110111112021
111201120211111011021011 **2022** 1 **2202** 110120110111112021102111
101101111201120211111011021011 **2022** 1 **2202** 110120110111112021102111101101
102212101101111201120211111011021011 **2022** 1 **2202** 110120110111112021102111101101212201
110101102212101101111201120211111011021011 **2022** 1 **2202** 110120110111112021102111101101212201101011
... ..

32 **2022** 3 **2202** 23
33232 **2022** 3 **2202** 23233
30223233232 **2022** 3 **2202** 23233232203
3330223233232 **2022** 3 **2202** 2323323220333
320323330223233232 **2022** 3 **2202** 232332322033323023
3203320323330223233232 **2022** 3 **2202** 2323323220333230233023
333203320323330223233232 **2022** 3 **2202** 232332322033323023302333
33322333203320323330223233232 **2022** 3 **2202** 23233232203332302330233322333
33233322333203320323330223233232 **2022** 3 **2202** 23233232203332302330233322333233
3002233233322333203320323330223233232 **2022** 3 **2202** 2323323220333230233023332233323322003
... ..

777 **2022** 7 **2202** 777
70202777 **2022** 7 **2202** 77720207
707270202777 **2022** 7 **2202** 777202072707
72707270202777 **2022** 7 **2202** 77720207270727
7272272707270202777 **2022** 7 **2202** 7772020727072722727
707227272272707270202777 **2022** 7 **2202** 777202072707272272722707
7707227272272707270202777 **2022** 7 **2202** 7772020727072722727227077
7777707227272272707270202777 **2022** 7 **2202** 7772020727072722727227077777
70077777707227272272707270202777 **2022** 7 **2202** 77720207270727227272270777777007
770027007777707227272272707270202777 **2022** 7 **2202** 7772020727072722727227077777700720077

... ..

9029 **2022** 9 **2202** 9209
9099029 **2022** 9 **2202** 9209909
90299099029 **2022** 9 **2202** 92099099209
9202990299099029 **2022** 9 **2202** 9209909920992029
90099202990299099029 **2022** 9 **2202** 92099099209920299009
90099990099202990299099029 **2022** 9 **2202** 92099099209920299009999009
999290099990099202990299099029 **2022** 9 **2202** 920990992099202990099990092999
999999290099990099202990299099029 **2022** 9 **2202** 920990992099202990099990092999999
99922999999290099990099202990299099029 **2022** 9 **2202** 92099099209920299009999009299999922999
992999922999999290099990099202990299099029 **2022** 9 **2202** 920990992099202990099990092999999229999299

... ..

18.2 Non Palindromic Prime Numbers Embedded With 2022

101 **2022** 101
1022101 **2022** 1012201
112111022101 **2022** 101220111211
12111112111022101 **2022** 10122011121111121
10212111112111022101 **2022** 10122011121111121201
11110212111112111022101 **2022** 10122011121111121201111
12221110212111112111022101 **2022** 101220111211111212011112221
121101122211110212111112111022101 **2022** 101220111211111212011112221101121
122001121101122211110212111112111022101 **2022** 101220111211111212011112221101121100221
101122001121101122211110212111112111022101 **2022** 101220111211111212011112221101121100221101

... ..

32 **2022** 23
330232 **2022** 232033
3330232 **2022** 2320333
30333330232 **2022** 23203333303
30330333330232 **2022** 232033333303303
33330330333330232 **2022** 232033333303303333
3333330330333330232 **2022** 23203333330330333333
333333303303333330232 **2022** 2320333333033033333333
33333333303303333330232 **2022** 232033333303303333333333
322023333333330330333330232 **2022** 23203333330330333333333320223
... ..

707 **2022** 707
7227707 **2022** 7077227
77727227707 **2022** 70772272777
7277727227707 **2022** 7077227277727
7277277727227707 **2022** 7077227277727727
720027277277727227707 **2022** 707722727772772720027
7720027277277727227707 **2022** 7077227277727727200277
702277720027277277727227707 **2022** 707722727772772720027772207
707222702277720027277277727227707 **2022** 707722727772772720027772207222707
777707222702277720027277277727227707 **2022** 707722727772772720027772207222707777
... ..

9209 **2022** 9029
99209 **2022** 90299
990999209 **2022** 902999099
92990999209 **2022** 90299909929
900992990999209 **2022** 902999099299009
929002900992990999209 **2022** 902999099299009200929
92922929002900992990999209 **2022** 90299909929900920092922929
9009292922929002900992990999209 **2022** 9029990992990092009292292929009
90299029009292922929002900992990999209 **2022** 90299909929900920092922929290092099209
... ..

19 Magic Square Type Embedded Palprimes

This section brings magic square type **palindromic prime numbers**, sometimes called as **palprimes**, where rows, columns and principal diagonals are also **palprimes**. The embedded properties are also true. Here we have given three examples of order 7×7 , where there is symmetry in representations

19.1 Magic Square Type Properties

1	1	1	1	9	1	1	1	1
1	0	0	0	3	0	0	0	1
1	0	2	2	0	2	2	0	1
1	7	2	6	5	6	2	7	1
9	6	0	8	7	8	0	6	9
1	7	2	6	5	6	2	7	1
1	0	2	2	0	2	2	0	1
1	0	0	0	3	0	0	0	1
1	1	1	1	9	1	1	1	1

1	1	1	1	9	1	1	1	1
1	0	0	0	3	0	0	0	1
1	1	3	5	3	5	3	1	1
1	9	2	2	0	2	2	9	1
9	1	1	6	1	6	1	1	9
1	9	2	2	0	2	2	9	1
1	1	3	5	3	5	3	1	1
1	0	0	0	3	0	0	0	1
1	1	1	1	9	1	1	1	1

1	1	1	1	9	1	1	1	1
1	0	0	0	3	0	0	0	1
1	1	5	6	3	6	5	1	1
1	0	2	2	0	2	2	0	1
9	3	7	7	7	7	7	3	9
1	0	2	2	0	2	2	0	1
1	1	5	6	3	6	5	1	1
1	0	0	0	3	0	0	0	1
1	1	1	1	9	1	1	1	1

1	1	1	1	9	1	1	1	1
1	0	0	0	3	0	0	0	1
1	1	8	6	2	6	8	1	1
1	9	2	2	0	2	2	9	1
9	1	1	7	1	7	1	1	9
1	9	2	2	0	2	2	9	1
1	1	8	6	2	6	8	1	1
1	0	0	0	3	0	0	0	1
1	1	1	1	9	1	1	1	1

1	1	1	1	9	1	1	1	1
1	0	0	0	3	0	0	0	1
1	3	2	5	3	5	2	3	1
1	9	2	2	0	2	2	9	1
9	3	7	7	7	7	7	3	9
1	9	2	2	0	2	2	9	1
1	3	2	5	3	5	2	3	1
1	0	0	0	3	0	0	0	1
1	1	1	1	9	1	1	1	1

1	1	1	1	9	1	1	1	1
1	0	0	0	3	0	0	0	1
1	6	3	4	3	4	3	6	1
1	9	2	2	0	2	2	9	1
9	2	1	2	1	2	1	2	9
1	9	2	2	0	2	2	9	1
1	6	3	4	3	4	3	6	1
1	0	0	0	3	0	0	0	1
1	1	1	1	9	1	1	1	1

The above examples are just have the properties similar to magic squares, i.e., these are palindromic prime numbers in rows columns and in principal diagonals. These don't have the embedded prime properties. Below are few examples with this property.

19.2 Magic Square Type Palprimes With Embedded Properties

3 7 1 9 1 9 1 7 3	1 7 3 7 7 7 3 7 1
7 8 8 8 6 8 8 8 7	7 5 2 2 0 2 2 5 7
1 8 2 2 0 2 2 8 1	3 2 4 3 4 3 4 2 3
9 8 2 8 8 8 2 8 9	7 2 3 4 0 4 3 2 7
1 6 0 8 7 8 0 6 1	7 0 4 0 9 0 4 0 7
9 8 2 8 8 8 2 8 9	7 2 3 4 0 4 3 2 7
1 8 2 2 0 2 2 8 1	3 2 4 3 4 3 4 2 3
7 8 8 8 6 8 8 8 7	7 5 2 2 0 2 2 5 7
3 7 1 9 1 9 1 7 3	1 7 3 7 7 7 3 7 1

Below are **embedded properties** of above two sets of **magic square type palprimes**:

160878061
 982888289 160878061 982888289
 788868887 182**2022**81 982888289 160878061 982888289 182**2022**81 788868887
 371919173 788868887 182**2022**81 982888289 160878061 982888289 182**2022**81 788868887 371919173

704090407
 723404327 704090407 723404327
 324343423 723404327 704090407 723404327 324343423
 173777371 752**2022**57 324343423 723404327 704090407 723404327 324343423 752**2022**57 173777371

By **embedded property** it is understood that two groups of 4 **palprimes** are **prime numbers**.

20 Palindromic-Type Expressions and Patterns

20.1 Reverse Square

The year 2022 and 2202 are reverse of each other. The squares, i.e., $2022^2 := 4088484$ and $2202^2 := 4848804$ are also reverse of each other. See below the pattern with this property

20.2 Palindromic-Type Square Expressions

Below are patterns with square of 2022 or square of numbers with 2022.

$$\begin{aligned} 2022^2 + 2202^2 &:= 4088484 + 4848804 \\ 20022^2 + 22002^2 &:= 400880484 + 484088004 \\ 200022^2 + 220002^2 &:= 40008800484 + 48400880004 \\ 2000022^2 + 2200002^2 &:= 4000088000484 + 4840008800004 \end{aligned}$$

$$\begin{aligned} 20221^2 + 12202^2 &= 408888841 + 148888804 \\ 200221^2 + 122002^2 &= 40088448841 + 14884488004 \\ 2000221^2 + 1220002^2 &= 4000884048841 + 1488404880004 \\ 20000221^2 + 12200002^2 &= 400008840048841 + 148840048800004 \end{aligned}$$

$$\begin{aligned} 2022001^2 + 1002202^2 &= 4088488044001 + 1004408848804 \\ 20220001^2 + 10002202^2 &= 408848440440001 + 100044044848804 \\ 202200001^2 + 100002202^2 &= 40884840404400001 + 10000440404848804 \\ 2022000001^2 + 1000002202^2 &= 4088484004044000001 + 1000004404004848804 \\ 20220000001^2 + 10000002202^2 &= 408848400040440000001 + 100000044040004848804 \end{aligned}$$

$$\begin{aligned} 20220002^2 + 20002202^2 &= 408848480880004 + 400088084848804 \\ 202200002^2 + 200002202^2 &= 40884840808800004 + 40000880804848804 \\ 2022000002^2 + 2000002202^2 &= 4088484008088000004 + 4000008808004848804 \\ 20220010002^2 + 20001002202^2 &= 408848804480980040004 + 400040089084408848804 \end{aligned}$$

$$\begin{aligned} 20220011^2 + 11002202^2 &= 408848844840121 + 121048448848804 \\ 202200011^2 + 110002202^2 &= 40884844448400121 + 12100484444848804 \\ 2022000011^2 + 1100002202^2 &= 4088484044484000121 + 1210004844404848804 \\ 20220000011^2 + 11000002202^2 &= 408848400444840000121 + 121000048444004848804 \end{aligned}$$

$$\begin{aligned} 202200111^2 + 111002202^2 &= 40884884888412321 + 12321488848848804 \\ 2022000111^2 + 1110002202^2 &= 4088484448884012321 + 1232104888444848804 \\ 20220000111^2 + 11100002202^2 &= 408848404488840012321 + 123210048884404848804 \end{aligned}$$

20.3 Palindromic-Type Expressions

$$2022 \times 11 + 11 \times 2202 = 22242 + 24222$$

$$2022 \times 12 + 21 \times 2202 = 24264 + 46242$$

$$2022 \times 13 + 31 \times 2202 = 26286 + 68262$$

$$2022 \times 21 + 12 \times 2202 = 42462 + 26424$$

$$2022 \times 22 + 22 \times 2202 = 44484 + 48444$$

$$2022 \times 31 + 13 \times 2202 = 62682 + 28626$$

$$2022 \times 101 + 101 \times 2202 = 204222 + 222402$$

$$2022 \times 102 + 201 \times 2202 = 206244 + 442602$$

$$2022 \times 103 + 301 \times 2202 = 208266 + 662802$$

$$2022 \times 111 + 111 \times 2202 = 224442 + 244422$$

$$2022 \times 112 + 211 \times 2202 = 226464 + 464622$$

$$2022 \times 113 + 311 \times 2202 = 228486 + 684822$$

$$2022 \times 121 + 121 \times 2202 = 244662 + 266442$$

$$2022 \times 122 + 221 \times 2202 = 246684 + 486642$$

$$2022 \times 131 + 131 \times 2202 = 264882 + 288462$$

$$2022 \times 201 + 102 \times 2202 = 406422 + 224604$$

$$2022 \times 202 + 202 \times 2202 = 408444 + 444804$$

$$2022 \times 211 + 112 \times 2202 = 426642 + 246624$$

$$2022 \times 212 + 212 \times 2202 = 428664 + 466824$$

$$2022 \times 221 + 122 \times 2202 = 446862 + 268644$$

$$2022 \times 222 + 222 \times 2202 = 448884 + 488844$$

$$2022 \times 301 + 103 \times 2202 = 608622 + 226806$$

$$2022 \times 311 + 113 \times 2202 = 628842 + 248826$$

$$2022 \times 1001 + 1001 \times 2202 = 2024022 + 2204202$$

$$2022 \times 1002 + 2001 \times 2202 = 2026044 + 4406202$$

$$2022 \times 1003 + 3001 \times 2202 = 2028066 + 6608202$$

$$2022 \times 1011 + 1101 \times 2202 = 2044242 + 2424402$$

$$2022 \times 1012 + 2101 \times 2202 = 2046264 + 4626402$$

$$2022 \times 1013 + 3101 \times 2202 = 2048286 + 6828402$$

$$\begin{aligned}2022 \times 1021 + 1201 \times 2202 &= 2064462 + 2644602 \\2022 \times 1022 + 2201 \times 2202 &= 2066484 + 4846602 \\2022 \times 1031 + 1301 \times 2202 &= 2084682 + 2864802 \\2022 \times 1101 + 1011 \times 2202 &= 2226222 + 2226222 \\2022 \times 1102 + 2011 \times 2202 &= 2228244 + 4428222 \\2022 \times 1111 + 1111 \times 2202 &= 2246442 + 2446422 \\2022 \times 1112 + 2111 \times 2202 &= 2248464 + 4648422 \\2022 \times 1121 + 1211 \times 2202 &= 2266662 + 2666622 \\2022 \times 1122 + 2211 \times 2202 &= 2268684 + 4868622 \\2022 \times 1131 + 1311 \times 2202 &= 2286882 + 2886822 \\2022 \times 1201 + 1021 \times 2202 &= 2428422 + 2248242 \\2022 \times 1211 + 1121 \times 2202 &= 2448642 + 2468442 \\2022 \times 1221 + 1221 \times 2202 &= 2468862 + 2688642 \\2022 \times 2001 + 1002 \times 2202 &= 4046022 + 2206404 \\2022 \times 2002 + 2002 \times 2202 &= 4048044 + 4408404 \\2022 \times 2011 + 1102 \times 2202 &= 4066242 + 2426604 \\2022 \times 2012 + 2102 \times 2202 &= 4068264 + 4628604 \\2022 \times 2021 + 1202 \times 2202 &= 4086462 + 2646804\end{aligned}$$

20.4 Palindromic-Type Patterns

$$\begin{aligned}2022 \times 11 + 11 \times 2202 &= 22242 + 24222 \\2022 \times 111 + 111 \times 2202 &= 224442 + 244422 \\2022 \times 1111 + 1111 \times 2202 &= 2246442 + 2446422 \\2022 \times 11111 + 11111 \times 2202 &= 22466442 + 24466422 \\2022 \times 22 + 22 \times 2202 &= 44484 + 48444 \\2022 \times 222 + 222 \times 2202 &= 448884 + 488844 \\2022 \times 2222 + 2222 \times 2202 &= 4492884 + 4892844 \\2022 \times 22222 + 22222 \times 2202 &= 44932884 + 48932844\end{aligned}$$

$$\begin{aligned}2022 \times 11 + 11 \times 2202 &= 22242 + 24222 \\2022 \times 101 + 101 \times 2202 &= 204222 + 222402 \\2022 \times 1001 + 1001 \times 2202 &= 2024022 + 2204202 \\2022 \times 10001 + 10001 \times 2202 &= 20222022 + 22022202\end{aligned}$$

$$\begin{aligned}2022 \times 13 + 31 \times 2202 &= 26286 + 68262 \\2022 \times 103 + 301 \times 2202 &= 208266 + 662802 \\2022 \times 1003 + 3001 \times 2202 &= 2028066 + 6608202 \\2022 \times 10003 + 30001 \times 2202 &= 22026066 + 66062202\end{aligned}$$

$$\begin{aligned}2022 \times 12 + 21 \times 2202 &= 24264 + 46242 \\2022 \times 102 + 201 \times 2202 &= 206244 + 442602 \\2022 \times 1002 + 2001 \times 2202 &= 2026044 + 4406202 \\2022 \times 10002 + 20001 \times 2202 &= 22024044 + 44042202\end{aligned}$$

$$\begin{aligned}2022 \times 12 + 21 \times 2202 &= 24264 + 46242 \\2022 \times 112 + 211 \times 2202 &= 226464 + 464622 \\2022 \times 1112 + 2111 \times 2202 &= 2248464 + 4648422 \\2022 \times 11112 + 21111 \times 2202 &= 22468464 + 46486422\end{aligned}$$

$$\begin{aligned}20221 \times 11 + 11 \times 12202 &= 222431 + 134222 \\20221 \times 101 + 101 \times 12202 &= 2042321 + 1232402 \\20221 \times 11011 + 11011 \times 12202 &= 222653431 + 134356222 \\20221 \times 1110111 + 1110111 \times 12202 &= 22447554531 + 13545574422\end{aligned}$$

21 Magic Squares

In this section there are few magic squares connected with 2022. These are of type block-wise, bordered and also two digits

21.1 Upside-Down Two Digits Magic Square With 22 and 2022

Below is magic square of order 4 with same digits are of 2022, i.e., 0 and 2. It is written in such a way that it can be seen **upside-down** with the same sum.

		4444	4444	4444	4444	
	0220	2022	0000	2202	4444	
4444	0002	2200	0222	2020	4444	
4444	2222	0020	2002	0200	4444	
4444	2000	0202	2220	0022	4444	
	4444	4444	4444	4444	4444	

See below the both magic squares. **Original** and **upside-down**:

0220	2022	0000	2202
0002	2200	0222	2020
2222	0020	2002	0200
2000	0202	2220	0022

2200	0222	2020	0002
0020	2002	0200	2222
0202	2220	0022	2000
2022	0000	2202	0220

The above magic is also **mirror looking**, but different magic sum as in mirror 2 becomes 5. There is no more 22 and 2022. They become 55 and 5505.

21.2 Bordered and Block-Bordered Magic Square of Order 11 With Magic Sum 22

21.2.1 First Type: Bordered Magic Square of Order 11 With Magic Sum 22

											22
-47	-39	-41	-43	-45	54	55	57	59	61	-49	22
62	-31	41	39	37	36	-27	-25	-23	-29	-58	22
60	-38	-15	-11	-13	22	23	25	-17	42	-56	22
58	-36	26	-7	-10	10	8	9	-22	40	-54	22
56	-34	24	13	3	-2	5	-9	-20	38	-52	22
-48	34	-16	12	4	2	0	-8	20	-30	52	22
-46	32	-14	-3	-1	6	1	7	18	-28	50	22
-44	30	-12	-5	14	-6	-4	11	16	-26	48	22
-42	28	21	15	17	-18	-19	-21	19	-24	46	22
-40	33	-37	-35	-33	-32	31	29	27	35	44	22
53	43	45	47	49	-50	-51	-53	-55	-57	51	22
22	22	22	22	22	22	22	22	22	22	22	22

In this example, the magic sums are

$$S_{3 \times 3} := 2022 \times \frac{4}{12} = 6$$

$$S_{5 \times 5} := 2022 \times \frac{6}{12} = 10$$

$$S_{7 \times 7} := 2022 \times \frac{8}{12} = 14$$

$$S_{9 \times 9} := 2022 \times \frac{10}{12} = 18$$

$$S_{11 \times 11} := 2022 \times \frac{12}{12} = 22$$

21.2.2 Second Type: Block-Bordered Magic Square of Order 11 With Magic Sum 22

											22
-47	-39	-41	-43	-45	54	55	57	59	61	-49	22
62	-17	32	-9	-12	25	-7	-19	30	-5	-58	22
60	-4	-18	28	-11	-16	33	-6	-14	26	-56	22
58	27	-8	-13	29	-3	-20	31	-10	-15	-54	22
56	1	-31	36	6	-38	38	-1	-33	40	-52	22
-48	41	0	-35	34	2	-30	39	4	-37	52	22
-46	-36	37	5	-34	42	-2	-32	35	3	50	22
-44	19	14	-27	24	7	-25	17	12	-23	48	22
-42	-22	18	10	-29	20	15	-24	22	8	46	22
-40	9	-26	23	11	-21	16	13	-28	21	44	22
53	43	45	47	49	-50	-51	-53	-55	-57	51	22
22	22	22	22	22	22	22	22	22	22	22	22

In this case the inner magic square is of order 9 with different magic sums. The magic sums of orders 9 and 11 are respectively, $S_{9 \times 9} := 18$ and $S_{11 \times 11} := 22$.

21.3 Magic Squares of Order 12 With Magic Sum 2022

Below are three **block-wise** of order 12 with magic sums 2022. These are with blocks of magic squares of orders 3, 4 and 6.

21.3.1 First Type: Blocks of Order 3

		2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022
	194	97	147	168	118	215	174	124	221	236	139	189	2022
2022	99	146	193	214	167	120	220	173	126	141	188	235	2022
2022	145	195	98	119	216	166	125	222	172	187	237	140	2022
2022	227	130	180	183	133	230	153	103	200	209	112	162	2022
2022	132	179	226	229	182	135	199	152	105	114	161	208	2022
2022	178	228	131	134	231	181	104	201	151	160	210	113	2022
2022	163	213	116	101	198	148	143	240	190	169	219	122	2022
2022	117	164	211	196	149	102	238	191	144	123	170	217	2022
2022	212	115	165	150	100	197	192	142	239	218	121	171	2022
2022	184	234	137	128	225	175	110	207	157	154	204	107	2022
2022	138	185	232	223	176	129	205	158	111	108	155	202	2022
2022	233	136	186	177	127	224	159	109	206	203	106	156	2022
	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022

The magic square is **pandiagonal**, but the blocks of order 3 are magic squares with different magic sums.

21.3.2 Second Type: Blocks of Order 4

		2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022
	151	204	97	222	152	203	98	221	153	202	99	220	2022
2022	114	205	168	187	113	206	167	188	112	207	166	189	2022
2022	240	115	186	133	239	116	185	134	238	117	184	135	2022
2022	169	150	223	132	170	149	224	131	171	148	225	130	2022
2022	154	201	100	219	155	200	101	218	156	199	102	217	2022
2022	111	208	165	190	110	209	164	191	109	210	163	192	2022
2022	237	118	183	136	236	119	182	137	235	120	181	138	2022
2022	172	147	226	129	173	146	227	128	174	145	228	127	2022
2022	157	198	103	216	158	197	104	215	159	196	105	214	2022
2022	108	211	162	193	107	212	161	194	106	213	160	195	2022
2022	234	121	180	139	233	122	179	140	232	123	178	141	2022
2022	175	144	229	126	176	143	230	125	177	142	231	124	2022
	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022

The magic square is **pandiagonal** with blocks of order 4 also **pandiagonal** magic squares having equal magic sums.

21.3.3 Third Type: Blocks of Order 6

												2022
97	233	232	225	104	120	98	234	231	226	103	119	2022
216	128	208	129	137	193	215	127	207	130	138	194	2022
192	185	153	160	176	145	191	186	154	159	175	146	2022
168	152	177	184	161	169	167	151	178	183	162	170	2022
121	200	136	201	209	144	122	199	135	202	210	143	2022
217	113	105	112	224	240	218	114	106	111	223	239	2022
99	235	230	227	102	118	100	236	229	228	101	117	2022
214	126	206	131	139	195	213	125	205	132	140	196	2022
190	187	155	158	174	147	189	188	156	157	173	148	2022
166	150	179	182	163	171	165	149	180	181	164	172	2022
123	198	134	203	211	142	124	197	133	204	212	141	2022
219	115	107	110	222	238	220	116	108	109	221	237	2022
2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022

The blocks of order 6 are of equal magic sums.

21.4 Bordered and Block-Bordered Magic Squares of Order 12

21.4.1 First Type: Bordered Magic Square

												2022
230	239	99	237	101	97	118	220	116	222	114	229	2022
112	209	204	134	202	136	132	122	216	120	210	225	2022
111	131	144	138	198	200	187	149	189	143	206	226	2022
227	207	141	182	180	153	186	154	156	196	130	110	2022
228	129	142	152	174	161	164	175	185	195	208	109	2022
235	214	147	158	167	172	169	166	179	190	123	102	2022
224	119	197	160	171	168	165	170	177	140	218	113	2022
106	211	192	178	162	173	176	163	159	145	126	231	2022
105	125	191	181	157	184	151	183	155	146	212	232	2022
233	213	194	199	139	137	150	188	148	193	124	104	2022
103	127	133	203	135	201	205	215	121	217	128	234	2022
108	98	238	100	236	240	219	117	221	115	223	107	2022
2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022

The magic sums are given by

$$\begin{aligned}
 S_{4 \times 4} &:= 2022 \times \frac{4}{12} = 674 \\
 S_{6 \times 6} &:= 2022 \times \frac{6}{12} = 1011 \\
 S_{8 \times 8} &:= 2022 \times \frac{8}{12} = 1348 \\
 S_{10 \times 10} &:= 2022 \times \frac{10}{12} = 1685 \\
 S_{12 \times 12} &:= 2022 \times \frac{12}{12} = 2022
 \end{aligned}$$

In the first case, there is a **Pythagorean triples** with magic sums:

$$S_{6 \times 6}^2 + S_{8 \times 8}^2 := S_{10 \times 10}^2$$

21.4.2 Second Type: Block Bordered Magic Square

												2022
236	234	99	240	100	102	218	216	117	222	118	120	2022
98	113	226	107	228	239	116	131	208	125	210	221	2022
104	108	227	114	225	233	122	126	209	132	207	215	2022
106	230	109	224	111	231	124	212	127	206	129	213	2022
232	223	112	229	110	105	214	205	130	211	128	123	2022
235	103	238	97	237	101	217	121	220	115	219	119	2022
182	180	153	186	154	156	200	198	135	204	136	138	2022
152	167	172	161	174	185	134	149	190	143	192	203	2022
158	162	173	168	171	179	140	144	191	150	189	197	2022
160	176	163	170	165	177	142	194	145	188	147	195	2022
178	169	166	175	164	159	196	187	148	193	146	141	2022
181	157	184	151	183	155	199	139	202	133	201	137	2022
2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022

It is formed by 4 equal sums **bordered** magic squares of order 6. In both the cases, sub-magic square sums are given by

$$\begin{aligned}
 S_{4 \times 4} &:= 2022 \times \frac{4}{12} = 674 \\
 S_{6 \times 6} &:= 2022 \times \frac{6}{12} = 1011 \\
 S_{12 \times 12} &:= 2022 \times \frac{12}{12} = 2022
 \end{aligned}$$

22 2022 In Magic Squares of Order 4

Below is 2022 written with 45 **pandiagonal equal sums** magic squares of order 4, i.e.,

$$S_{4 \times 4} := 1442$$

These magic squares are constructed using continuous natural numbers from 1 to 720.

Below is another image considering numbers as 2 by 2, i.e. 20-22. These are the same digits as appearing in previous image.

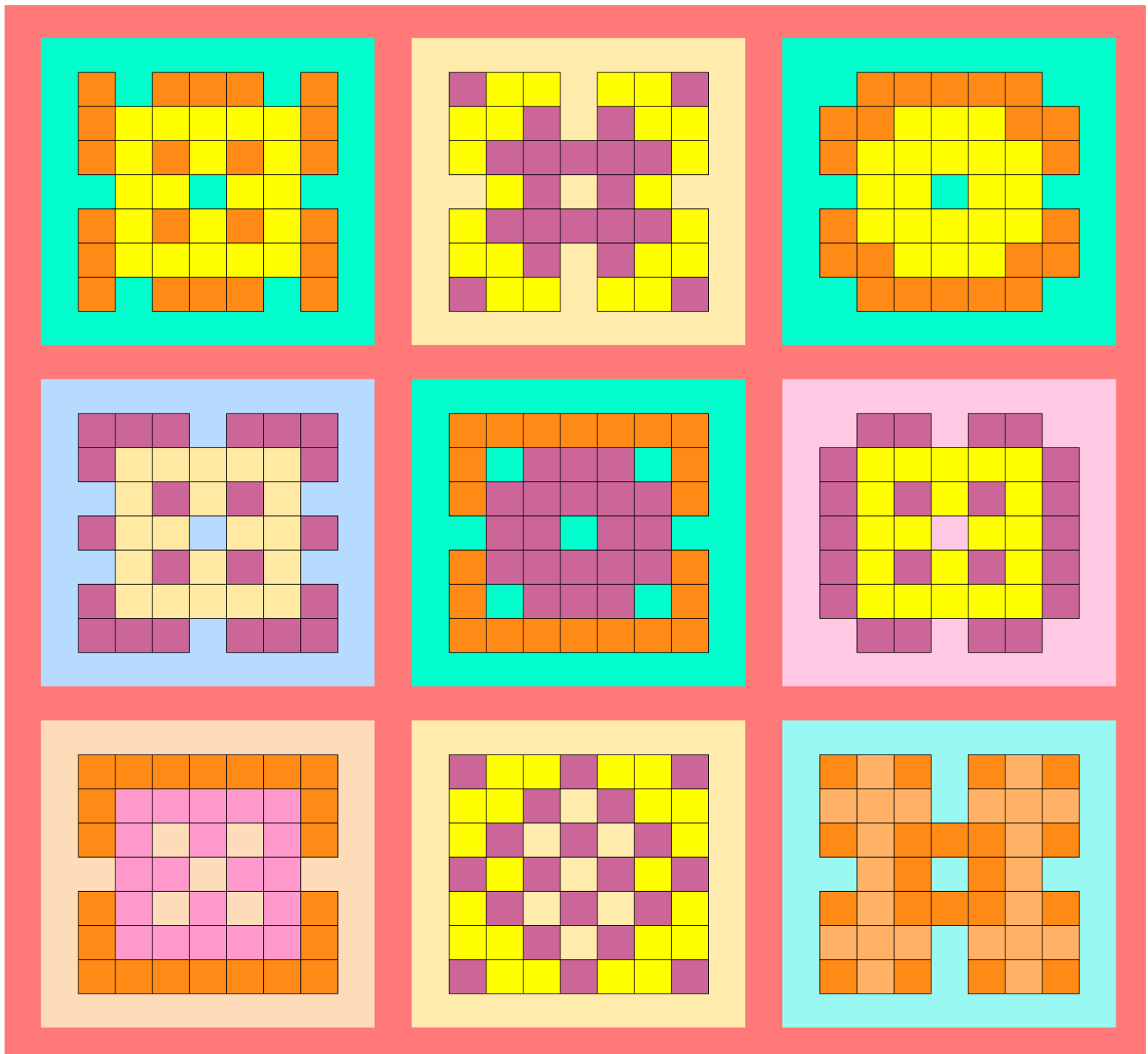
7	716	1	718	15	708	9	710	23	700	17	702	95	628	89	630	103	620	97	622	111	612	105	614	
2	717	8	715	10	709	16	707	18	701	24	699	90	629	96	627	98	621	104	619	106	613	112	611	
720	3	714	5	712	11	706	13	704	19	698	21	632	91	626	93	624	99	618	101	616	107	610	109	
713	6	719	4	705	14	711	12	697	22	703	20	625	94	631	92	617	102	623	100	609	110	615	108	
								31	692	25	694	183	540	177	542						119	604	113	606
								26	693	32	691	178	541	184	539						114	605	120	603
								696	27	690	29	544	179	538	181						608	115	602	117
								689	30	695	28	537	182	543	180						601	118	607	116
55	668	49	670	47	676	41	678	39	684	33	686	175	548	169	550						127	596	121	598
50	669	56	667	42	677	48	675	34	685	40	683	170	549	176	547						122	597	128	595
672	51	666	53	680	43	674	45	688	35	682	37	552	171	546	173						600	123	594	125
665	54	671	52	673	46	679	44	681	38	687	36	545	174	551	172						593	126	599	124
63	660	57	662									167	556	161	558						135	588	129	590
58	661	64	659									162	557	168	555						130	589	136	587
664	59	658	61									560	163	554	165						592	131	586	133
657	62	663	60									553	166	559	164						585	134	591	132
71	652	65	654	79	644	73	646	87	636	81	638	159	564	153	566	151	572	145	574	143	580	137	582	
66	653	72	651	74	645	80	643	82	637	88	635	154	565	160	563	146	573	152	571	138	581	144	579	
656	67	650	69	648	75	642	77	640	83	634	85	568	155	562	157	576	147	570	149	584	139	578	141	
649	70	655	68	641	78	647	76	633	86	639	84	561	158	567	156	569	150	575	148	577	142	583	140	
279	444	273	446	287	436	281	438	295	428	289	430	191	532	185	534	199	524	193	526	207	516	201	518	
274	445	280	443	282	437	288	435	290	429	296	427	186	533	192	531	194	525	200	523	202	517	208	515	
448	275	442	277	440	283	434	285	432	291	426	293	536	187	530	189	528	195	522	197	520	203	514	205	
441	278	447	276	433	286	439	284	425	294	431	292	529	190	535	188	521	198	527	196	513	206	519	204	
								303	420	297	422										215	508	209	510
								298	421	304	419										210	509	216	507
								424	299	418	301										512	211	506	213
								417	302	423	300										505	214	511	212
327	396	321	398	319	404	313	406	311	412	305	414	239	484	233	486	231	492	225	494	223	500	217	502	
322	397	328	395	314	405	320	403	306	413	312	411	234	485	240	483	226	493	232	491	218	501	224	499	
400	323	394	325	408	315	402	317	416	307	410	309	488	235	482	237	496	227	490	229	504	219	498	221	
393	326	399	324	401	318	407	316	409	310	415	308	481	238	487	236	489	230	495	228	497	222	503	220	
335	388	329	390									247	476	241	478									
330	389	336	387									242	477	248	475									
392	331	386	333									480	243	474	245									
385	334	391	332									473	246	479	244									
343	380	337	382	351	372	345	374	359	364	353	366	255	468	249	470	263	460	257	462	271	452	265	454	
338	381	344	379	346	373	352	371	354	365	360	363	250	469	256	467	258	461	264	459	266	453	272	451	
384	339	378	341	376	347	370	349	368	355	362	357	472	251	466	253	464	259	458	261	456	267	450	269	
377	342	383	340	369	350	375	348	361	358	367	356	465	254	471	252	457	262	463	260	449	270	455	268	

23 Colored Pattern Designs With 20-22

Below are few patterns on 2022 with two colors having 20 and 22. These colors are on the boards of 7×7 and 9×9 .

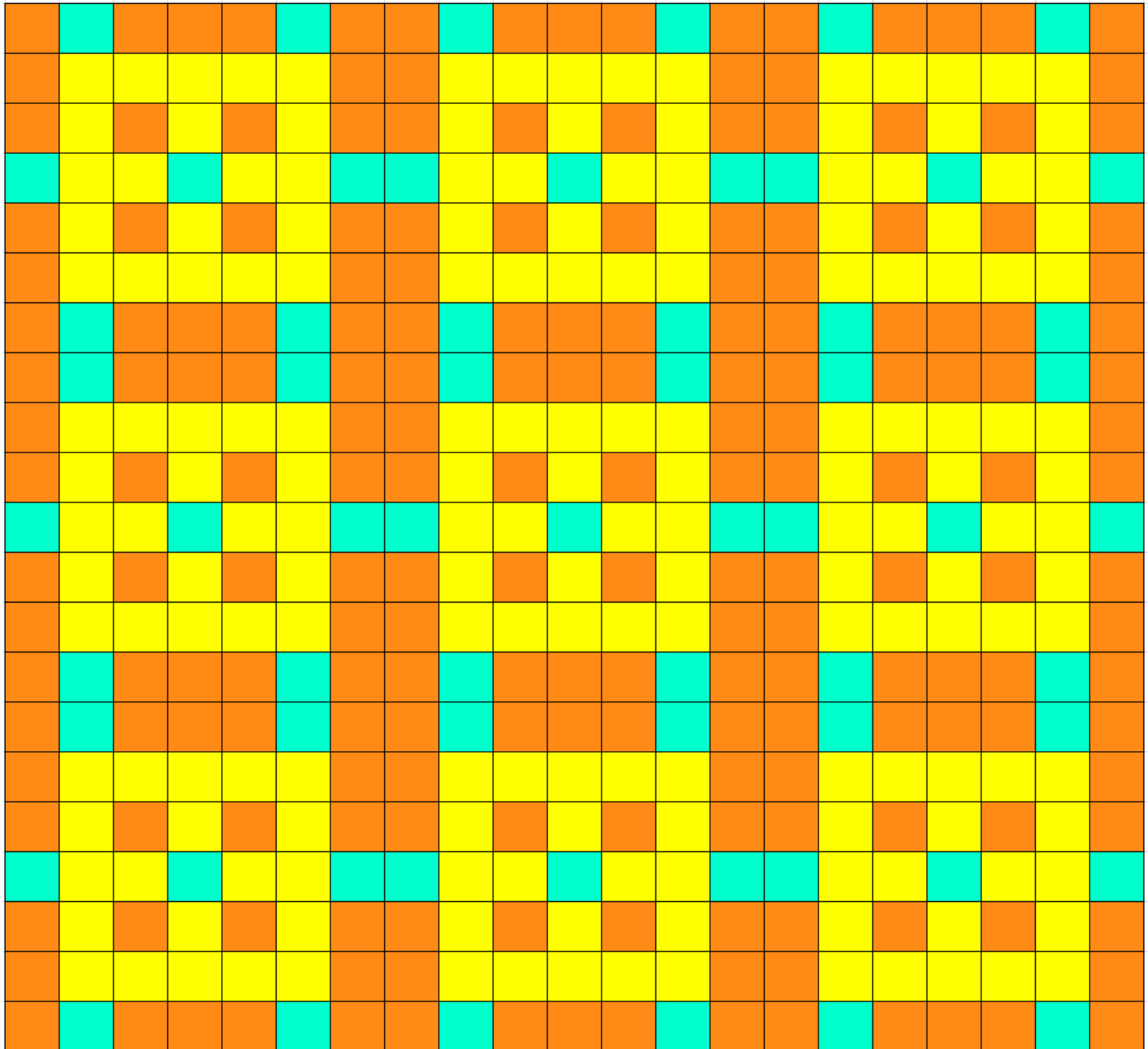
23.1 Colored Patterns With 20-22 On a Board of 7×7

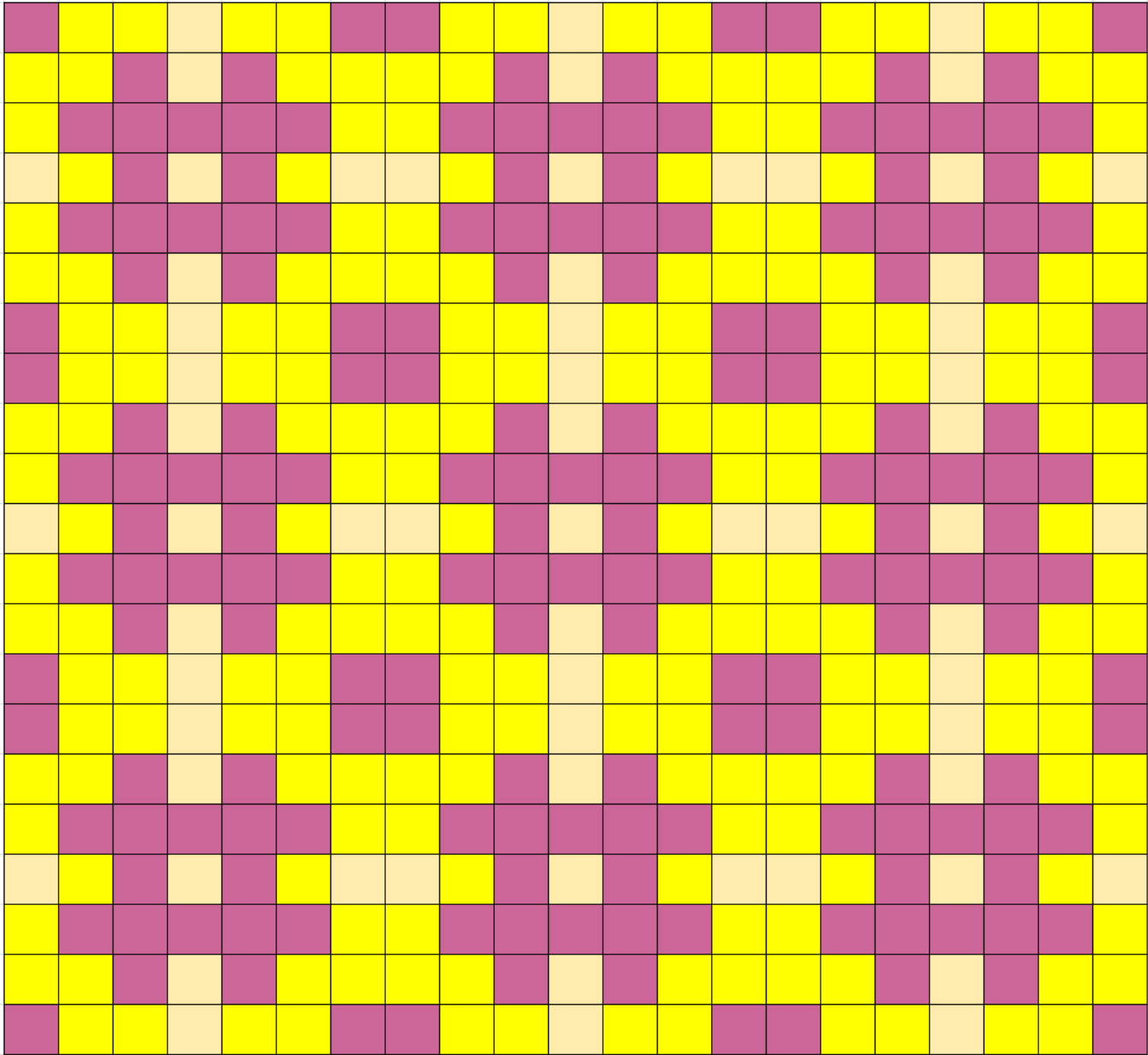
Below are nine designs given together in a single figure;

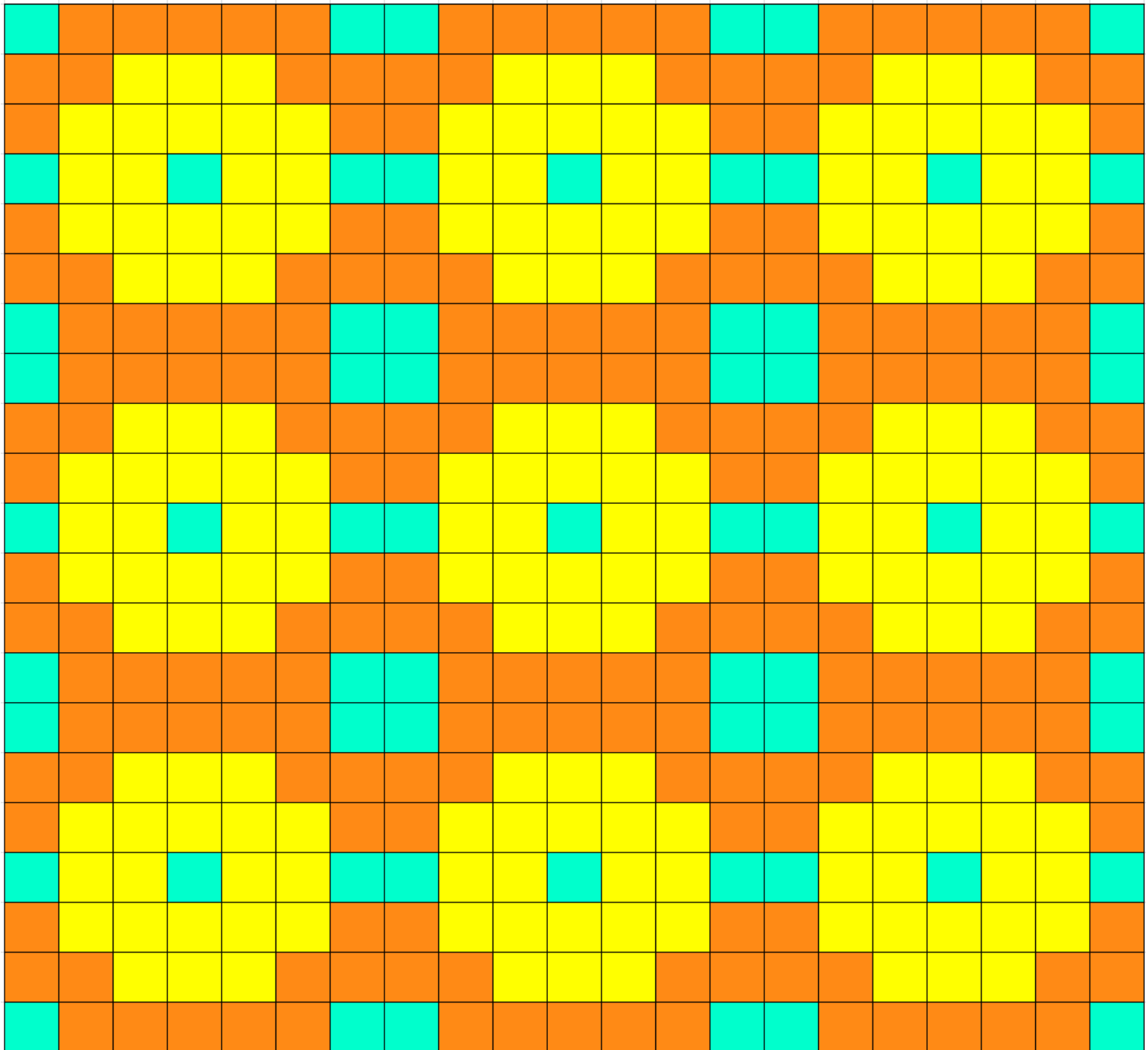


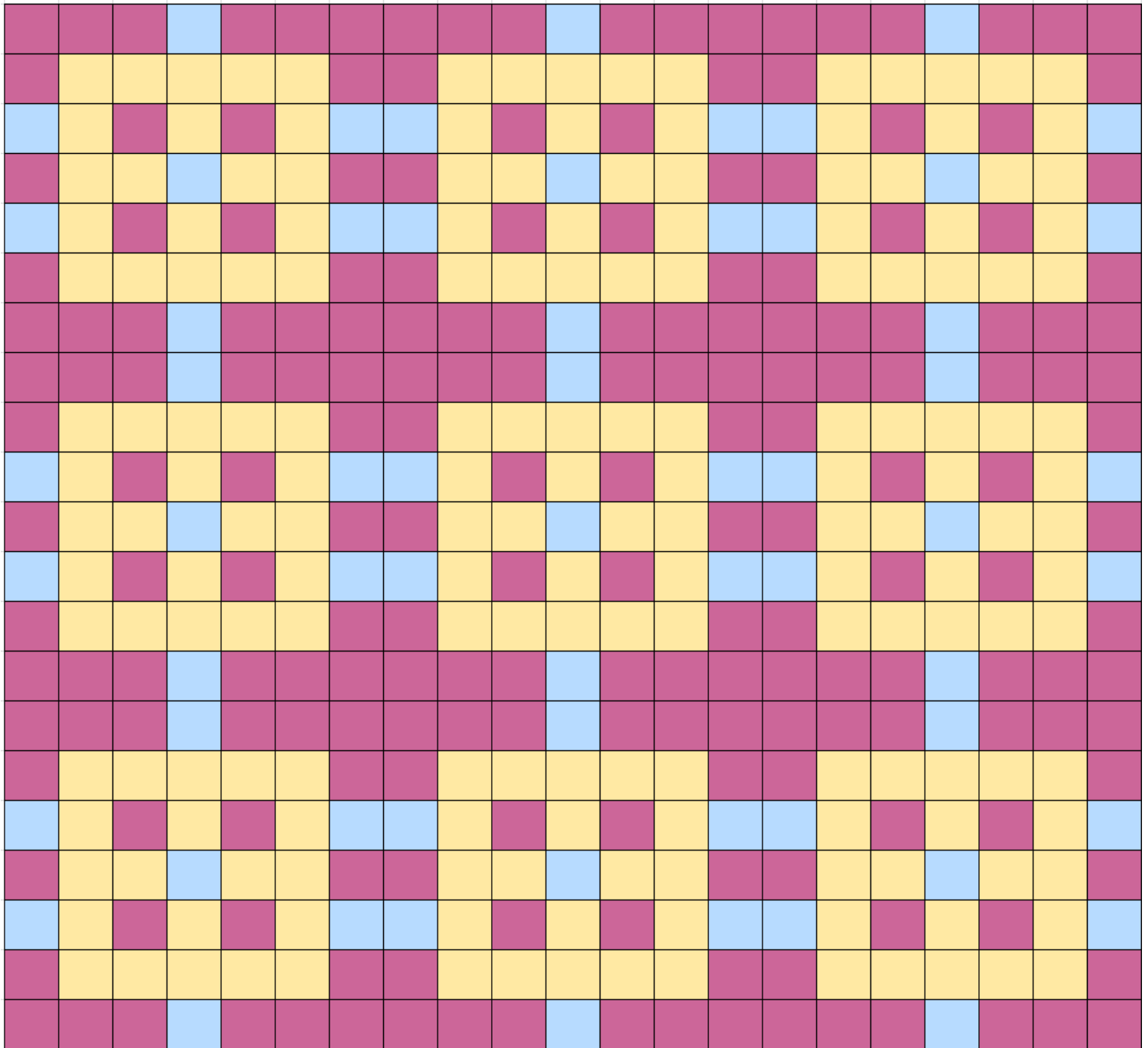
There are 9 different figures with two colors each representing 20-22 on a board of 7×7 .

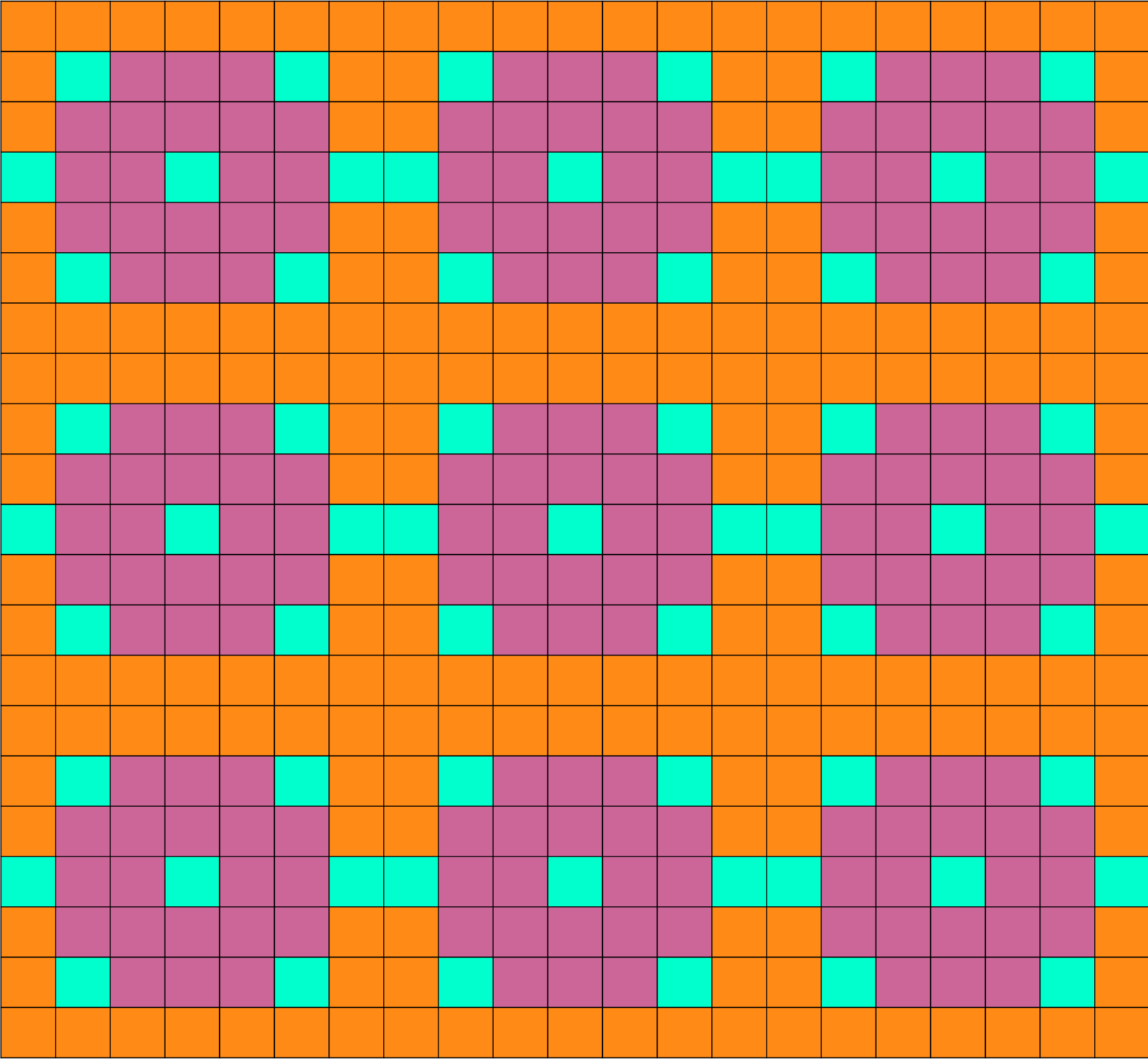
Let's write separately the above 9 designs in repeated way. These forms interesting new patterns:

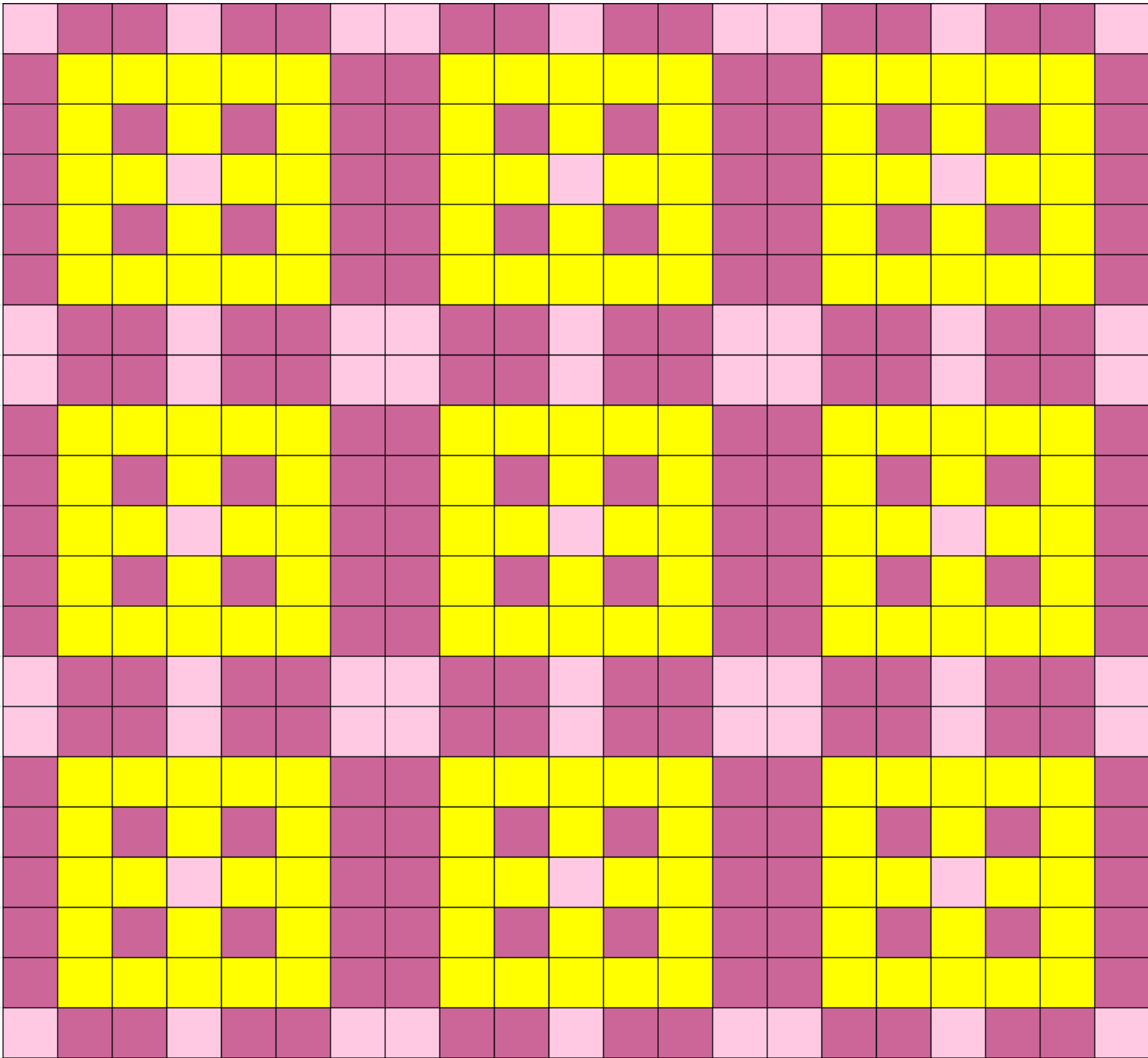


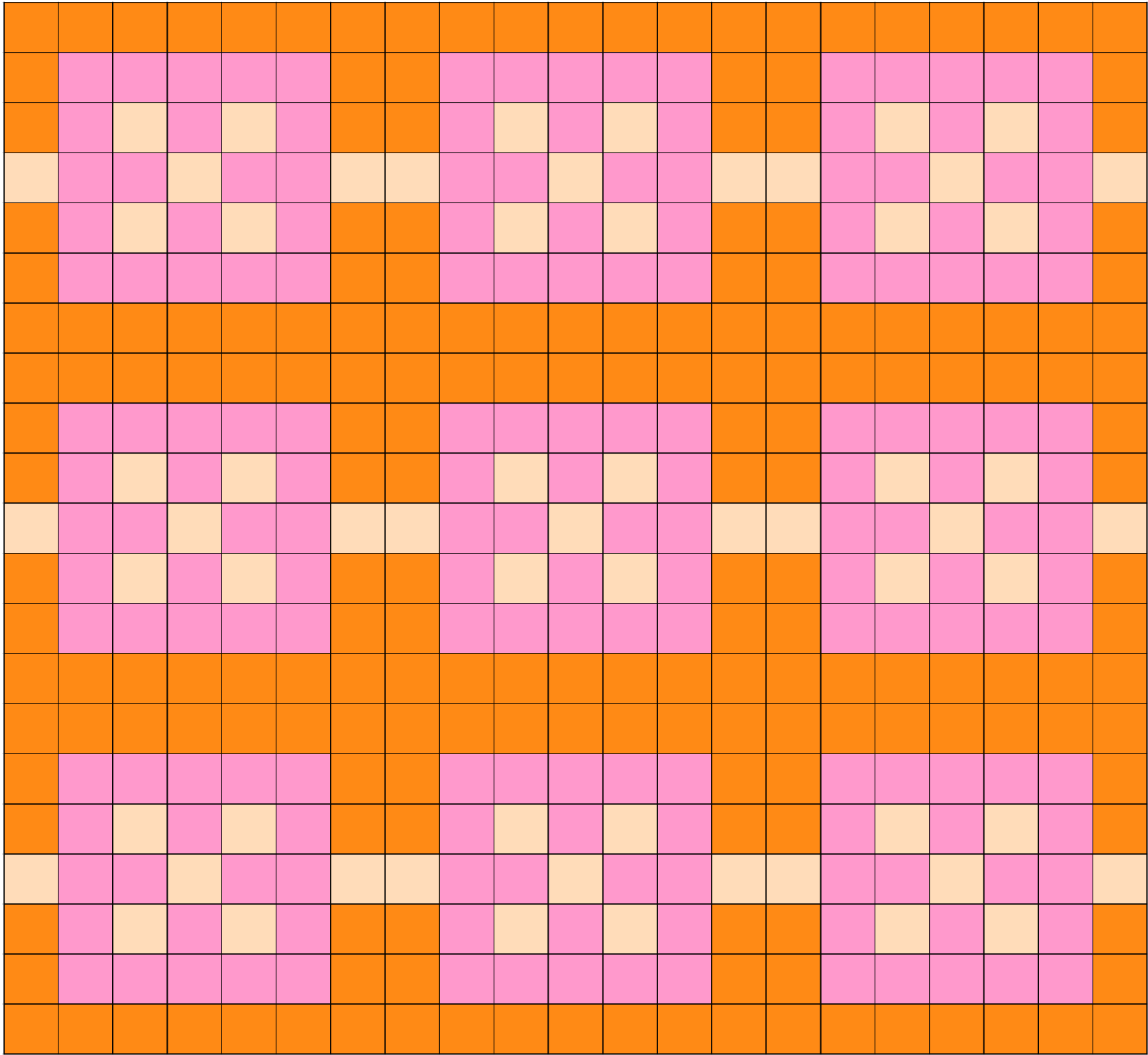


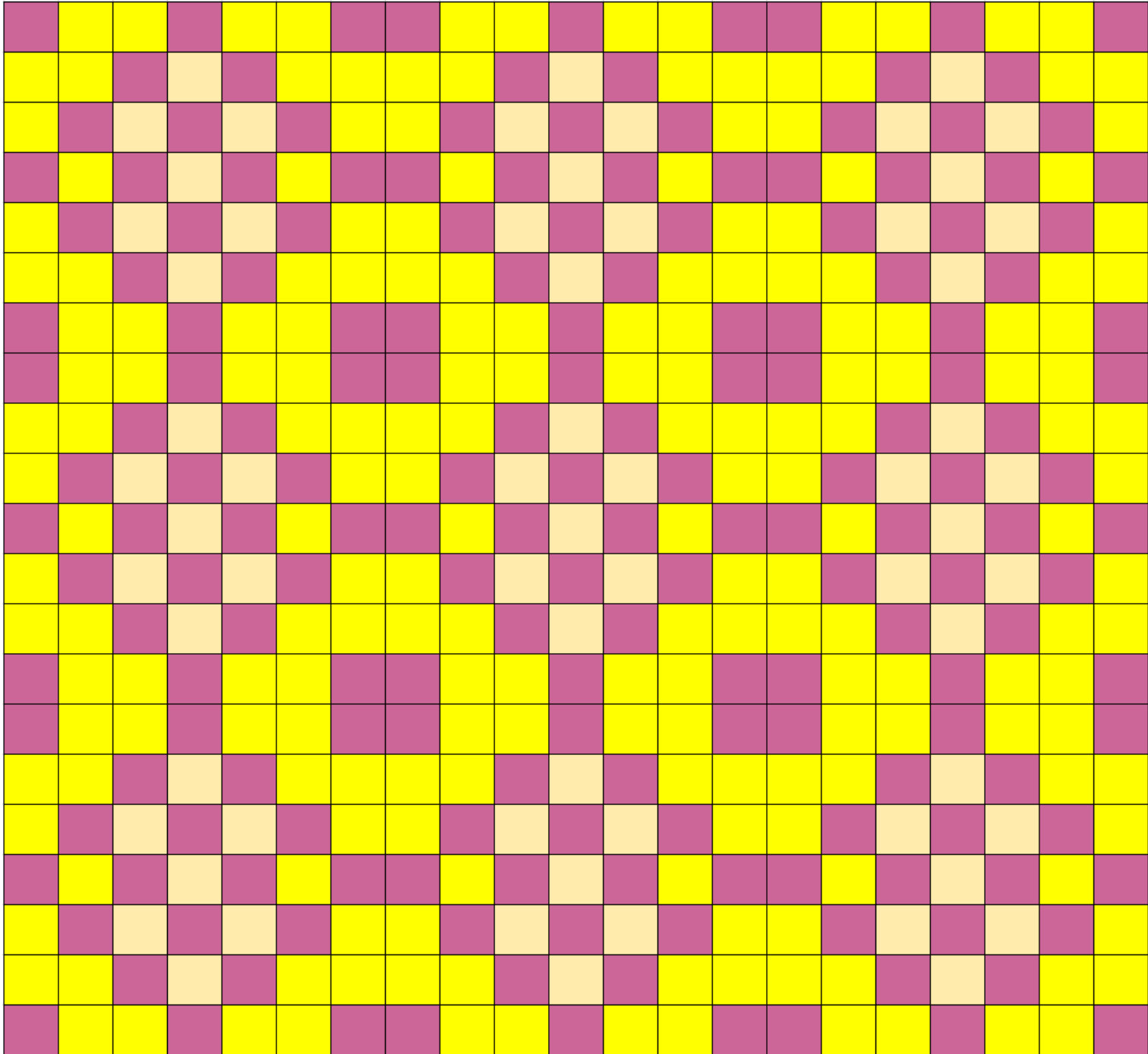


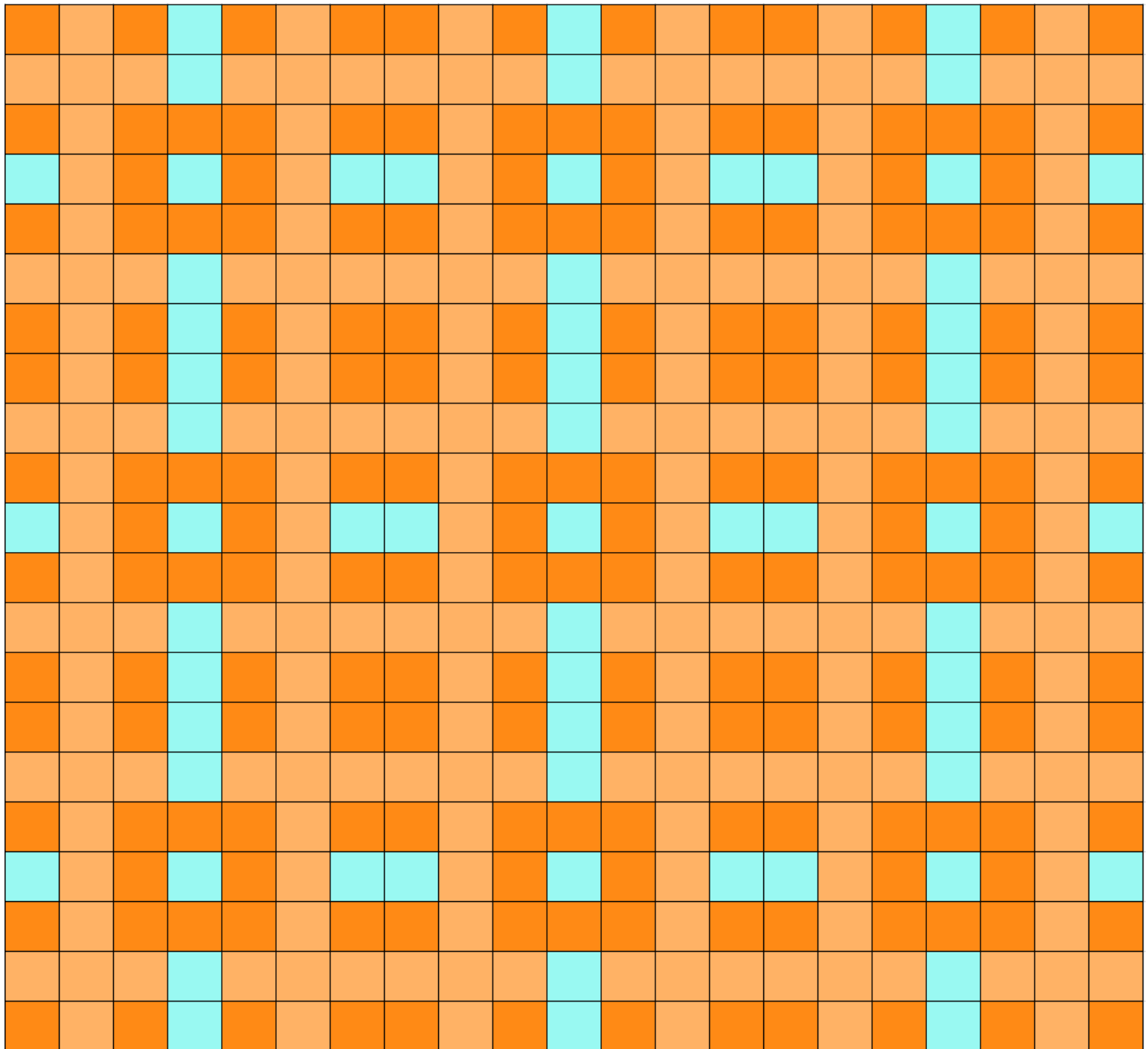






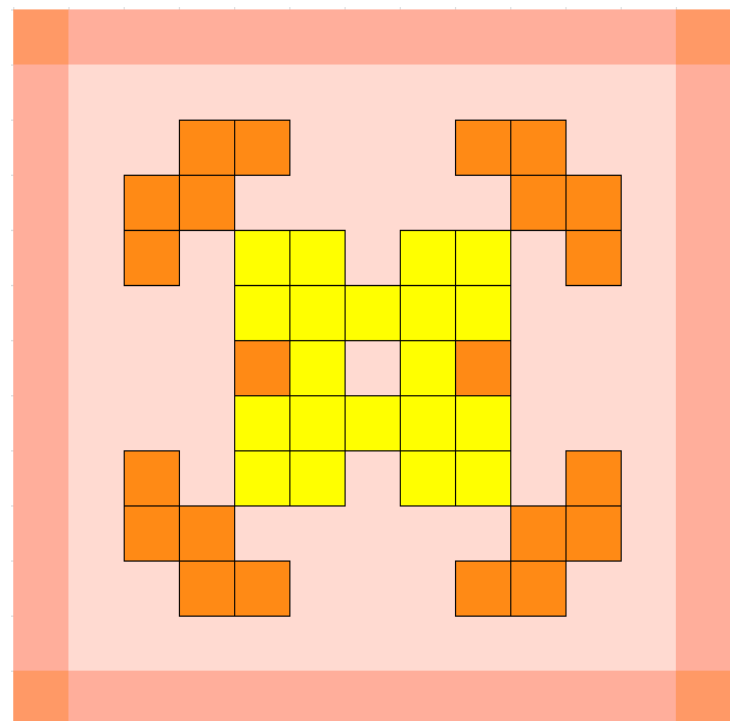
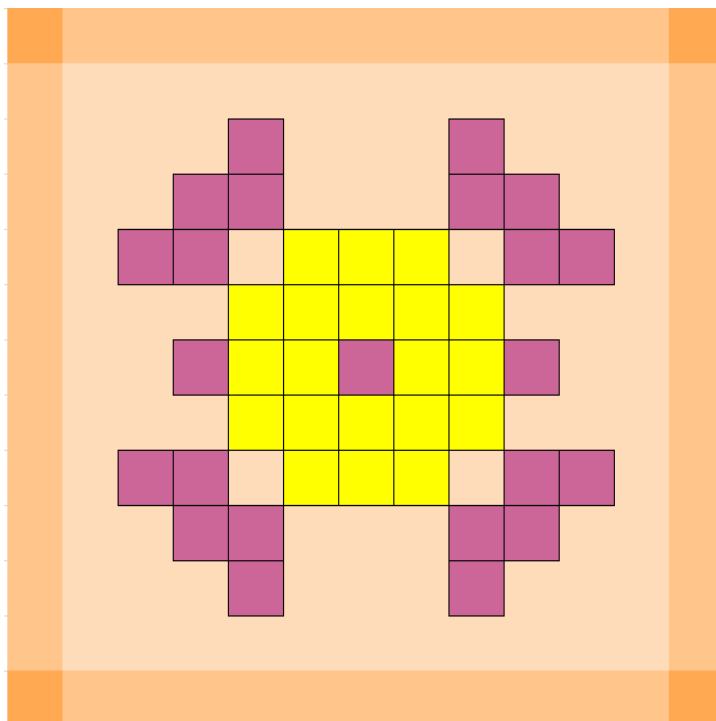
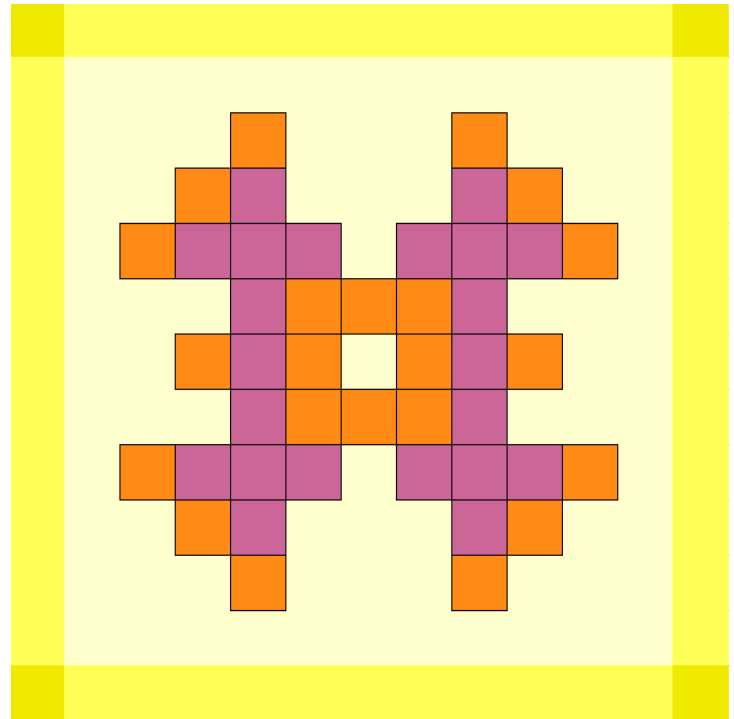
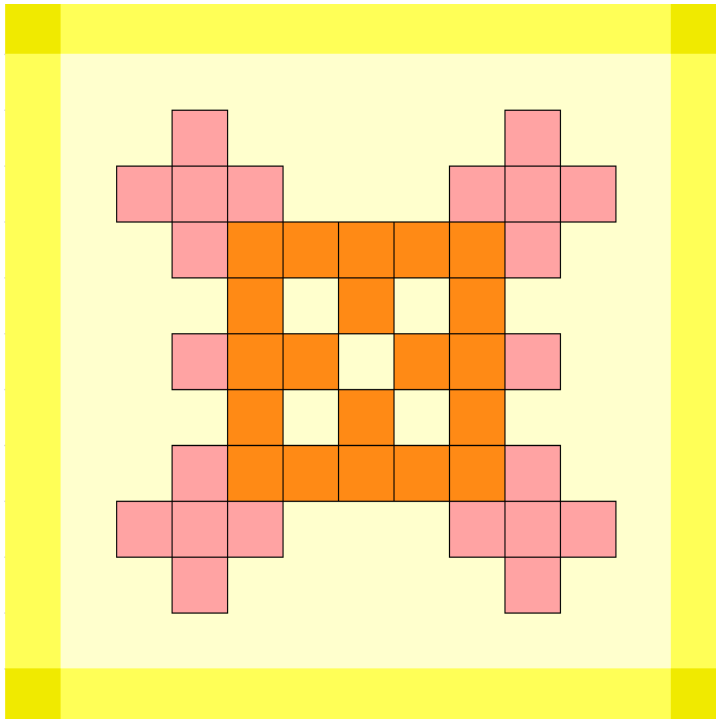


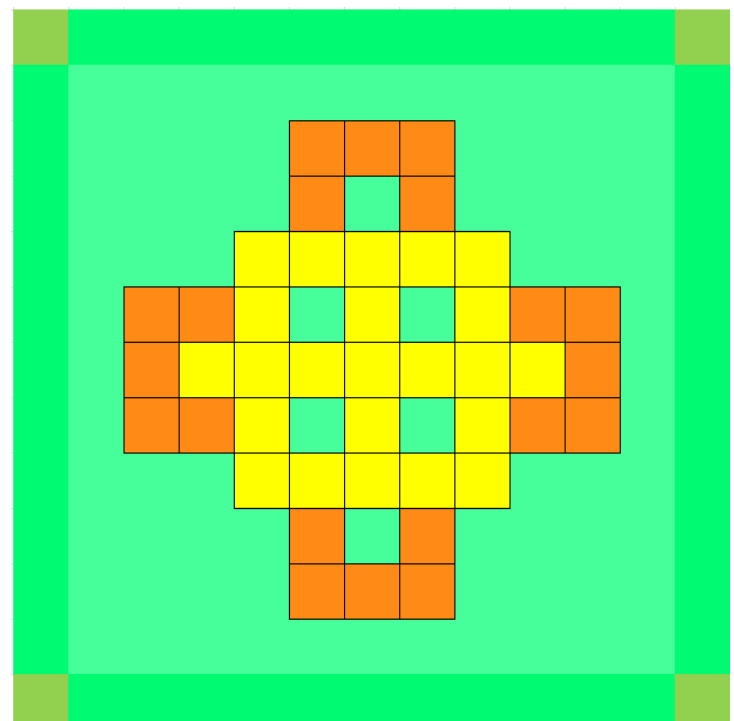
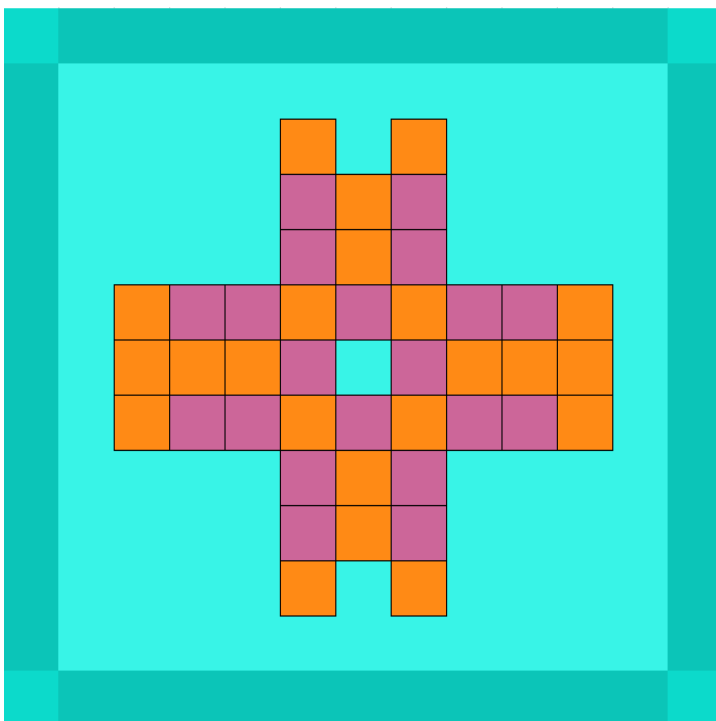
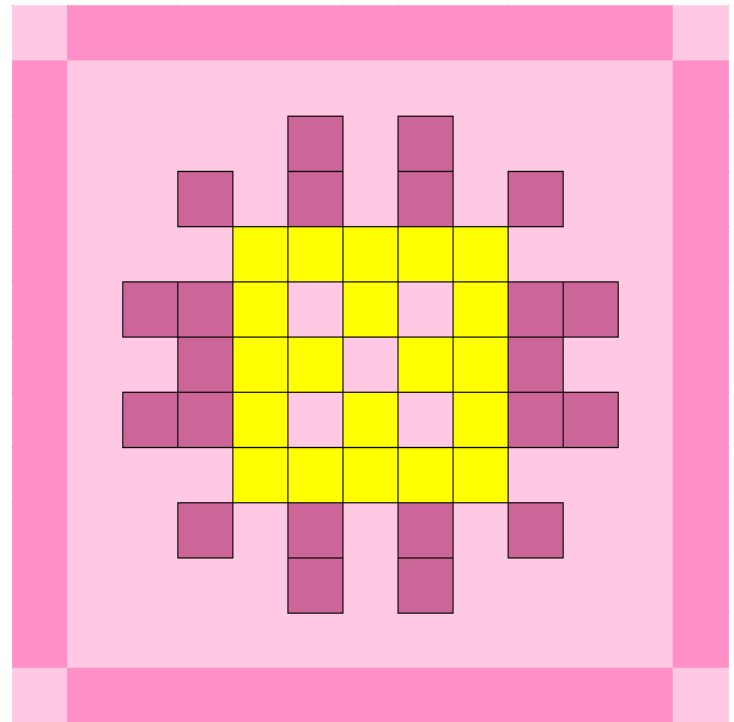
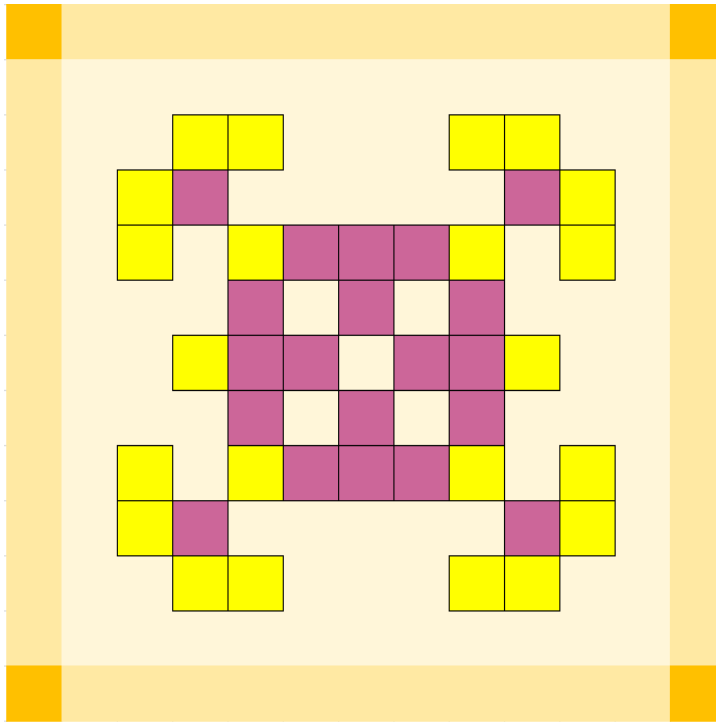




23.2 Colored Patterns With 20-22 On a Board of 9×9

The above subsection represent numbers based on two colors representing 20 and 22 drawn on a board of 7×7 . Below are more examples of similar kind of designs but on a board of 9×9 . In this case, we have much more possibilities.





Above we have written only 8 different designs, but there are much more possibilities.

24 References

The whole work is based on author's work on **recreation of numbers** and **magic squares**. Subject-wise detailed list of publications on these two topics are can be seen at the following links:

- Inder J. Taneja, **Recreation of Numbers**, <https://inderjtaneja.com/2019/06/27/publications-recreation-of-numbers/>.
- Inder J. Taneja, **Magic Squares**, <https://inderjtaneja.com/2019/06/27/publications-magic-squares/>.

*Publication list of author's work on **recreation of numbers** and **magic squares** as pdf file for download is given at above links.*