23 and 2023 in Numbers and Patterns, **Zenodo**,
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23 and 2023 in Numbers and Patterns

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W E L C O M E - 2023
Number Patterns for 23 and 2023

7	716	1	718	15	708	9	710	23	700	17	702
2	717	8	715	10	709	16	707	18	701	24	699
720	3	714	5	712	11	706	13	704	19	698	21
713	6	719	4	705	14	711	12	697	22	703	20
								31	692	25	694
								26	693	32	691
								696	27	690	29
								689	30	695	28
55	668	49	670	47	676	41	678	39	684	33	686
50	669	56	667	42	677	48	675	34	685	40	683
672	51	666	53	680	43	674	45	688	35	682	37
665	54	671	52	673	46	679	44	681	38	687	36
63	660	57	662								
58	661	64	659								
664	59	658	61								
657	62	663	60								
71	652	65	654	79	644	73	646	87	636	81	638
66	653	72	651	74	645	80	643	82	637	88	635
656	67	650	69	648	75	642	77	640	83	634	85
649	70	655	68	641	78	647	76	633	86	639	84

95	628	89	630	103	620	97	622	111	612	105	614
90	629	96	627	98	621	104	619	106	613	112	611
632	91	626	93	624	99	618	101	616	107	610	109
625	94	631	92	617	102	623	100	609	110	615	108
183	540	177	542					119	604	113	606
178	541	184	539					114	605	120	603
544	179	538	181					608	115	602	117
537	182	543	180					601	118	607	116
175	548	169	550					127	596	121	598
170	549	176	547					122	597	128	595
552	171	546	173					600	123	594	125
545	174	551	172					593	126	599	124
167	556	161	558					135	588	129	590
162	557	168	555					130	589	136	587
560	163	554	165					592	131	586	133
553	166	559	164					585	134	591	132
159	564	153	566	151	572	145	574	143	580	137	582
154	565	160	563	146	573	152	571	138	581	144	579
568	155	562	157	576	147	570	149	584	139	578	141
561	158	567	156	569	150	575	148	577	142	583	140

191	532	185	534	199	524	193	526	207	516	201	518
186	533	192	531	194	525	200	523	202	517	208	515
536	187	530	189	528	195	522	197	520	203	514	205
529	190	535	188	521	198	527	196	513	206	519	204
								215	508	209	510
								210	509	216	507
								512	211	506	213
								505	214	511	212
239	484	233	486	231	492	225	494	223	500	217	502
234	485	240	483	226	493	232	491	218	501	224	499
488	235	482	237	496	227	490	229	504	219	498	221
481	238	487	236	489	230	495	228	497	222	503	220
247	476	241	478								
242	477	248	475								
480	243	474	245								
473	246	479	244								
255	468	249	470	263	460	257	462	271	452	265	454
250	469	256	467	258	461	264	459	266	453	272	451
472	251	466	253	464	259	458	261	456	267	450	269
465	254	471	252	457	262	463	260	449	270	455	268

279	444	273	446	287	436	281	438	295	428	289	430
274	445	280	443	282	437	288	435	290	429	296	427
448	275	442	277	440	283	434	285	432	291	426	293
441	278	447	276	433	286	439	284	425	294	431	292
								303	420	297	422
								298	421	304	419
								424	299	418	301
								417	302	423	300
327	396	321	398	319	404	313	406	311	412	305	414
322	397	328	395	314	405	320	403	306	413	312	411
400	323	394	325	408	315	402	317	416	307	410	309
393	326	399	324	401	318	407	316	409	310	415	308
								335	388	329	390
								330	389	336	387
								392	331	386	333
								385	334	391	332
359	364	353	366	351	372	345	374	343	380	337	382
354	365	360	363	346	373	352	371	338	381	344	379
368	355	362	357	376	347	370	349	384	339	378	341
361	358	367	356	369	350	375	348	377	342	383	340

★ Upside Down and Mirror Looking 2023 ★

6+9+69+609+1+609+609+96+9+6

1+1001+11+8+1001+1

2+5+2+1001+1001+5+2+5

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Abstract

This work brings representations of 23 and 2023 in different ways. These representations are of ***crazy-type, running numbers, single digit, single letter, Triangular, Fibonacci, palindromic-type, prime numbers, embedded, repeated digits, magic squares****, etc. Among two numbers 23 and 2023, the number 23 is a prime number. The digits 2, 0, 2 and 3 of 2023 are written in 45 equal sums magic squares of order 4 using consecutive numbers from 1 to 720.*

Contents

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1 Crazy Representations

Below are representations of 2023 in terms of 1 to 9 and 9 to 1. These are with **basic operations** along with **factorial**, **square-root**, **Fibonacci sequence**, **Triangular numbers**, etc

1.1 Basic Operations

$$\begin{aligned} \mathbf{23} &:= 1+2-3+45+67-89 \\ &:= 9+87-65-4-3-2+1 \end{aligned}$$

$$\begin{aligned} \mathbf{2023} &:= 12\times 3\times (4+5)\times 6+7+8\times 9 \\ &:= 9\times 8+7+6\times 54\times 3\times 2\times 1 \end{aligned}$$

1.2 Factorial

$$\begin{aligned} \mathbf{2023} &:= -1-2\times 3!!+(4\times(-5!+6)-(7!-8!)/9) \\ &:= 9\times(8!/7!-6!)+\left(5!+4^{3!}\right)\times 2-1 \end{aligned}$$

http://arxiv.org/abs/1302.1479

1.3 Pattern with 2023: Days of Month - Increasing and Decreasing

$$
\begin{aligned}
01\,\mathbf{2023} &:= -1+(2+3!)!+4!+5\times(6-7!/8\times 9) &&= (9+8!/7!)\times 6!+5!+4!-3!!/2-1\\
02\,\mathbf{2023} &:= -1+2\times 3!!\times 4+5^6+7!/8+9 &&= 9\times(8+7!/6)+5\times(4\times 3!!-2)+1\\
03\,\mathbf{2023} &:= -1+(2+3!)!+4!+5!\times(6-7!/8)/9 &&= 9+8!+7!/6!-5!-4^{3}!\times 2-1\\
04\,\mathbf{2023} &:= 1+(2+3!)!/4!+5!/6-7+8!+9 &&= 9+8!+7+6!+(5!\times 4+3)\times 2+1\\
05\,\mathbf{2023} &:= 1+2+3!!+(4-5!+(6!+7)\times 8)\times 9 &&= 9+8!-7+(6^5+4!)\times 3/2+1\\
06\,\mathbf{2023} &:= (1+2)^3+4\times 5^6-7\times 8\times 9 &&= (9+8!/7)\times 6-(5!-4!^{3})\times 2+1\\
07\,\mathbf{2023} &:= 1+2\times(3!!+4)+5+6\times 7!+8!+9 &&= 9+8!+7!\times 6+5+(4+3!!)\times 2+1\\
08\,\mathbf{2023} &:= -1+(-2+3!!)\times 4\times(5!/6+7)+8!/9 &&= 9-8\times 7+(6!-5+(4!/3)!)\times 2\times 1\\
09\,\mathbf{2023} &:= -1-2\times 3!-4+5!\times(6!+7\times 8-9) &&= 9\times 8!/7+6-5!-4!+(3!+2)!+1\\
10\,\mathbf{2023} &:= -1+2\times 3!!+(4^5\times 6+7!-8)\times 9 &&= 9\times(8\times(7!-5\times 6!)-4!)-2\times 3!!-1
\end{aligned}
$$

$$
\begin{aligned}
11\,\mathbf{2023} &:= (1+2)!!-((3-4\times 5)\times(6!+7)-8)\times 9 &&= 9+8!+7\times((6+5\times 4^{3}!)/2-1)\\
12\,\mathbf{2023} &:= 1+((2+3!!)\times 4!+5!-6)\times 7-8\times 9 &&= 9+(8+7!+6!/5!)\times 4!+3!!-2\times 1\\
13\,\mathbf{2023} &:= 1+(2\times 3!!-4)\times 5!+6+7-8!+9 &&= 9-8!+7+6-5!\times(4-3!!\times 2)+1\\
14\,\mathbf{2023} &:= (1+2)!\times(3!\times 4!+5+6\times 7!)-8!+9 &&= (9+8!-(7!-6\times 5)\times 4)\times(3!+2-1)\\
15\,\mathbf{2023} &:= -(1+2)!+3!!+4!+5\times(6\times 7!+8+9) &&= 9-8+7!+(6+5!-4!)\times(3!!\times 2+1)\\
16\,\mathbf{2023} &:= -1+2^{3!+4}\times(5!-6)+(7!-8)\times 9 &&= 9+8!/7!+6!+5+4\times(3!+2)!+1\\
17\,\mathbf{2023} &:= -(1+2)!!-3\times 4+5\times(-6!-7!+8!-9) &&= 9-8!+7!-6\times((5-4!\times 3!!)\times 2+1)\\
18\,\mathbf{2023} &:= 1-(2+3!)!+4!-(5^6-7-8!)\times 9 &&= 9-8\times 7+(6+5!)\times(4+3!!\times 2+1)\\
19\,\mathbf{2023} &:= -1+2\times 3!!+(4!\times(5!+6)\times 7+8)\times 9 &&= 9\times(8+7\times(6+5!)\times 4!)+3!!\times 2-1\\
20\,\mathbf{2023} &:= (1+2)!!/3+(4!+5\times 6!\times 7)\times 8-9 &&= 9\times 8!/(7!/6)+5\times((4!/3)!-2)+1
\end{aligned}
$$

$$
\begin{aligned}
21\,\mathbf{2023} &:= -1+2\times 3!!+4!+(5+6\times 7)\times 8!/9 && = (9+8!-7!)\times 6-(5!+4!-3!!)/2+1\\
22\,\mathbf{2023} &:= 1+2\times((3+4!-5)\times(6+7!)+8-9) && = (9\times(8+7!)-6!/5!)\times 4+(3!+2)!-1\\
23\,\mathbf{2023} &:= (1+2)!^{3}\times 4!+5\times(6+7!+8!)+9 && = 9\times 8-(7\times(6!-(5!+4^{3})^{2})+1)\\
24\,\mathbf{2023} &:= -1-2\times 3!+4\times 5+6\times(7+8!+9) && = (9+8!+7)\times 6!/5!-4+3!\times 2-1\\
25\,\mathbf{2023} &:= (1+2)^{3}-4+5\times 6!\times 7!/(8\times 9) && = 9-8!+7\times((6-5!\times(4!-3!!))/2-1)\\
26\,\mathbf{2023} &:= (1+2)!-3\times(4!-5!/6\times 7!)-8!+9 && = 9+8!\times 7-6-(5!+(4!/3)!)/2\times 1\\
27\,\mathbf{2023} &:= -1-2^{3!}-4!-5!+(6\times 7!+8)\times 9 && = (9+8!+7!)\times 6+(5^{4}-3!!)\times 2-1\\
28\,\mathbf{2023} &:= -1+(2\times 3!-4)!-5!+6\times(-7+8!-9) && = (9+8!)\times 7-6\times 5!+(4!-3)^{2}-1\\
29\,\mathbf{2023} &:= -1+2\times(-3+(4!+5)\times(-6+7!-8+9)) && = 9\times 8^{(}7-6)\times 5)-4\times(3!!+2)-1\\
30\,\mathbf{2023} &:= 12+(3\times 4!-5-6)\times(7!-89) && = 9\times(8!-7!)-(6^{5}-4!-3)\times 2+1\\
31\,\mathbf{2023} &:= 12+(3+4)\times(5-6!+(7!-8)\times 9) && = 9\times(8!-7!-6!+5+4!)+3!!+2\times 1
\end{aligned}
$$

https://doi.org/10.5281/zenodo.5831208

1.4 1 to 10 Numbers: Increasing and Decreasing

$$
\begin{aligned}
\mathbf{2023} &:= 12\times(3\times 4+5)\times 6+789+10\\
&:= 10+98+(7+6)\times 5+43^{2}+1
\end{aligned}
$$

1.5 Numbers From 1 to 100 in Terms of Digits of 20233202

Below are numbers 1 to 100 written in terms of digit of **palindromic-type** number **20233202**.

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$$\mathbf{1} := ((20-23)/3)^{20-2}$$
$$\mathbf{2} := 2+0\times 233202$$
$$\mathbf{3} := 20-2-33+20-2$$
$$\mathbf{4} := 2-0\times 23320+2$$
$$\mathbf{5} := 20/(23-3)+2+02$$
$$\mathbf{6} := 20/(2+3)+32\times 0+2$$
$$\mathbf{7} := 20+2-33+20-2$$
$$\mathbf{8} := 20/2+332\times 0-2$$
$$\mathbf{9} := 20+23-32-02$$
$$\mathbf{10} := 20+2\times(3+3)-20-2$$
$$\mathbf{11} := -20+233-202$$
$$\mathbf{12} := 20/2+332\times 0+2$$
$$\mathbf{13} := 20-2-3+32\times 0-2$$
$$\mathbf{14} := 20+2\times(3+3)-20+2$$
$$\mathbf{15} := 2+02+33-20-2$$
$$\mathbf{16} := 20-2+3\times 32\times 0-2$$
$$\mathbf{17} := (20-23)/3+20-2$$
$$\mathbf{18} := 20+2332\times 0-2$$
$$\mathbf{19} := 20-2-(3/3)^{20}+2$$
$$\mathbf{20} := -2+0\times 233+20+2$$

$$\mathbf{21} := -20-2+33+20/2$$
$$\mathbf{22} := 20+2332\times 0+2$$
$$\mathbf{23} := 20+2+3+32\times 0-2$$
$$\mathbf{24} := 20-2+(3+32\times 0)\times 2$$
$$\mathbf{25} := 20/2+33-20+2$$
$$\mathbf{26} := 2\times 0+2+3+3+20-2$$
$$\mathbf{27} := 20\times 2+3-32/02$$
$$\mathbf{28} := 20+23+3-20+2$$
$$\mathbf{29} := 20-2+33-20-2$$
$$\mathbf{30} := (20+23-3+20)/2$$
$$\mathbf{31} := 2\times 0+233-202$$
$$\mathbf{32} := 20\times 2-3-3+2\times 0-2$$
$$\mathbf{33} := 20-2+33-20+2$$
$$\mathbf{34} := 20-23-3+20\times 2$$
$$\mathbf{35} := 20+2-3^3+20\times 2$$
$$\mathbf{36} := 20+23+3-20/2$$
$$\mathbf{37} := 20+2+33-20+2$$
$$\mathbf{38} := 2\times(0\times 233+20)-2$$
$$\mathbf{39} := (20-2)\times 3+3-20+2$$
$$\mathbf{40} := 20-23+3+20\times 2$$

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$$\mathbf{41} := -20 - 2 - 3 + 3 \times (20 + 2)$$
$$\mathbf{42} := -20 + (2 - 3 + 32) \times 02$$
$$\mathbf{43} := 2 \times 0 \times 2 + 33 + 20/2$$
$$\mathbf{44} := 2 \times (0 \times 233 + 20 + 2)$$
$$\mathbf{45} := 20 - 2 + 3 \times 3 + 20 - 2$$
$$\mathbf{46} := -20 + 23 + 3 + 20 \times 2$$
$$\mathbf{47} := 2 \times 0 - 2 + 3^3 + 20 + 2$$
$$\mathbf{48} := -20 + 2 + 33 \times (2 + 0 \times 2)$$
$$\mathbf{49} := 20 + 2 - 3 + 3 \times 20/2$$
$$\mathbf{50} := 20 + 2 \times (3 + 3) + 20 - 2$$
$$\mathbf{51} := 20 + 233 - 202$$
$$\mathbf{52} := 2 \times 0 + 2 \times (33 - 20) \times 2$$
$$\mathbf{53} := 2 \times 0 + 23 + 32 - 02$$
$$\mathbf{54} := (20 - 2^3) \times 3 + 20 - 2$$
$$\mathbf{55} := 20 - 23 + 3 \times 20 - 2$$
$$\mathbf{56} := 2/02 + 33 + 20 + 2$$
$$\mathbf{57} := 2 \times 0 + 23 + 32 + 02$$
$$\mathbf{58} := 20 + 23 - 3 + 20 - 2$$
$$\mathbf{59} := 2 + 02 + 33 + 20 + 2$$
$$\mathbf{60} := -20/(2 + 3) \times (3 - 20 + 2)$$

$$\mathbf{61} := 20/2 + 33 + 20 - 2$$
$$\mathbf{62} := 20 + 2 - (3 - 3 - 20) \times 2$$
$$\mathbf{63} := 20 - 2 + 3^3 + 20 - 2$$
$$\mathbf{64} := 2 \times 0 \times 23 + 32 \times 02$$
$$\mathbf{65} := -2 + 02 \times 33 + 2/02$$
$$\mathbf{66} := 2 \times 0 \times 23 + 3 \times (20 + 2)$$
$$\mathbf{67} := 20 + 23 \times 3 - 20 - 2$$
$$\mathbf{68} := (2 + 02 \times 33) \times 2/02$$
$$\mathbf{69} := (20 - 2) \times 3 - 3 + 20 - 2$$
$$\mathbf{70} := (20 \times 2 - 33) \times 20/2$$
$$\mathbf{71} := 20 + 23 \times 3 - 20 + 2$$
$$\mathbf{72} := (20 - 2)/3 \times 3 \times 2 \times 02$$
$$\mathbf{73} := 20 - 2 + 33 + 20 + 2$$
$$\mathbf{74} := (20/(2 + 3))^3 + 20/2$$
$$\mathbf{75} := 20 \times (2 + 3) - 3 - 20 - 2$$
$$\mathbf{76} := 2 \times 0 + 2 \times 33 + 20/2$$
$$\mathbf{77} := 20 + 23 + 32 + 02$$
$$\mathbf{78} := 20 \times (2 + 3/3) + 20 - 2$$
$$\mathbf{79} := 2 - 02 + (3 \times 3)^2 - 2$$
$$\mathbf{80} := 20/2 + (33 + 2) \times 02$$

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$$
\begin{aligned}
\mathbf{81} &:= 2 + 023 \times 3 + 20/2 \\
\mathbf{82} &:= 20 + 2 \times 33 - 2 \times 02 \\
\mathbf{83} &:= 20/2 + 33 + 20 \times 2 \\
\mathbf{84} &:= (2 + 0 \times 2) \times 33 + 20 - 2 \\
\mathbf{85} &:= 20 + 2 - 3 + 3 \times (20 + 2) \\
\mathbf{86} &:= 20 + (-2 + 3 + 32) \times 02 \\
\mathbf{87} &:= 20 + 23 \times 3 - 2 + 0 \times 2 \\
\mathbf{88} &:= (2 + 0 \times 2) \times 33 + 20 + 2 \\
\mathbf{89} &:= 20 \times 2 - 3 \times (3 - 20) - 2 \\
\mathbf{90} &:= 20 + (2 + 33 + 2 \times 0) \times 2
\end{aligned}
\qquad
\begin{aligned}
\mathbf{91} &:= 20 - 2 + 33 + 20 \times 2 \\
\mathbf{92} &:= 2 + (-02 + 3^3 + 20) \times 2 \\
\mathbf{93} &:= 2 + 023 \times 3 + 20 + 2 \\
\mathbf{94} &:= 2 + (02 \times 33 - 20) \times 2 \\
\mathbf{95} &:= 20 + 2 + 33 + 20 \times 2 \\
\mathbf{96} &:= (2 + 02 \times 33 - 20) \times 2 \\
\mathbf{97} &:= 20 \times (2 + 3) - 3 + 2 - 02 \\
\mathbf{98} &:= 2 \times 0 + 2 \times (3^3 + 20 + 2) \\
\mathbf{99} &:= 20 \times (2 + 3) - 3 + 2 \times 0 + 2 \\
\mathbf{100} &:= 20 \times (-2 - 33 + 20 \times 2)
\end{aligned}
$$

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

2 Single Digit Representations

2.1 Single Digit

$$
\begin{aligned}
\mathbf{23} &:= 11 + 11 + 1 && = 22 + \frac{2}{2} && = 3^3 - 3 - \frac{3}{3} \\
&:= 4 + 4 + 4 + \frac{44}{4} && = 5 \times 5 - \frac{5+5}{5} && = 6 + 6 + \frac{66}{6} \\
&:= 7 + 7 + 7 + \frac{7+7}{7} && = 8 + 8 + 8 - \frac{8}{8} && = \frac{99 + 99 + 9}{9}
\end{aligned}
$$

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$$\begin{aligned}
\mathbf{2023} &:= (1+1)^{11} - (1+1) \times (11+1) - 1 \\
&:= \left(2 \times 22 + \frac{2}{2}\right)^2 - 2 \\
&:= 3 + 3 + (3+3) \times (333+3) + \frac{3}{3} \\
&:= 4 + 4 + (4+4) \times (4^4 - 4) - \frac{4}{4} \\
&:= \left(\frac{5+5}{5}\right)^{\frac{55}{5}} - 5 \times 5 \\
&:= 6 + 66 \times (6 \times 6 - 6) + 6 \times 6 + \frac{6}{6} \\
&:= 7 + 7 \times (7 \times (7 \times 7 - 7) - 7) + 7 \\
&:= \left(8 + 8 + \frac{8}{8}\right) \times \left(8 + \frac{888}{8}\right) \\
&:= 999 + \left(\frac{9+9}{9}\right)^{9+\frac{9}{9}}
\end{aligned}$$

https://doi.org/10.5281/zenodo.2538893

2.2 Patterns in Single Digit

Below are few patterns based on the above representations:

$$\begin{aligned}
\mathbf{23} &:= 22 + \frac{2}{2} \\
\mathbf{223} &:= 222 + \frac{2}{2} \\
\mathbf{22223} &:= 2222 + \frac{2}{2} \\
\mathbf{222223} &:= 22222 + \frac{2}{2}
\end{aligned}$$

$$\begin{aligned}
\mathbf{23} &:= 4 + 4 + 4 + \frac{44}{4} \\
\mathbf{123} &:= 4 + 4 + 4 + \frac{444}{4} \\
\mathbf{1123} &:= 4 + 4 + 4 + \frac{4444}{4} \\
\mathbf{11123} &:= 4 + 4 + 4 + \frac{44444}{4}
\end{aligned}$$

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$$\mathbf{23} := 6+6+\frac{66}{6} \qquad \mathbf{23} := 8+8+8-\frac{8}{8}$$
$$\mathbf{243} := 66+66+\frac{666}{6} \qquad \mathbf{253} := 88+88+88-\frac{88}{8}$$
$$\mathbf{2443} := 666+666+\frac{6666}{6} \qquad \mathbf{2553} := 888+888+888-\frac{888}{8}$$
$$\mathbf{24443} := 6666+6666+\frac{66666}{6} \qquad \mathbf{25553} := 8888+8888+8888-\frac{8888}{8}$$

$$\mathbf{23} := \frac{99+99+9}{9} \qquad \mathbf{2023} := 6+66\times(6\times 6-6)+6\times 6+\frac{6}{6}$$
$$\mathbf{233} := \frac{999+999+99}{9} \qquad \mathbf{20023} := 6+666\times(6\times 6-6)+6\times 6+\frac{6}{6}$$
$$\mathbf{2333} := \frac{9999+9999+999}{9} \qquad \mathbf{200023} := 6+6666\times(6\times 6-6)+6\times 6+\frac{6}{6}$$
$$\mathbf{23333} := \frac{99999+99999+9999}{9} \qquad \mathbf{2000023} := 6+66666\times(6\times 6-6)+6\times 6+\frac{6}{6}$$

https://doi.org/10.5281/zenodo.3930382

3 Single Letter Representations

Below are different representations for 23 and 2023 written in **single letter a**:

$$\mathbf{23} := \frac{aa+aa+a}{a}$$

$$\mathbf{2023} := \frac{aaaaaa\times(a+a)+(aa+aa-a)\times aaa}{a\times aaa}$$
$$:= \frac{(aaaaa-a)\times(a+a)}{a\times aa}+\frac{a+a+a}{a}$$

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

https://doi.org/10.5281/zenodo.2557025

3.1 Patterns in Single Letter

Below are three different patterns for 23 written in single letter **a**:

$$\mathbf{23} := \frac{aa + aa + a}{a}$$
$$\mathbf{123} := \frac{aaa + aa + a}{a}$$
$$\mathbf{1123} := \frac{aaaa + aa + a}{a}$$
$$\mathbf{11123} := \frac{aaaaa + aa + a}{a}$$

$$\mathbf{23} := \frac{aa + aa + a}{a}$$
$$\mathbf{123} := \frac{aaa + aa + a}{a}$$
$$\mathbf{1223} := \frac{aaaa + aaa + a}{a}$$
$$\mathbf{12223} := \frac{aaaaa + aaaa + a}{a}$$

$$\mathbf{23} := \frac{(aa + aa + a) \times a}{a \times a}$$
$$\mathbf{253} := \frac{(aa + aa + a) \times aa}{a \times a}$$
$$\mathbf{2553} := \frac{(aa + aa + a) \times aaa}{a \times a}$$
$$\mathbf{25553} := \frac{(aa + aa + a) \times aaaa}{a \times a}$$

$$\mathbf{23} := \frac{aaa - aa - aa + a + a + a}{a + a + a + a}$$
$$\mathbf{273} := \frac{aaaa - aa - aa + a + a + a}{a + a + a + a}$$
$$\mathbf{2773} := \frac{aaaaa - aa - aa + a + a + a}{a + a + a + a}$$
$$\mathbf{27773} := \frac{aaaaa - aa - aa + a + a + a}{a + a + a + a}$$

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$$\mathbf{23} := \frac{(aaa - a) \times (a + a)}{a \times aa} + \frac{a + a + a}{a}$$
$$\mathbf{2023} := \frac{(aaaaa - a) \times (a + a)}{a \times aa} + \frac{a + a + a}{a}$$
$$\mathbf{202023} := \frac{(aaaaaaa - a) \times (a + a)}{a \times aa} + \frac{a + a + a}{a}$$
$$\mathbf{20202023} := \frac{(aaaaaaaaa - a) \times (a + a)}{a \times aa} + \frac{a + a + a}{a}$$

$$\mathbf{2023} := \frac{(aaaaa - a) \times (a + a)}{(a \times aa} + \frac{a + a + a}{a}$$
$$\mathbf{20203} := \frac{(aaaaaa - aa) \times (a + a)}{(a \times aa} + \frac{a + a + a}{a}$$
$$\mathbf{202003} := \frac{(aaaaaaa - aaa) \times (a + a)}{(a \times aa} + \frac{a + a + a}{a}$$
$$\mathbf{2020003} := \frac{(aaaaaaaa - aaaa) \times (a + a)}{(a \times aa} + \frac{a + a + a}{a}$$

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

https://doi.org/10.5281/zenodo.3928507

23 and 2023 in Numbers and Patterns, **Zenodo**,
December 22, 2022, pp. 1-51, https://doi.org/10.5281/zenodo.7473340

4 Pyramid-Type Power Representations

$$
\begin{aligned}
\mathbf{23} &:= -0^0 + 1^1 - 2^2 + 3^3 \\
&:= 0^0 + 1^4 + 2^3 + 3^2 + 4^1 \\
&:= 0^4 + 1^5 + 2^3 + 3^2 + 4^1 + 5^0 \\
&:= 0^2 + 1^6 + 2^5 - 3^4 + 4^3 + 5^0 + 6^1 \\
&:= 0^6 + 1^7 + 2^4 - 3^5 + 4^0 + 5^2 + 6^3 + 7^1 \\
&:= 0^6 + 1^8 - 2^1 - 3^7 + 4^5 + 5^4 + 6^0 + 7^2 + 8^3 \\
&:= 0^6 - 1^9 + 2^8 - 3^7 + 4^5 + 5^4 + 6^3 + 7^0 + 8^1 + 9^2
\end{aligned}
$$

$$
\begin{aligned}
\mathbf{2023} &:= 0^2 + 1^5 - 2^3 + 3^6 + 4^1 + 5^0 + 6^4 \\
&:= 0^4 - 1^7 + 2^0 + 3^6 + 4^5 + 5^1 + 6^3 + 7^2 \\
&:= 0^5 + 1^7 + 2^8 + 3^6 + 4^1 + 5^4 + 6^0 + 7^3 + 8^2 \\
&:= 0^7 + 1^9 + 2^3 - 3^8 + 4^6 + 5^5 + 6^4 + 7^2 + 8^1 + 9^0
\end{aligned}
$$

It is understood that $0^0 = 1$ and $0^a = 1$, $a \neq 0$.

https://doi.org/10.5281/zenodo.3637662

23 and 2023 in Numbers and Patterns, **Zenodo**,
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4.1 Pattern with Power Representations

$$\mathbf{2023}\,0 := 0^8 + 1^9 + 2^3 + 3^7 + 4^5 + 5^6 + 6^4 + 7^1 + 8^0 + 9^2$$
$$\mathbf{2023}\,1 := 0^8 + 1^9 + 2^3 + 3^7 + 4^5 + 5^6 + 6^4 + 7^0 + 8^1 + 9^2$$
$$\mathbf{2023}\,2 := 0^6 - 1^9 - 2^8 + 3^7 + 4^0 + 5^3 + 6^4 + 7^5 + 8^2 + 9^1$$
$$\mathbf{2023}\,3 := 0^6 - 1^9 + 2^8 + 3^4 + 4^7 + 5^5 + 6^2 + 7^3 + 8^1 + 9^0$$
$$\mathbf{2023}\,4 := 0^6 - 1^9 + 2^8 + 3^4 + 4^7 + 5^5 + 6^2 + 7^3 + 8^0 + 9^1$$
$$\mathbf{2023}\,5 := 0^6 + 1^9 + 2^8 + 3^4 + 4^7 + 5^5 + 6^2 + 7^3 + 8^1 + 9^0$$
$$\mathbf{2023}\,6 := 0^6 + 1^9 + 2^8 + 3^4 + 4^7 + 5^5 + 6^2 + 7^3 + 8^0 + 9^1$$
$$\mathbf{2023}\,7 := 0^8 + 1^9 + 2^6 + 3^7 + 4^1 + 5^4 + 6^2 + 7^5 + 8^3 + 9^0$$
$$\mathbf{2023}\,8 := 0^5 - 1^8 + 2^9 + 3^6 + 4^7 + 5^3 + 6^1 + 7^4 + 8^0 + 9^2$$
$$\mathbf{2023}\,9 := 0^6 - 1^8 + 2^9 + 3^7 + 4^3 + 5^4 + 6^2 + 7^5 + 8^1 + 9^0$$

$$1\,\mathbf{2023} := 0^6 + 1^9 + 2^7 + 3^8 + 4^5 + 5^3 + 6^1 + 7^0 + 8^4 + 9^2$$
$$2\,\mathbf{2023} := 0^5 - 1^8 + 2^9 + 3^6 + 4^7 + 5^1 + 6^3 + 7^0 + 8^4 + 9^2$$
$$3\,\mathbf{2023} := 0^1 + 1^7 + 2^8 + 3^9 + 4^6 + 5^5 + 6^2 + 7^0 + 8^4 + 9^3$$
$$4\,\mathbf{2023} := 0^6 - 1^9 + 2^7 + 3^8 + 4^1 + 5^3 + 6^2 + 7^4 + 8^5 + 9^0$$
$$5\,\mathbf{2023} := 0^6 + 1^9 + 2^8 + 3^0 + 4^7 + 5^3 + 6^1 + 7^4 + 8^5 + 9^2$$
$$6\,\mathbf{2023} := 0^6 + 1^9 + 2^8 + 3^7 + 4^4 + 5^0 + 6^3 + 7^2 + 8^1 + 9^5$$
$$7\,\mathbf{2023} := 0^6 + 1^9 + 2^5 + 3^7 + 4^8 + 5^3 + 6^2 + 7^0 + 8^4 + 9^1$$
$$8\,\mathbf{2023} := 0^1 - 1^9 + 2^8 + 3^6 + 4^5 + 5^7 + 6^4 + 7^0 + 8^3 + 9^2$$
$$9\,\mathbf{2023} := 0^6 + 1^7 - 2^5 + 3^9 + 4^8 + 5^0 + 6^3 + 7^2 + 8^1 + 9^4$$

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$$10\mathbf{2023} := 0^3 - 1^9 - 2^7 + 3^0 + 4^8 + 5^6 + 6^1 + 7^5 + 8^4 + 9^2$$
$$11\mathbf{2023} := 0^8 + 1^9 + 2^4 + 3^6 + 4^1 + 5^7 + 6^2 + 7^3 + 8^5 + 9^0$$
$$12\mathbf{2023} := 0^1 + 1^9 + 2^8 + 3^7 + 4^5 + 5^4 + 6^3 + 7^6 + 8^2 + 9^0$$
$$13\mathbf{2023} := 0^3 + 1^8 + 2^6 + 3^9 + 4^1 + 5^7 + 6^4 + 7^0 + 8^5 + 9^2$$
$$14\mathbf{2023} := 0^6 + 1^8 + 2^9 + 3^0 + 4^2 + 5^7 + 6^3 + 7^1 + 8^4 + 9^5$$
$$15\mathbf{2023} := 0^7 + 1^0 + 2^8 + 3^9 + 4^3 + 5^2 + 6^5 + 7^6 + 8^1 + 9^4$$
$$16\mathbf{2023} := 0^8 + 1^0 - 2^4 + 3^9 + 4^7 + 5^2 + 6^5 + 7^6 + 8^3 + 9^1$$
$$17\mathbf{2023} := 0^1 - 1^7 + 2^9 + 3^4 + 4^8 + 5^3 + 6^6 + 7^0 + 8^2 + 9^5$$
$$18\mathbf{2023} := 0^1 - 1^2 + 2^6 + 3^9 + 4^8 + 5^7 + 6^4 + 7^5 + 8^3 + 9^0$$
$$19\mathbf{2023} := 0^6 + 1^0 + 2^7 + 3^1 - 4^9 + 5^8 + 6^3 + 7^2 + 8^4 + 9^5$$

$$\mathbf{2023}00 := 0^1 + 1^8 - 2^9 + 3^5 + 4^2 + 5^7 + 6^3 + 7^6 + 8^0 + 9^4$$
$$\mathbf{2023}01 := 0^3 - 1^9 + 2^7 + 3^1 - 4^8 + 5^5 + 6^2 + 7^4 + 8^6 + 9^0$$
$$\mathbf{2023}02 := 0^8 + 1^9 - 2^5 - 3^3 + 4^2 + 5^7 + 6^0 + 7^6 + 8^1 + 9^4$$
$$\mathbf{2023}03 := 0^2 - 1^5 - 2^9 + 3^8 + 4^4 + 5^7 + 6^3 + 7^6 + 8^1 + 9^0$$
$$\mathbf{2023}04 := 0^2 - 1^5 - 2^9 + 3^8 + 4^4 + 5^7 + 6^3 + 7^6 + 8^0 + 9^1$$
$$\mathbf{2023}05 := 0^2 + 1^5 - 2^9 + 3^8 + 4^4 + 5^7 + 6^3 + 7^6 + 8^1 + 9^0$$
$$\mathbf{2023}06 := 0^2 + 1^5 - 2^9 + 3^8 + 4^4 + 5^7 + 6^3 + 7^6 + 8^0 + 9^1$$
$$\mathbf{2023}07 := 0^8 + 1^0 - 2^9 + 3^5 + 4^2 + 5^7 + 6^3 + 7^6 + 8^1 + 9^4$$
$$\mathbf{2023}08 := 0^0 + 1^8 - 2^9 + 3^5 + 4^2 + 5^7 + 6^3 + 7^6 + 8^1 + 9^4$$
$$\mathbf{2023}09 := 0^3 + 1^9 + 2^7 + 3^0 - 4^8 + 5^5 + 6^2 + 7^4 + 8^6 + 9^1$$

$$\begin{aligned}
\mathbf{202310} &:= 0^5 + 1^9 - 2^8 + 3^2 + 4^1 + 5^7 + 6^3 + 7^6 + 8^0 + 9^4 \\
\mathbf{202311} &:= 0^4 + 1^9 - 2^5 + 3^8 - 4^3 + 5^7 + 6^1 + 7^6 + 8^2 + 9^0 \\
\mathbf{202312} &:= 0^5 - 1^9 - 2^8 + 3^2 + 4^0 + 5^7 + 6^3 + 7^6 + 8^1 + 9^4 \\
\mathbf{202313} &:= 0^2 - 1^9 - 2^4 - 3^7 - 4^8 + 5^3 + 6^5 + 7^1 + 8^6 + 9^0 \\
\mathbf{202314} &:= 0^5 + 1^9 - 2^8 + 3^2 + 4^0 + 5^7 + 6^3 + 7^6 + 8^1 + 9^4 \\
\mathbf{202315} &:= 0^1 - 1^9 + 2^4 + 3^7 - 4^8 + 5^5 + 6^2 + 7^3 + 8^6 + 9^0 \\
\mathbf{202316} &:= 0^5 + 1^9 - 2^8 + 3^1 + 4^2 + 5^7 + 6^3 + 7^6 + 8^0 + 9^4 \\
\mathbf{202317} &:= 0^5 - 1^9 - 2^8 - 3^0 + 4^2 + 5^7 + 6^3 + 7^6 + 8^1 + 9^4 \\
\mathbf{202318} &:= 0^8 + 1^9 + 2^2 - 3^5 + 4^1 + 5^7 + 6^3 + 7^6 + 8^0 + 9^4 \\
\mathbf{202319} &:= 0^5 - 1^9 - 2^8 + 3^0 + 4^2 + 5^7 + 6^3 + 7^6 + 8^1 + 9^4
\end{aligned}$$

https://doi.org/10.5281/zenodo.2553326
https://doi.org/10.5281/zenodo.3637662

5 Narcissistic-Type Representations

$$\begin{aligned}
\mathbf{23} &:= -2^2 + 3^3 \\
&:= \frac{-2^2 + 3^3}{2^1 - 3^0} \\
&= \frac{2^7 + 3^7}{2^4 + 3^4}
\end{aligned}$$

$$\mathbf{2023} := \frac{2^0 + 0^0 + 2^{11} - 3^3}{-2^0 - 0^0 + 2^1 + 3^0}$$

https://doi.org/10.5281/zenodo.2572770
https://doi.org/10.5281/zenodo.3820428

6 Selfie Fractions for 23 and 2023

6.1 Selfie Fractions

$$\frac{\mathbf{23}}{46} := \frac{2+3}{4+6} \qquad \frac{\mathbf{23}}{69} := \frac{2+3}{6+9}$$

$$\frac{1156}{\mathbf{2023}} := \frac{(1+1)\times 5+6}{20+2^3} \qquad \frac{1445}{\mathbf{2023}} := \frac{1^4\times 4\times 5}{20+2^3} \qquad \frac{1734}{\mathbf{2023}} := \frac{17+3+4}{20+2^3}$$

$$\frac{\mathbf{2023}}{2312} := \frac{20+2^3}{2^{3+1\times 2}}$$
$$\frac{\mathbf{2023}}{2601} := \frac{2+02+3}{2+6+01}$$
$$\frac{\mathbf{2023}}{3468} := \frac{20+2^3}{34+6+8}$$
$$\frac{\mathbf{2023}}{4046} := \frac{2\times 0\times 2+3}{4\times 0\times 4+6}$$
$$\frac{\mathbf{2023}}{4046} := \frac{2\times 02\times 3}{4\times(0\times 4+6)}$$
$$\frac{\mathbf{2023}}{4046} := \frac{2^{02+3}}{40+4\times 6}$$
$$\frac{\mathbf{2023}}{4046} := \frac{2+02+3}{4+04+6}$$
$$\frac{\mathbf{2023}}{4046} := \frac{2+023}{4+046}$$
$$\frac{\mathbf{2023}}{4046} := \frac{20+23}{40+46}$$
$$\frac{\mathbf{2023}}{4046} := \frac{202+3}{404+6}$$

$$\frac{\mathbf{2023}}{4335} := \frac{2+02+3}{4+3+3+5}$$
$$\frac{\mathbf{2023}}{4624} := \frac{2+02+3}{4+6+2+4}$$
$$\frac{\mathbf{2023}}{4913} := \frac{2+02+3}{4+9+1+3}$$
$$\frac{\mathbf{2023}}{5491} := \frac{2+02+3}{5+4+9+1}$$
$$\frac{\mathbf{2023}}{6069} := \frac{2\times 0\times 2+3}{6\times 0\times 6+9}$$
$$\frac{\mathbf{2023}}{6069} := \frac{2+0\times 2+3}{6+0\times 6+9}$$
$$\frac{\mathbf{2023}}{6069} := \frac{2+02+3}{6+06+9}$$
$$\frac{\mathbf{2023}}{6069} := \frac{2+0\times 23}{6+0\times 69}$$
$$\frac{\mathbf{2023}}{6069} := \frac{2+023}{6+069}$$
$$\frac{\mathbf{2023}}{6069} := \frac{20+23}{60+69}$$

$$\frac{\mathbf{2023}}{6069} := \frac{202+3}{606+9}$$
$$\frac{\mathbf{2023}}{6358} := \frac{2+02+3}{6+3+5+8}$$
$$\frac{\mathbf{2023}}{6647} := \frac{2+02+3}{6+6+4+7}$$
$$\frac{\mathbf{2023}}{6936} := \frac{2+02+3}{6+9+3+6}$$
$$\frac{\mathbf{2023}}{7514} := \frac{2+02+3}{7+5+14}$$
$$\frac{\mathbf{2023}}{8092} := \frac{2+0\times 23}{8+0\times 92}$$
$$\frac{\mathbf{2023}}{8092} := \frac{20+23}{80+92}$$
$$\frac{\mathbf{2023}}{8959} := \frac{2+02+3}{8+9+5+9}$$
$$\frac{\mathbf{2023}}{9537} := \frac{20+2^3}{95+37}$$
$$\frac{\mathbf{2023}}{9826} := \frac{20+2^3}{(9+8)\times(2+6)}$$

https://doi.org/10.5281/zenodo.2604531
https://doi.org/10.5281/zenodo.3474267

6.2 Selfie Fractions: Multiple Choices

$$
\begin{aligned}
\frac{\mathbf{2023}}{16184} &:= \frac{2+023}{16+184} && = \frac{2+0\times 23}{16^{(}1^{8}4)}\\
&:= \frac{20+2\times 3}{16\times(1+8+4)} && = \frac{2\times 0\times 2+3}{1\times 6\times 1^{8}\times 4}\\
&:= \frac{(20+2)\times 3}{16\times(1+8\times 4)} && = \frac{2\times(0\times 2+3)}{16+1\times 8\times 4}\\
&:= \frac{2\times 02\times 3}{1\times(6+18)\times 4} && = \frac{2^{02\times 3}}{16\times 1\times 8\times 4}\\
&:= \frac{2+0\times 2+3}{1+6+1+8\times 4} && = \frac{2+02\times 3}{(1+6+1+8)\times 4}\\
&:= \frac{2+02^{3}}{16\times(1^{8}+4)} && = \frac{2+02+3}{1\times(6+1\times 8)\times 4}\\
&:= \frac{20+2^{3}}{(1+6\times 1)\times 8\times 4} && = \frac{2^{02+3}}{(1+6+1)\times 8\times 4}
\end{aligned}
$$

$$
\begin{aligned}
\frac{\mathbf{2023}}{10115} &:= \frac{2+023}{10+115} && = \frac{2\times 0\times 2+3}{1\times 01\times 15}\\
&:= \frac{(2+02^{3}}{10\times 1\times 1\times 5} && = \frac{(2+0\times 2+3}{10+1\times 15}\\
&:= \frac{(2\times 02\times 3)}{1+011)\times 5} && = \frac{(2^{02+3}}{10\times(1+15)}\\
&:= \frac{(2+0\times 23}{(1+01\times 1)\times 5} && = \frac{(2\times(0\times 2+3)}{(1+01)\times 15}\\
&:= \frac{(2^{02\times 3}}{10\times(1+1)^{5}} && = \frac{20\times(2+3)}{10^{1+1}\times 5)}
\end{aligned}
$$

https://doi.org/10.5281/zenodo.2604531
https://doi.org/10.5281/zenodo.3474267

6.3 Patterned Selfie Fractions for 23

$$\frac{\mathbf{23}}{1449} := \frac{2^3}{14\times 4\times 9}$$
$$\frac{\mathbf{23}}{14490} := \frac{2^3}{14\times 4\times 90}$$
$$\frac{\mathbf{23}}{144900} := \frac{2^3}{14\times 4\times 900}$$
$$\frac{\mathbf{23}}{1449000} := \frac{2^3}{14\times 4\times 9000}$$

$$\frac{\mathbf{23}}{253} := \frac{2+3}{2+53}$$
$$\frac{\mathbf{23}}{2553} := \frac{2+3}{2+553}$$
$$\frac{\mathbf{23}}{25553} := \frac{2+3}{2+5553}$$
$$\frac{\mathbf{23}}{255553} := \frac{2+3}{2+55553}$$

https://doi.org/10.5281/zenodo.3520096

6.4 Patterned Selfie Fractions for 2023

$$\frac{\mathbf{2023}}{10115} := \frac{20\times(2+3)}{10^{(1+1)}\times 5}$$
$$\frac{\mathbf{2023}}{101150} := \frac{20\times(2+3)}{10^{(1+1)}\times 50}$$
$$\frac{\mathbf{2023}}{1011500} := \frac{20\times(2+3)}{10^{(1+1)}\times 500}$$

$$\frac{\mathbf{2023}}{12138} := \frac{2^{02\times 3}}{12\times(1+3)\times 8}$$
$$\frac{\mathbf{2023}}{121380} := \frac{2^{02\times 3}}{12\times(1+3)\times 80}$$
$$\frac{\mathbf{2023}}{1213800} := \frac{2^{02\times 3}}{12\times(1+3)\times 800}$$

$$\frac{\mathbf{2023}}{13294} := \frac{20+2^3}{(1+(3+2)\times 9)\times 4}$$
$$\frac{\mathbf{2023}}{132940} := \frac{20+2^3}{(1+(3+2)\times 9)\times 40}$$
$$\frac{\mathbf{2023}}{1329400} := \frac{20+2^3}{(1+(3+2)\times 9)\times 400}$$

$$\frac{\mathbf{2023}}{15028} := \frac{20+2^3}{(1+5^{02})\times 8}$$
$$\frac{\mathbf{2023}}{150280} := \frac{20+2^3}{(1+5^{02})\times 80}$$
$$\frac{\mathbf{2023}}{1502800} := \frac{20+2^3}{(1+5^{02})\times 800}$$

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$$\frac{\mathbf{2023}}{16184} := \frac{20+2^3}{(1+6\times 1)\times 8\times 4}$$
$$\frac{\mathbf{2023}}{161840} := \frac{20+2^3}{(1+6\times 1)\times 8\times 40}$$
$$\frac{\mathbf{2023}}{1618400} := \frac{20+2^3}{(1+6\times 1)\times 8\times 400}$$

$$\frac{\mathbf{2023}}{18207} := \frac{20+2^3}{18\times 2\times 07}$$
$$\frac{\mathbf{2023}}{182070} := \frac{20+2^3}{18\times 2\times 070}$$
$$\frac{\mathbf{2023}}{1820700} := \frac{20+2^3}{18\times 2\times 0700}$$

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23 and 2023 in Numbers and Patterns, **Zenodo**,
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7 Semi-Selfie Representations for 23 and 2023

7.1 Semi-Selfie Representations

$$
\begin{aligned}
\mathbf{23^3} := \mathbf{12167} &= (1+21-6+7)^3 \\
\\
\mathbf{23^4} := \mathbf{279841} &= (2+7+9+8-4+1)^4 \\
&= (27-9+8-4+1)^4 \\
\\
\mathbf{23^5} := \mathbf{6436343} &= (6+4+3+6+3+4-3)^5 \\
\\
\mathbf{23^6} := \mathbf{148035889} &= (14+8+03+5-8-8+9)^6 \\
&= (1+48-035+8-8+9)^6 \\
&= (14+80+3+5-88+9)^6 \\
&= (1+4+80+35-8-89)^6 \\
\\
\mathbf{23^7} := \mathbf{3404825447} &= (3+4+04+8-2+5+4+4-7)^7 \\
&= (34+048-2-54+4-7)^7 \\
&= (3-40+48-25+44-7)^7 \\
&= (-3+404-825+447)^7 \\
\\
\mathbf{23^8} := \mathbf{78310985281} &= (7+8+31-09-8+5-2-8-1)^8 \\
&= (78+31-098+5-2+8+1)^8 \\
&= (7+83-1-098+5+28-1)^8 \\
&= (7+8-31+098-52-8+1)^8 \\
&= (-7+83-109+85-28-1)^8 \\
\\
\mathbf{2023^3} := \mathbf{8279186167} &= (82+79+1861-6+7)^3
\end{aligned}
$$

https://doi.org/10.5281/zenodo.3338366

23 and 2023 in Numbers and Patterns, **Zenodo**,
December 22, 2022, pp. 1-51, https://doi.org/10.5281/zenodo.7473340

7.2 Power 23

$$\begin{aligned} \mathbf{2}^{\mathbf{23}} &:= 8388608 && = (8+38+8-60+8)^{23} \\ \mathbf{3}^{\mathbf{23}} &:= 94143178827 && = (941-43+1-7-882-7)^{23} \end{aligned}$$

https://doi.org/10.5281/zenodo.3338366

8 Running Equality Expressions

$$\begin{aligned} \mathbf{23} &:= 1\times 23 && = 45+67-89 \\ &:= 1\times 23 && = 4-56+78-\sqrt{9} \\ &:= (1+2)^3-4 && = -56+7+8\times 9 \\ &:= 1-23+45 && = 6-7+8\times\sqrt{9} \\ &:= -1+23-4+5 && = 6-7+8\times\sqrt{9} \end{aligned}$$

$$\begin{aligned} \mathbf{23} &:= \sqrt{9}\times 8-7+6 && = 54-32+1 \\ &:= \sqrt{9}\times 8-7+6 && = 5-4+32-10 \\ &:= 9+\sqrt{87-6}+5 && = 4\times 3\times 2-1 \\ &:= 9+8+7-6+5 && = 4\times 3\times 2-1 = 43-2\times 10 \\ &:= 9-8+76-54 && = (3!-2)!-1 = 3+2\times 10 \\ &:= 98-76+5-4 && = (3!-2)!-1 = 3+2\times 10 \\ &:= \sqrt{9}\times 8-7+6 && = 54-32+1 \\ &:= \sqrt{9}\times 8-7+6 && = 5-4+32-10 \end{aligned}$$

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$$\begin{aligned}\mathbf{23} &:= (1+2)^3 - 4 &&= 56 - 78 + T(9)\\ &:= 1 - 23 + 45 &&= 6 - F(7) + F(8) + 9 = 6 - T(7) + T(8) + 9\\ &:= 1^2 - 34 + 56 = -7 + F(8) + 9\end{aligned}$$

$$\begin{aligned}\mathbf{23} &:= (-9 + F(8) \times 7)/6 &&= 54 - 32 + 1 &&= 5 - 4 + 32 - 10\\ &:= 9 + F(8) - 7 \times (6-5) &&= 4 - F(3) + 21 &&= 43 - 2 \times 10\\ &:= 9 + F(8) - 7 &&= 65 - 43 + 2 - 1 &&= 6 - 5 + 4 - F(3) + 2 \times 10\\ &:= 98 - 76 + 5 - 4 &&= F(3) + 21 &&= 3 + 2 \times 10\end{aligned}$$

$$\mathbf{2023} := -9 + (F(8) + F(F(7))) \times F(6) = -5^{F(F(4))} + F(3) \times 2^{10}$$

In case of 2023 we have only in reverse order. The functions **F** and **T** are the **Fibonacci** and **Triangular** numbers.

http://rgmia.org/papers/v20/v20a35.pdf
https://doi.org/10.5281/zenodo.2483327
https://doi.org/10.5281/zenodo.5761752

9 Selfie Representations

9.1 Digit's Order and Reverse Order of Digits

Below are different **selfie representations** of 23 and 2023. These are in terms of **Fibonacci** and **Triangular** numbers.

$$\begin{aligned}\mathbf{23} &:= -2^2 + 3^3 \\ &:= 2 + T(T(3)) = 2 + F(F(3!)) \\ &:= T(T(3)) + 2 = (F(F(3!)) + 2)\end{aligned}$$

$$\begin{aligned}\mathbf{2023} &:= T(T(2)) + 0!) + T((T(2) \times T(T(3))) \\ &:= T((T(T(3)) \times T(2)) + 0! + T(T(2))\end{aligned}$$

https://doi.org/10.5281/zenodo.2567571
https://doi.org/10.5281/zenodo.2574136

10 Special Functions Representations

$$\begin{aligned}\mathbf{2023} &:= F(3) + F(7) + F(9) + F(14) + F(17) && \textbf{F := Fibonacci} \\ &:= T(22) + T(59) && \textbf{T := Triangular} \\ &:= Q(1) + Q(2) + Q(13) + Q(43) && \textbf{Q := Quadratic} \\ &:= C(2) + C(5) + C(6) + C(7) + C(11) && \textbf{C := Cubic}\end{aligned}$$

/https://rgmia.org/papers/v21/v21a06.pdf
/https://rgmia.org/papers/v21/v21a07.pdf

11 Power Representations

11.1 Powers of 2, 3 and 5

$$\mathbf{23} := 2^4 + 2^3 - 2^0$$

$$\begin{aligned}\mathbf{2023} &:= 2^{11} - 2^5 + 2^2 + 2^1 + 2^0 \\ &:= 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^2 + 2^1 + 2^0 \\ &:= 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^4 - 2^3 - 2^2 + 2^1 + 2^0\end{aligned}$$

$$\mathbf{23^2} := 3^2 + 14^2 + 18^2$$
$$:= 3^2 + 6^2 + 22^2$$
$$:= 6^2 + 13^2 + 18^2$$

$$\mathbf{23^3} := 6^3 + 14^3 + 15^3 + 18^3 \quad \mathbf{23^5} := 1^5 + 7^5 + 8^5 + 14^5 + 15^5 + 18^5 + 20^5$$

https://doi.org/10.5281/zenodo.2565729

11.2 Power 2

$$\mathbf{2023} := 1^2 + 2^2 + 13^2 + 43^2$$
$$:= 1^2 + 5^2 + 29^2 + 34^2$$
$$:= 1^2 + 7^2 + 23^2 + 38^2$$
$$:= 1^2 + 11^2 + 26^2 + 35^2$$
$$:= 1^2 + 13^2 + 22^2 + 37^2$$
$$:= 2^2 + 5^2 + 25^2 + 37^2$$
$$:= 2^2 + 7^2 + 11^2 + 43^2$$
$$:= 2^2 + 7^2 + 17^2 + 41^2$$
$$:= 2^2 + 11^2 + 23^2 + 37^2$$
$$:= 2^2 + 13^2 + 25^2 + 35^2$$
$$:= 2^2 + 17^2 + 19^2 + 37^2$$
$$:= 3^2 + 5^2 + 15^2 + 42^2$$
$$:= 3^2 + 5^2 + 30^2 + 33^2$$
$$:= 3^2 + 9^2 + 13^2 + 42^2$$
$$:= 3^2 + 13^2 + 18^2 + 39^2$$
$$:= 3^2 + 14^2 + 27^2 + 33^2$$
$$:= 3^2 + 18^2 + 27^2 + 31^2$$
$$:= 3^2 + 21^2 + 22^2 + 33^2$$
$$:= 5^2 + 6^2 + 21^2 + 39^2$$
$$:= 5^2 + 7^2 + 10^2 + 43^2$$
$$:= 5^2 + 10^2 + 23^2 + 37^2$$
$$:= 5^2 + 11^2 + 14^2 + 41^2$$
$$:= 5^2 + 14^2 + 29^2 + 31^2$$
$$:= 5^2 + 17^2 + 22^2 + 35^2$$
$$:= 5^2 + 19^2 + 26^2 + 31^2$$
$$:= 6^2 + 9^2 + 15^2 + 41^2$$
$$:= 6^2 + 13^2 + 27^2 + 33^2$$
$$:= 7^2 + 11^2 + 22^2 + 37^2$$
$$:= 7^2 + 13^2 + 19^2 + 38^2$$
$$:= 7^2 + 17^2 + 23^2 + 34^2$$
$$:= 7^2 + 22^2 + 23^2 + 31^2$$
$$:= 9^2 + 14^2 + 15^2 + 39^2$$
$$:= 9^2 + 18^2 + 23^2 + 33^2$$
$$:= 10^2 + 11^2 + 29^2 + 31^2$$
$$:= 10^2 + 13^2 + 23^2 + 35^2$$
$$:= 11^2 + 13^2 + 17^2 + 38^2$$
$$:= 13^2 + 14^2 + 17^2 + 37^2$$
$$:= 13^2 + 15^2 + 27^2 + 30^2$$
$$:= 13^2 + 18^2 + 21^2 + 33^2$$
$$:= 13^2 + 22^2 + 23^2 + 29^2$$
$$:= 14^2 + 19^2 + 25^2 + 29^2$$
$$:= 18^2 + 21^2 + 23^2 + 27^2$$

https://doi.org/10.5281/zenodo.2565729

11.3 Power 3

$$\mathbf{2023} := 2^3 + 5^3 + 6^3 + 7^3 + 11^3$$

11.4 Pattern with Power 2

$$\begin{aligned}
\mathbf{23} &:= 3^2 + 4^2 - 1^2 - 1^2 \\
\mathbf{2300} &:= 30^2 + 40^2 - 10^2 - 10^2 \\
\mathbf{230000} &:= 300^2 + 400^2 - 100^2 - 100^2 \\
\mathbf{23000000} &:= 3000^2 + 4000^2 - 1000^2 - 1000^2 \\
\mathbf{2300000000} &:= 30000^2 + 40000^2 - 10000^2 - 10000^2
\end{aligned}$$

$$\begin{aligned}
\mathbf{23} &:= 5^2 - 1^2 - 1^2 = 3^2 + 4^2 - 1^2 - 1^2 \\
\mathbf{3023} &:= 55^2 - 1^2 - 1^2 = 33^2 + 44^2 - 1^2 - 1^2 \\
\mathbf{308023} &:= 555^2 - 1^2 - 1^2 = 333^2 + 444^2 - 1^2 - 1^2 \\
\mathbf{30858023} &:= 5555^2 - 1^2 - 1^2 = 3333^2 + 4444^2 - 1^2 - 1^2 \\
\mathbf{3086358023} &:= 55555^2 - 1^2 - 1^2 = 33333^2 + 44444^2 - 1^2 - 1^2
\end{aligned}$$

$$\begin{aligned}
\mathbf{23}^2 &:= 529 \\
\mathbf{233}^2 &:= 54289 \\
\mathbf{2333}^2 &:= 5442889 \\
\mathbf{23333}^2 &:= 544428889
\end{aligned}
\qquad
\begin{aligned}
\mathbf{231}^2 &:= 53361 \\
\mathbf{2331}^2 &:= 5433561 \\
\mathbf{23331}^2 &:= 544335561 \\
\mathbf{233331}^2 &:= 54443355561
\end{aligned}$$

$$\mathbf{2023}^2 := 4092529 \qquad \mathbf{20231}^2 := 409293361$$
$$\mathbf{20023}^2 := 400920529 \qquad \mathbf{200231}^2 := 40092453361$$
$$\mathbf{200023}^2 := 40009200529 \qquad \mathbf{2000231}^2 := 4000924053361$$
$$\mathbf{2000023}^2 := 4000092000529 \qquad \mathbf{20000231}^2 := 400009240053361$$

https://doi.org/10.5281/zenodo.2558522

11.5 Multiplicative Patterns with 23

$$\mathbf{23} \times 34 := 782 \qquad \mathbf{23} \times 77 := 1771$$
$$\mathbf{23} \times 334 := 7682 \qquad \mathbf{23} \times 777 := 17871$$
$$\mathbf{23} \times 3334 := 76682 \qquad \mathbf{23} \times 7777 := 178871$$
$$\mathbf{23} \times 33334 := 766682 \qquad \mathbf{23} \times 77777 := 1788871$$

https://doi.org/10.5281/zenodo.2558522

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12 Pythagorean Triples for 23 and 2023

12.1 Pythagorean Triples

$$\begin{aligned} 264^2 + \mathbf{23^2} &:= 265^2 \\ \\ 952^2 + 1785^2 &= \mathbf{2023^2} \\ 1127^2 + 1680^2 &= \mathbf{2023^2} \\ \\ \mathbf{2023^2} + 2040^2 &= 2873^2 \\ \mathbf{2023^2} + 6936^2 &= 7225^2 \\ \mathbf{2023^2} + 17136^2 &= 17255^2 \\ \mathbf{2023^2} + 41736^2 &= 41785^2 \\ \mathbf{2023^2} + 120360^2 &= 120377^2 \\ \mathbf{2023^2} + 292320^2 &= 292327^2 \end{aligned}$$

12.2 Pythagorean Triples Pattern for 23

$$\begin{aligned} 264^2 + \mathbf{23^2} &:= 265^2 \\ 20604^2 + \mathbf{203^2} &:= 20605^2 \\ 2006004^2 + \mathbf{2003^2} &:= 2006005^2 \\ 200060004^2 + \mathbf{20003^2} &:= 200060005^2 \end{aligned}$$

https://doi.org/10.5281/zenodo.4603197

12.3 Magic Squares Generated by Pythagorean Triples

Below few examples of **Pythagorean triples** generating magic squares, where the number **2023** is one of the entries of magic squares.

1. **(135, 1008, 1017)** $\Rightarrow 1017 - 1008 = 3^2$, $S_{3\times 3} := 6075$, $T_9 := 135^2$,
   $E := \{2017, 2019, 2021, \mathbf{2023}, \ldots, 2031, 2033\}$ or
   $E := \{2021, 2022, \mathbf{2023}, \ldots, 2028, 2029\}$

2. **(615, 21008, 21017)** $\Rightarrow 21017 - 21008 = 3^2$, $S_{3\times 3} := 126075$, $T_9 := 615^2$,
   $E := \{42017, 42019, 42021, 4\mathbf{2023}, \ldots, 42031, 42033\}$ or
   $E := \{42021, 42022, 4\mathbf{2023},$
   $\ldots, 42028, 42029\}$

Both these results generates magic squares of order 3, having the number **2023** as one of the entries. The generating triples **(135, 1008, 1017)** and **(615, 21008, 21017)** are Pythagorean triples. See below these four magic squares.

https://doi.org/10.5281/zenodo.4837491

12.4 Magic Squares

Based on triples given above, below are 4 magic squares of orders 3 referring the first and second items. First two are for the triples **(135, 1008, 1017)** and last two are for the triples **(615, 21008, 21017)**

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

			6075
2023	2033	2019	*6075*
2021	2025	2029	*6075*
2031	2017	2027	*6075*
6075	*6075*	*6075*	*6075*

			126075
42024	42029	42022	*126075*
4**2023**	42025	42027	*126075*
42028	42021	42026	*126075*
126075	*126075*	*126075*	*126075*

			126075
4**2023**	42033	42019	*126075*
42021	42025	42029	*126075*
42031	42017	42027	*126075*
126075	*126075*	*126075*	*126075*

https://doi.org/10.5281/zenodo.5115214

13 Palindromic-Type Expressions

13.1 Expressions with 23 and 2023

$$11 \times \mathbf{23} + 32 \times 11 := 253 + 352$$

$$112 \times \mathbf{23} + 32 \times 211 := 2576 + 6752$$
$$301 \times \mathbf{23} + 32 \times 103 := 6923 + 3296$$
$$202 \times \mathbf{23} + 32 \times 202 := 4646 + 6464$$
$$212 \times \mathbf{23} + 32 \times 212 := 4876 + 6784$$
$$113 \times \mathbf{23} + 32 \times 311 := 2599 + 9952$$
$$303 \times \mathbf{23} + 32 \times 303 := 6969 + 9696$$

$$11 \times \mathbf{2023} + 3202 \times 11 = 22253 + 35222 := 57475$$

$$101 \times \mathbf{2023} + 3202 \times 101 = 204323 + 323402 := 527725$$
$$111 \times \mathbf{2023} + 3202 \times 111 = 224553 + 355422 := 579975$$
$$102 \times \mathbf{2023} + 3202 \times 201 = 206346 + 643602 := 849948$$

$$10001 \times \mathbf{2023} + 3202 \times 10001 = 20232023 + 32023202 := 52255225$$
$$10002 \times \mathbf{2023} + 3202 \times 20001 = 20234046 + 64043202 := 84277248$$
$$10011 \times \mathbf{2023} + 3202 \times 11001 = 20252253 + 35225202 := 55477455$$
$$10012 \times \mathbf{2023} + 3202 \times 21001 = 20254276 + 67245202 := 87499478$$
$$10021 \times \mathbf{2023} + 3202 \times 12001 = 20272483 + 38427202 := 58699685$$
$$10101 \times \mathbf{2023} + 3202 \times 10101 = 20434323 + 32343402 := 52777725$$
$$10102 \times \mathbf{2023} + 3202 \times 20101 = 20436346 + 64363402 := 84799748$$
$$10111 \times \mathbf{2023} + 3202 \times 11101 = 20454553 + 35545402 := 55999955$$

https://doi.org/10.5281/zenodo.2541174
https://doi.org/10.5281/zenodo.2541187

13.2 Patterns with 23 and 2023

$$
\begin{aligned}
11 \times \mathbf{23} + 32 \times 11 &= 253 + 352 &:= 605 \\
111 \times \mathbf{23} + 32 \times 111 &= 2553 + 3552 &:= 6105 \\
1111 \times \mathbf{23} + 32 \times 1111 &= 25553 + 35552 &:= 61105 \\
11111 \times \mathbf{23} + 32 \times 11111 &= 255553 + 355552 &:= 611105
\end{aligned}
$$

$$
\begin{aligned}
102 \times \mathbf{23} + 32 \times 201 &= 2346 + 6432 &:= 8778 \\
1002 \times \mathbf{23} + 32 \times 2001 &= 23046 + 64032 &:= 87078 \\
10002 \times \mathbf{23} + 32 \times 20001 &= 230046 + 640032 &:= 870078 \\
100002 \times \mathbf{23} + 32 \times 200001 &= 2300046 + 6400032 &:= 8700078
\end{aligned}
$$

$$
\begin{aligned}
103 \times \mathbf{23} + 32 \times 301 &= 2369 + 9632 &:= 12001 \\
1003 \times \mathbf{23} + 32 \times 3001 &= 23069 + 96032 &:= 119101 \\
10003 \times \mathbf{23} + 32 \times 30001 &= 230069 + 960032 &:= 1190101 \\
100003 \times \mathbf{23} + 32 \times 300001 &= 2300069 + 9600032 &:= 11900101
\end{aligned}
$$

$$
\begin{aligned}
12 \times \mathbf{23} + 32 \times 21 &= 276 + 672 \\
112 \times \mathbf{23} + 32 \times 211 &= 2576 + 6752 \\
1112 \times \mathbf{23} + 32 \times 2111 &= 25576 + 67552 \\
11112 \times \mathbf{23} + 32 \times 21111 &= 255576 + 675552
\end{aligned}
$$

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$$
\begin{aligned}
13 \times \mathbf{23} + 32 \times 31 &= 299 + 992 \\
113 \times \mathbf{23} + 32 \times 311 &= 2599 + 9952 \\
1113 \times \mathbf{23} + 32 \times 3111 &= 25599 + 99552 \\
11113 \times \mathbf{23} + 32 \times 31111 &= 255599 + 995552
\end{aligned}
$$

https://doi.org/10.5281/zenodo.2541174
https://doi.org/10.5281/zenodo.2541187
https://doi.org/10.5281/zenodo.2541198

14 Fixed Digits Repetitions Prime Patterns

14.1 Prime Patterns With 23 and 2023

14.1.1 Length 5

23	**23**	**23**
3390 **23**	3645 **23**	5421 **23**
3390 3390 **23**	3645 3645 **23**	5421 5421 **23**
3390 3390 3390 **23**	3645 3645 3645 **23**	5421 5421 5421 **23**
3390 3390 3390 3390 **23**	3645 3645 3645 3645 **23**	5421 5421 5421 5421 **23**

23	**23**	**23**
5850 **23**	6774 **23**	7803 **23**
5850 5850 **23**	6774 6774 **23**	7803 7803 **23**
5850 5850 5850 **23**	6774 6774 6774 **23**	7803 7803 7803 **23**
5850 5850 5850 5850 **23**	6774 6774 6774 6774 **23**	7803 7803 7803 7803 **23**

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23
13206 **23**
13206 13206 **23**
13206 13206 13206 **23**
13206 13206 13206 13206 **23**

23
13794 **23**
13794 13794 **23**
13794 13794 13794 **23**
13794 13794 13794 13794 **23**

23
29652 **23**
29652 29652 **23**
29652 29652 29652 **23**
29652 29652 29652 29652 **23**

23
43827 **23**
43827 43827 **23**
43827 43827 43827 **23**
43827 43827 43827 43827 **23**

23
64848 **23**
64848 64848 **23**
64848 64848 64848 **23**
64848 64848 64848 64848 **23**

23
70431 **23**
70431 70431 **23**
70431 70431 70431 **23**
70431 70431 70431 70431 **23**

23
85761 **23**
85761 85761 **23**
85761 85761 85761 **23**
85761 85761 85761 85761 **23**

23
89730 **23**
89730 89730 **23**
89730 89730 89730 **23**
89730 89730 89730 89730 **23**

23
95337 **23**
95337 95337 **23**
95337 95337 95337 **23**
95337 95337 95337 95337 **23**

https://doi.org/10.5281/zenodo.4445395
https://doi.org/10.5281/zenodo.4265818

14.1.2 Length 6

23
93093 **23**
93093 93093 **23**
93093 93093 93093 **23**
93093 93093 93093 93093 **23**
93093 93093 93093 93093 93093 **23**

23
23 4029
23 4029 4029
23 4029 4029 4029
23 4029 4029 4029 4029
23 4029 4029 4029 4029 4029

23
2 51195 **3**
2 51195 51195 **3**
2 51195 51195 51195 **3**
2 51195 51195 51195 51195 **3**
2 51195 51195 51195 51195 51195 **3**

23
2 82443 **3**
2 82443 82443 **3**
2 82443 82443 82443 **3**
2 82443 82443 82443 82443 **3**
2 82443 82443 82443 82443 82443 **3**

23
2 8733 **3**
2 8733 8733 **3**
2 8733 8733 8733 **3**
2 8733 8733 8733 8733 **3**
2 8733 8733 8733 8733 8733 **3**

https://doi.org/10.5281/zenodo.2561096
https://doi.org/10.5281/zenodo.4265818

14.1.3 Length 7

31 **2023**
31 **2023** 8859
31 **2023** 8859 8859
31 **2023** 8859 8859 8859
31 **2023** 8859 8859 8859 8859
31 **2023** 8859 8859 8859 8859 8859
31 **2023** 8859 8859 8859 8859 8859 8859

2023 40 09
2023 40 15 09
2023 40 15 15 09
2023 40 15 15 15 09
2023 40 15 15 15 15 09
2023 40 15 15 15 15 15 09
2023 40 15 15 15 15 15 15 09

2023 41 67
2023 41 96 67
2023 41 96 96 67
2023 41 96 96 96 67
2023 41 96 96 96 96 67
2023 41 96 96 96 96 96 67
2023 41 96 96 96 96 96 96 67

2023 4377
2023 4377 69
2023 4377 69 69
2023 4377 69 69 69
2023 4377 69 69 69 69
2023 4377 69 69 69 69 69
2023 4377 69 69 69 69 69 69

https://doi.org/10.5281/zenodo.2560668
https://doi.org/10.5281/zenodo.4265818

14.1.4 Length 8

202 **3** 4177
202 681 **3** 4177
202 681 681 **3** 4177
202 681 681 681 **3** 4177
202 681 681 681 681 **3** 4177
202 681 681 681 681 681 **3** 4177
202 681 681 681 681 681 681 **3** 4177
202 681 681 681 681 681 681 681 **3** 4177

https://doi.org/10.5281/zenodo.2560640
https://doi.org/10.5281/zenodo.4265818

15 Embedded Prime and Palindromic Prime Numbers

15.1 Non Palindromic Primes

23
333 **23** 333
33 333 **23** 333 33
3322233 333 **23** 333 3322233
3223323322233 333 **23** 333 3322233233223
3333332233233222233 333 **23** 333 3322233233223333333
33222223333332233233222233 333 **23** 333 3322233233223333332222233
3223323322222333333223323322233 333 **23** 333 332223323322333333222223323322333333
333333323223323322222333333223323322233 333 **23** 333 33222332332233333322222332332233333333

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303 **2023** 303
323303 **2023** 303323
322323303 **2023** 303323223
32322322323303 **2023** 30332322322323
320332322322323303 **2023** 303323223223233023
33303320332322322323303 **2023** 30332322322323302330333
32233303320332322322323303 **2023** 30332322322323302330333223
32332233303320332322322323303 **2023** 30332322322323302330333223323
3332332233303320332322322323303 **2023** 3033232232232330233033322332333

https://doi.org/10.5281/zenodo.4307875

15.2 Palindromic Primes with 23

303 **23032** 303
302 303 **23032** 303 203
32322302 303 **23032** 303 20322323
3332322302 303 **23032** 303 2032232333
3022023332322302 303 **23032** 303 2032232333202203
302233022023332322302 303 **23032** 303 203223233320220332203
33303302233022023332322302 303 **23032** 303 20322323332022033220330333
333233303302233022023332322302 303 **23032** 303 203223233320220332203303332333
30222333233303302233022023332322302 303 **23032** 303 20322323332022033220330333233322203

121 **23132** 121
122 121 **23132** 121 221
3122 121 **23132** 121 2213
13213122 121 **23132** 121 22131231
32313213122 121 **23132** 121 22131231323
332313213122 121 **23132** 121 221312313233
3112332313213122 121 **23132** 121 2213123132332113
33112332313213122 121 **23132** 121 22131231323321133
11133112332313213122 121 **23132** 121 22131231323321133111

32 **23232** 23
3333 32 **23232** 23 3333
322233333 32 **23232** 23 333332223
332223322233333 32 **23232** 23 333332223322233
33333333322233222333333 32 **23232** 23 3333322233222333333333
333333333333333322233222333333 32 **23232** 23 33333222332222333333333333333
3333333333333333322233222333333 32 **23232** 23 333332223322223333333333333333
333333233333333333333333322233222333333 32 **23232** 23 33333222332222333333333333333332333333

333 **23432** 333
322 333 **23432** 333 223
3332322 333 **23432** 333 2232333
32323332322 333 **23432** 333 22323332323
33423323233332322 333 **23432** 333 22323332332332433
3443433423323233332322 333 **23432** 333 2232333232332433433443
342234234434334233232333232 333 **23432** 333 22323333232332433434432432243
32323422342344343342332323332322 333 **23432** 333 223233332323324334344324322432323
3234323234223423443433423323233332322 333 **23432** 333 22323333232332433434432432243224323234323

325 **23532** 532
3522 325 **23532** 532 2253
3333522 325 **23532** 532 2253333
32223333522 325 **23532** 532 22533332223
3233532223333522 325 **23532** 532 2253333222353323
335332335322223333522 325 **23532** 532 22533332223533233533
32553353323353222333352 2 325 **23532** 532 225333322235332335335523
3225332553353323353222333352 2 325 **23532** 532 22533332223533233533552335223
333333225332553353323353222333352 2 325 **23532** 532 225333322235332335335523352233333

3 **23632** 3
336 3 **23632** 3 633
3623336 3 **23632** 3 6333263
3633623336 3 **23632** 3 6333263363
336223633623336 3 **23632** 3 633326336322633
333336223633623336 3 **23632** 3 633326336322633333
362333333362236336233 36 3 **23632** 3 6333263363226333333263
33223623333333622363362333 6 3 **23632** 3 633326336322633333332632233
3662332236233333336223633623336 3 **23632** 3 6333263363226333333326322332663

33 **23732** 33
37 33 **23732** 33 73
72237 33 **23732** 33 73227
322272237 33 **23732** 33 732272223
732322272237 33 **23732** 33 732272223237
7732322272237 33 **23732** 33 7322722232377
327732322272237 33 **23732** 33 732272223237723
33327732322272237 33 **23732** 33 732272223237723337

323 **23832** 323
33222 323 **23832** 323 22233
333222 323 **23832** 323 222333
32382333222 323 **23832** 323 22233328323
3338323823332 22 323 **23832** 323 222333283238333
38823338323823332 22 323 **23832** 323 22233328323832883
3228388233383238233322 2 323 **23832** 323 222333283238333283838223
38883228388233383238233322 2 323 **23832** 323 22233328323833328838238883
3232338883228388233383238233322 2 323 **23832** 323 222333283238333288382238883323

92 **23932** 29
37 92 **23932** 29 73
3937 92 **23932** 29 7393
993937 92 **23932** 29 739399
932993937 92 **23932** 29 739399239
723932993937 92 **23932** 29 739399239327
9723932993937 92 **23932** 29 7393992393279
79723932993937 92 **23932** 29 73939923932797
737797239329939 37 92 **23932** 29 739399239327973737

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15.3 Palindromic Primes with 2023

3022 **202303202** 2203
3033022 **202303202** 2203303
3033033022 **202303202** 2203303303
3022023033033022 **202303202** 2203303303202203
330220230330330 22 **202303202** 22033033032022033
32303330220230330330 22 **202303202** 220330330320220330323
3202332303330220230330330 22 **202303202** 2203303303202203330332332023
320202320233230333022023033033022 **202303202** 22033033032022033303323320232023
33333202023202332303330220230330330 22 **202303202** 220330330320220333032332023202023333

33 **202323202** 33
303233 **202323202** 332303
33303233 **202323202** 33230333
3333303233 **202323202** 3323033333
3202023333303233 **202323202** 3323033333202023
330333202023333303233 **202323202** 332303333320202333033
30303330333202023333303233 **202323202** 33230333332020233303330303
323323030333033320202333303233 **202323202** 332303333320202333033303032323
3333233230303330333202023333303233 **202323202** 3323033333202023330333030323323333

32 **202343202** 23
302332 **202343202** 233203
3423302332 **202343202** 2332033243
30343423302332 **202343202** 23320332434303
3243034342330 2332 **202343202** 23320332434303423
34443243034342330 2332 **202343202** 23320332434303423444 3
3243444324303434233023 32 **202343202** 23320332434303423444 3423
3233243444324303434233023 32 **202343202** 23320332434303423444 3423323
342223233243444324303434233023 32 **202343202** 23320332434303423444 3423323222 43

32 **202353202** 23
32232 **202353202** 23223
303232232 **202353202** 232232303
303303232232 **202353202** 232232303303
3050230330323 2232 **202353202** 2322323033032 0503
330502303303232232 **202353202** 232232303303205033
32322330502303303232232 **202353202** 23223230330320503322323
3032332322330502303303232232 **202353202** 2322323033032050332232332303
33033032332322330502303303232232 **202353202** 23223230330320503322323323033033

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303 **202363202** 303
3622303 **202363202** 3032263
33622303 **202363202** 30322633
30333622303 **202363202** 30322633303
300230333622303 **202363202** 303226333032003
3366300230333622303 **202363202** 3032263330320036633
336333366300230333622303 **202363202** 303226333032003663333633
33202336333366300230333622303 **202363202** 3032263330320036633336320233
3603332023363333663002303336223 03 **202363202** 30322633303200366333633202333063

302 **202373202** 203
723302 **202373202** 203327
327723302 **202373202** 203327723
302327723302 **202373202** 203327723203
333302327723302 **202373202** 203327723203333
7723333023277233 02 **202373202** 2033277232033332 77
72772333302327723302 **202373202** 20332772320333327727
702727723333023277233 02 **202373202** 203327723203333277272 07
33327027277233330232772330 2 **202373202** 2033277232033332772720723 33

323 **202383202** 323
382323 **202383202** 323283
302382323 **202383202** 323283203
3322302382323 **202383202** 3232832032233
330233223023823 23 **202383202** 32328320322332033
3282330233223023823 23 **202383202** 323283203223320332823
303328233023322302382323 **202383202** 3232832032233203328233033303
3033303328233023322302382323 **202383202** 323283203223320332823303330322303
303223033303328233023322302382323 **202383202** 3232832032233203328233033303303223033

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3 **202393202** 3
333 **202393202** 333
39333 **202393202** 33393
922939333 **202393202** 333939229
32922939333 **202393202** 33393922923
32232922939333 **202393202** 33393922923223
33332232922939333 **202393202** 33393922923223333
900333332232922939333 **202393202** 33393922923223333009
9323900333332232922939333 **202393202** 333939229232233333 30093239

https://doi.org/10.5281/zenodo.4307875

16 Same Digits Equality Expressions

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

16.1 Powers and Plus Minus

$$\begin{aligned}
\mathbf{23} &:= -1^0 - 1^9 + 5^2 &&= -10 - 19 + 52 \\
&:= -1^1 - 1^8 + 5^2 &&= -11 - 18 + 52 \\
&:= -1^2 - 1^7 + 5^2 &&= -12 - 17 + 52 \\
&:= 1^2 - 22^0 + 23^1 &&= 12 - 220 + 231 \\
&:= -1^3 - 1^6 + 5^2 &&= -13 - 16 + 52 \\
&:= -1^4 - 1^5 + 5^2 &&= -14 - 15 + 52 \\
&:= -1^8 - 21^0 + 25^1 &&= -18 - 210 + 251 \\
&:= 2^2 - 20^0 + 20^1 &&= 22 - 200 + 201 \\
&:= 3^2 + 15^1 - 16^0 &&= 32 + 151 - 160 \\
&:= 3^4 + 58^0 - 59^1 &&= 34 + 580 - 591 \\
&:= 4^2 + 8^1 - 10^0 &&= 42 + 81 - 100
\end{aligned}$$

$$\textbf{2023} := -16^0 + 43^2 + 175^1 = -160 + 432 + 1751$$
$$:= 44^2 + 72^0 + 86^1 \quad = 442 + 720 + 861$$

https://doi.org/10.5281/zenodo.3597506

16.2 Factorial-Powers

$$\textbf{23} := 1! - 2! + 2! \times 2! \times 3! = -1^1 \times 2^2 + 2^2 - 2^2 + 3^3$$
$$:= -1! + 3! \times 4! - 5! \quad = 1^5 + 3^4 - 4^3 + 5^1$$

$$\textbf{2023}\,2 := (1! + 5! + 2! + 6!) \times 4! = -1^4 + 5^6 + (2^5 \times 6^2) \times 4^1$$

https://doi.org/10.5281/zenodo.2573569

16.3 Factorial, Fibonacci and Triangular

$$\textbf{23} := -1! - 3! \times 5! + 4! + 6! = -F(1) \times F(3) + F(5) \times (-F(4) + F(6))$$
$$= T(1) + T(3) - T(5) + T(4) + T(6)$$

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$$
\begin{aligned}
\mathbf{23} &:= -F(2)+F(4)+F(8) && = -T(2)-T(4)+T(8)\\
&:= F(3)-F(7)+F(9) && = T(3)-T(7)+T(9)\\
&:= -F(1)\times F(2)+F(4)+F(8) && = -T(1)\times T(2)-T(4)+T(8)\\
&:= F(1)\times F(3)-F(7)+F(9) && = T(1)\times T(3)-T(7)+T(9)\\
&:= F(1)-F(3)+F(4)+F(8) && = -T(1)+T(3)\times T(4)-T(8)\\
&:= (-F(1)+F(4))\times F(5)+F(7) && = T(1)\times T(4)-T(5)+T(7)\\
&:= F(2)\times F(4)\times F(5)+F(6) && = -T(2)-T(4)+T(5)+T(6)\\
&:= F(2)\times F(5)\times F(3)+F(7) && = T(2)\times T(5)+T(3)-T(7)\\
&:= F(2)-F(3)+F(4)+F(8) && = T(2)-T(3)-T(4)+T(8)\\
&:= -F(2)+F(4)+F(6)+F(7) && = T(2)\times T(4)+T(6)-T(7)\\
&:= -F(4)-F(6)+F(7)+F(8) && = T(4)+T(6)+T(7)-T(8)\\
&:= F(5)\times F(7)-F(6)-F(9) && = -T(5)-T(7)+T(6)+T(9)\\
&:= -F(1)\times F(4)+F(3)\times F(7) && = -T(1)-T(4)+T(3)+T(7)\\
&:= -F(1)-F(3)\times F(5)+F(9) && = -T(1)-T(3)-T(5)+T(9)\\
&:= -F(3)\times (F(4)-F(6))+F(7) && = T(3)+T(4)-T(6)+T(7)\\
&:= -F(1)+(F(2)+F(3))\times F(6) && = -T(1)-T(2)+T(3)+T(6)\\
&:= -F(2)+F(4)+F(8) && = -T(2)-T(4)+T(8)\\
&:= F(3)-F(7)+F(9) && = T(3)-T(7)+T(9)\\
&:= F(1)-F(3)+F(4)+F(8) && = -T(1)+T(3)\times T(4)-T(8)\\
&:= -F(2)+F(4)+F(6)+F(7) && = T(2)\times T(4)+T(6)-T(7)\\
&:= F(2)-F(3)+F(4)+F(8) && = T(2)-T(3)-T(4)+T(8)\\
&:= -F(4)-F(6)+F(7)+F(8) && = T(4)+T(6)+T(7)-T(8)
\end{aligned}
$$

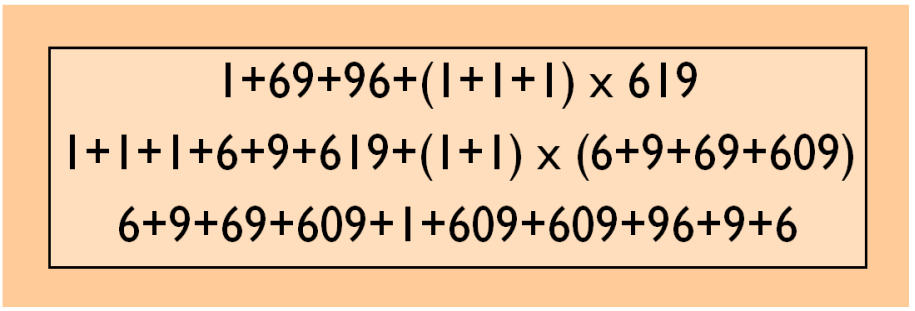
https://doi.org/10.5281/zenodo.2574151

17 Upside Down and Mirror Looking

17.1 Upside Down

$$
\begin{aligned}
\mathbf{2023} &:= 1+69+96+(1+1+1)\times 619\\
&:= 1+1+1+6+9+619+(1+1)\times(6+9+69+609)\\
&:= 6+9+69+609+1+609+609+96+9+6
\end{aligned}
$$

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

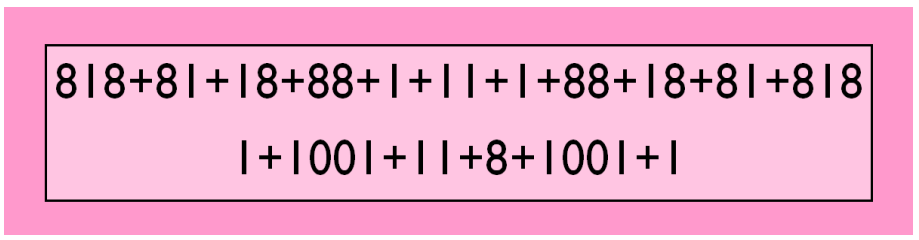


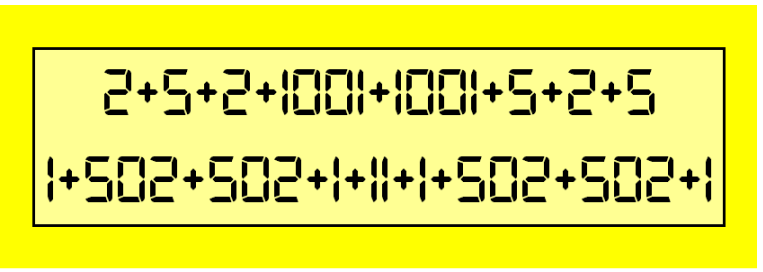
17.2 Upside Down and Mirror Looking

$$\begin{aligned} \textbf{2023} &:= 818+81+18+88+1+11+1+88+18+81+818 \\ &:= 1+1001+11+8+1001+1 \end{aligned}$$

$$\begin{aligned} \textbf{2023} &:= 1+1+502+502+11+502+502+1+1 \\ &:= 2+5+2+1001+1001+5+2+5 \end{aligned}$$

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





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18 2023 in Magic Squares of Order 4

Below is 2023 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.

7	716	1	718	15	708	9	710	23	700	17	702
2	717	8	715	10	709	16	707	18	701	24	699
720	3	714	5	712	11	706	13	704	19	698	21
713	6	719	4	705	14	711	12	697	22	703	20
								31	692	25	694
								26	693	32	691
								696	27	690	29
								689	30	695	28
55	668	49	670	47	676	41	678	39	684	33	686
50	669	56	667	42	677	48	675	34	685	40	683
672	51	666	53	680	43	674	45	688	35	682	37
665	54	671	52	673	46	679	44	681	38	687	36
63	660	57	662								
58	661	64	659								
664	59	658	61								
657	62	663	60								
71	652	65	654	79	644	73	646	87	636	81	638
66	653	72	651	74	645	80	643	82	637	88	635
656	67	650	69	648	75	642	77	640	83	634	85
649	70	655	68	641	78	647	76	633	86	639	84

95	628	89	630	103	620	97	622	111	612	105	614
90	629	96	627	98	621	104	619	106	613	112	611
632	91	626	93	624	99	618	101	616	107	610	109
625	94	631	92	617	102	623	100	609	110	615	108
183	540	177	542					119	604	113	606
178	541	184	539					114	605	120	603
544	179	538	181					608	115	602	117
537	182	543	180					601	118	607	116
175	548	169	550					127	596	121	598
170	549	176	547					122	597	128	595
552	171	546	173					600	123	594	125
545	174	551	172					593	126	599	124
167	556	161	558					135	588	129	590
162	557	168	555					130	589	136	587
560	163	554	165					592	131	586	133
553	166	559	164					585	134	591	132
159	564	153	566	151	572	145	574	143	580	137	582
154	565	160	563	146	573	152	571	138	581	144	579
568	155	562	157	576	147	570	149	584	139	578	141
561	158	567	156	569	150	575	148	577	142	583	140

191	532	185	534	199	524	193	526	207	516	201	518
186	533	192	531	194	525	200	523	202	517	208	515
536	187	530	189	528	195	522	197	520	203	514	205
529	190	535	188	521	198	527	196	513	206	519	204
								215	508	209	510
								210	509	216	507
								512	211	506	213
								505	214	511	212
239	484	233	486	231	492	225	494	223	500	217	502
234	485	240	483	226	493	232	491	218	501	224	499
488	235	482	237	496	227	490	229	504	219	498	221
481	238	487	236	489	230	495	228	497	222	503	220
247	476	241	478								
242	477	248	475								
480	243	474	245								
473	246	479	244								
255	468	249	470	263	460	257	462	271	452	265	454
250	469	256	467	258	461	264	459	266	453	272	451
472	251	466	253	464	259	458	261	456	267	450	269
465	254	471	252	457	262	463	260	449	270	455	268

279	444	273	446	287	436	281	438	295	428	289	430
274	445	280	443	282	437	288	435	290	429	296	427
448	275	442	277	440	283	434	285	432	291	426	293
441	278	447	276	433	286	439	284	425	294	431	292
								303	420	297	422
								298	421	304	419
								424	299	418	301
								417	302	423	300
327	396	321	398	319	404	313	406	311	412	305	414
322	397	328	395	314	405	320	403	306	413	312	411
400	323	394	325	408	315	402	317	416	307	410	309
393	326	399	324	401	318	407	316	409	310	415	308
								335	388	329	390
								330	389	336	387
								392	331	386	333
								385	334	391	332
359	364	353	366	351	372	345	374	343	380	337	382
354	365	360	363	346	373	352	371	338	381	344	379
368	355	362	357	376	347	370	349	384	339	378	341
361	358	367	356	369	350	375	348	377	342	383	340

7	716	1	718	15	708	9	710	23	700	17	702
2	717	8	715	10	709	16	707	18	701	24	699
720	3	714	5	712	11	706	13	704	19	698	21
713	6	719	4	705	14	711	12	697	22	703	20
								31	692	25	694
								26	693	32	691
								696	27	690	29
								689	30	695	28
55	668	49	670	47	676	41	678	39	684	33	686
50	669	56	667	42	677	48	675	34	685	40	683
672	51	666	53	680	43	674	45	688	35	682	37
665	54	671	52	673	46	679	44	681	38	687	36
63	660	57	662								
58	661	64	659								
664	59	658	61								
657	62	663	60								
71	652	65	654	79	644	73	646	87	636	81	638
66	653	72	651	74	645	80	643	82	637	88	635
656	67	650	69	648	75	642	77	640	83	634	85
649	70	655	68	641	78	647	76	633	86	639	84

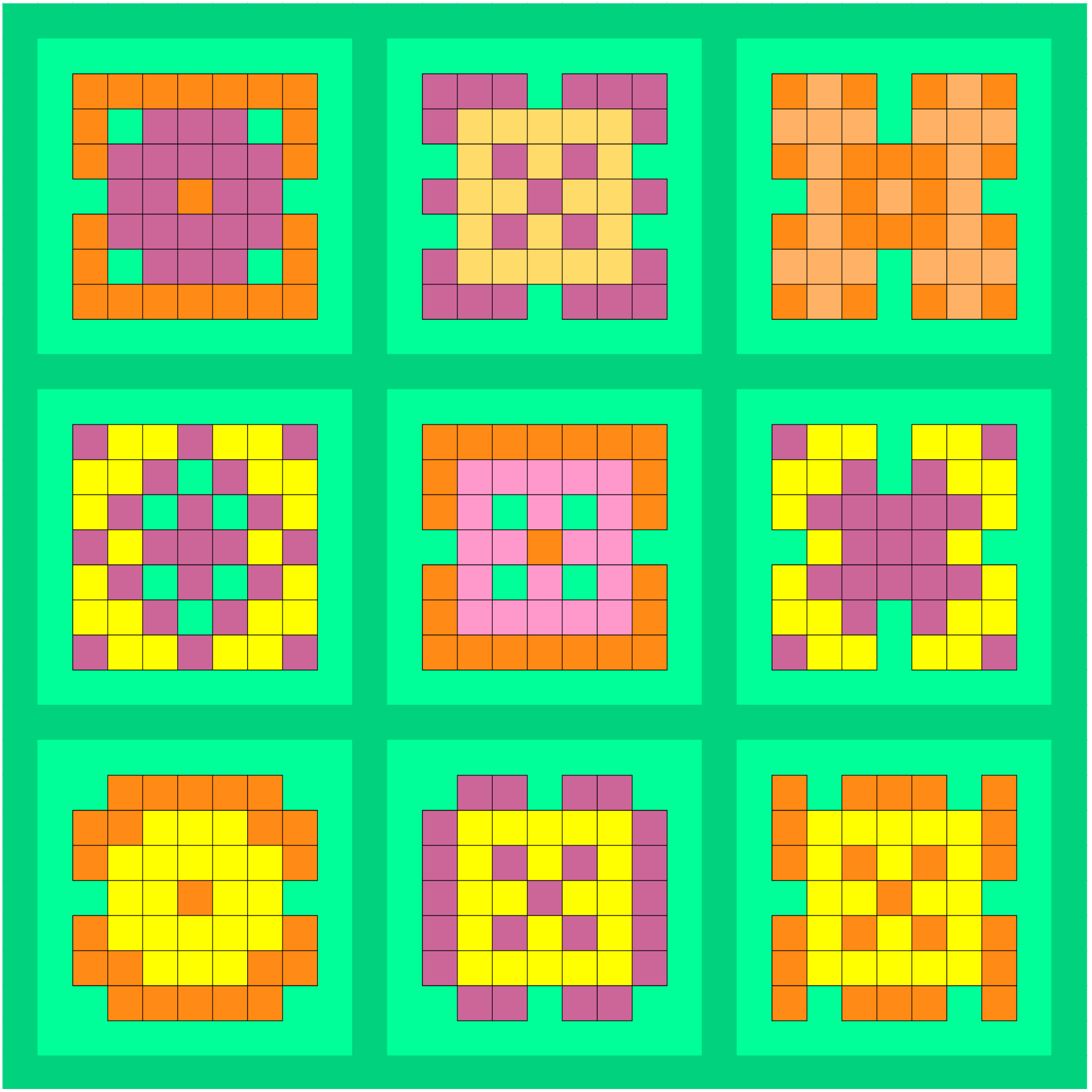
95	628	89	630	103	620	97	622	111	612	105	614
90	629	96	627	98	621	104	619	106	613	112	611
632	91	626	93	624	99	618	101	616	107	610	109
625	94	631	92	617	102	623	100	609	110	615	108
183	540	177	542					119	604	113	606
178	541	184	539					114	605	120	603
544	179	538	181					608	115	602	117
537	182	543	180					601	118	607	116
175	548	169	550					127	596	121	598
170	549	176	547					122	597	128	595
552	171	546	173					600	123	594	125
545	174	551	172					593	126	599	124
167	556	161	558					135	588	129	590
162	557	168	555					130	589	136	587
560	163	554	165					592	131	586	133
553	166	559	164					585	134	591	132
159	564	153	566	151	572	145	574	143	580	137	582
154	565	160	563	146	573	152	571	138	581	144	579
568	155	562	157	576	147	570	149	584	139	578	141
561	158	567	156	569	150	575	148	577	142	583	140

191	532	185	534	199	524	193	526	207	516	201	518
186	533	192	531	194	525	200	523	202	517	208	515
536	187	530	189	528	195	522	197	520	203	514	205
529	190	535	188	521	198	527	196	513	206	519	204
								215	508	209	510
								210	509	216	507
								512	211	506	213
								505	214	511	212
239	484	233	486	231	492	225	494	223	500	217	502
234	485	240	483	226	493	232	491	218	501	224	499
488	235	482	237	496	227	490	229	504	219	498	221
481	238	487	236	489	230	495	228	497	222	503	220
247	476	241	478								
242	477	248	475								
480	243	474	245								
473	246	479	244								
255	468	249	470	263	460	257	462	271	452	265	454
250	469	256	467	258	461	264	459	266	453	272	451
472	251	466	253	464	259	458	261	456	267	450	269
465	254	471	252	457	262	463	260	449	270	455	268

279	444	273	446	287	436	281	438	295	428	289	430
274	445	280	443	282	437	288	435	290	429	296	427
448	275	442	277	440	283	434	285	432	291	426	293
441	278	447	276	433	286	439	284	425	294	431	292
								303	420	297	422
								298	421	304	419
								424	299	418	301
								417	302	423	300
327	396	321	398	319	404	313	406	311	412	305	414
322	397	328	395	314	405	320	403	306	413	312	411
400	323	394	325	408	315	402	317	416	307	410	309
393	326	399	324	401	318	407	316	409	310	415	308
								335	388	329	390
								330	389	336	387
								392	331	386	333
								385	334	391	332
359	364	353	366	351	372	345	374	343	380	337	382
354	365	360	363	346	373	352	371	338	381	344	379
368	355	362	357	376	347	370	349	384	339	378	341
361	358	367	356	369	350	375	348	377	342	383	340

23 and 2023 in Numbers and Patterns, **Zenodo**,
December 22, 2022, pp. 1-51, https://doi.org/10.5281/zenodo.7473340

19 Two Colors Patterns with 20-23



23 and 2023 in Numbers and Patterns, **Zenodo**,
December 22, 2022, pp. 1-51, https://doi.org/10.5281/zenodo.7473340

20 References

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

- Inder J. Taneja, **Recreation of Numbers**, *https://numbers-magic.com/?p=671*.
- Inder J. Taneja, **Magic Squares**, *https://numbers-magic.com/?p=668*.