The first nine-digit determinant becomes the second upon a one-step counter-clockwise rotation of the 6, 7, 9 configuration; the second becomes the third upon interchange of 7 and 8; the third becomes the fourth upon interchange of 8 and 9; the fourth becomes the fifth upon a two-step rotation of the 9, 6, 8, 5 configuration. In the last determinant, the nine digits are in order of magnitude along a main diagonal and the two broken diagonals parallel to it.

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REITERATIVE ROUTINES APPLIED TO 1979

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(A) Sum the digits of the integer.

$1 + 9 + 7 + 9 = 26, \quad 2 + 6 = 8,$ the digital root of 1979.

(B) Compute the absolute difference of the integer and its reverse.

1979	7812	5625	360	297	495	99
9791	2187	5265	063	792	594	99
7812	5625	360	297	495	99	0

Seven operations to reach the inevitable 0.

(C) Add the integer and its reverse.

1979	11770	19481	37972	65945	120901
9791	07711	18491	27973	54956	109021
11770	19481	37972	65945	120901	229922

Six operations to reach a palindrome. Continuing the procedure for 18 more operations produces the palindrome 8813200023188.

(D) The Kaprekar routine. Arrange the digits in descending order, and from it subtract its reverse.

9971	8721	7443	9963	6642	7641
1799	1278	3447	3699	2466	1467
8172	7443	3996	6264	4176	6174

Six operations to reach Kaprekar's constant, the self-replicating 6174.

(E) The Collatz algorithm. If it is odd, triple it and add 1; if it is even, divide it by 2.

1979	530	143	233	1132	911	122
5938	265	430	700	566	2734	61
2969	796	215	350	283	1367	184
8908	398	646	175	850	4102	92
4454	199	323	526	425	2051	46
2227	598	970	263	1276	6154	23
6682	299	485	790	638	3077	70
3341	898	1456	395	319	9232	35
10024	449	728	1186	958	4616	106
5012	1348	364	593	479	2308	53
2506	674	182	1780	1438	1154	160
1253	337	91	890	719	577	80
3760	1012	274	445	2158	1732	40
1880	506	137	1336	1079	866	20
940	253	412	668	3238	433	10
470	760	206	334	1619	1300	5
235	380	103	167	4858	650	16
706	190	310	502	2429	325	8
353	95	155	251	7288	976	4
1060	286	466	754	3644	488	2
			377	1822	244	1

It takes 143 operations to reach the inevitable 1.

(F) 1979 is part of a ten-digit multiplicative bracelet wherein each element is the units' digit of the product of the four preceding digits, namely:

1 9 7 9 7 9 9 3 1 3'1 9 7 9.

(G) 1979 is part of a 1560-digit additive bracelet wherein each element is the units' digit of the sum of the four preceding digits, namely:

19796 13992 33758 33938 33714 ... .

The complete bracelet is included in "A Digital Bracelet for 1967," *The Fibonacci Quarterly* 5 (1967):477-480.

(H) Add the squares of the digits of the integers. $1^2 + 9^2 + 7^2 + 9^2 = 212$. Subsequent terms in the sequence are 9, 81, 65, 61, 37, 58, 89, 145, 42, 20, 4, 16, 37. Six operations to enter an eight-member loop.

(I) Add the cubes of the digits of the integers. $1^3 + 9^3 + 7^3 + 9^3 = 1802$, followed by 521, 134, 92, 737, 713, 371. Seven operations to reach the self-replicating 371.

(J) Add the fourth powers of the digits of the integers. $1^4 + 9^4 + 7^4 + 9^4 = 15524$, then 1523, 723, 2498, 10929, 13139, 6725, 4338, 4514, 1138, 4179, 9219, 13139. Six operations to enter a seven-member loop.

(K) Add the squares of the odd digits to the sum of the even digits. 1979, 212, 5, 25, 27, 51, 26, 8. Seven operations to reach the self-replicating 8.

(L) Add the squares of the even digits to the sum of the odd digits. 1979, 26, 40, 16, 37, 10, 1. Six operations to reach the self-replicating 1.

(M) Add the squares of the composite digits to the sum of the other digits. $1 + 9^2 + 7 + 9^2 = 170$, then 8, 64, 52, 7. Five operations to reach the self-replicating 7.

(N) Add the composite digits to the sum of the squares of the other digits. $1^2 + 9 + 7^2 + 9 = 68$, then 14, 5, 25, 29, 13, 10, 1. Eight operations to reach the self-replicating 1.

(O) For a four-digit integer *abcd*, compute $a^4 + b^3 + c^2 + d$. $1^4 + 9^3 + 7^2 + 9 = 788$, then 415, 70, 49, 25, 9. Six operations to reach the self-replicating 9.

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1979 AND ASSOCIATED PRIMES

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(A) The prime 1979, which contains only one prime digit, is a concatenation of the two primes 19 and 79. Of the seven different two-digit integers that can be formed from the digits of 1979, five are primes. Their sum, 17 + 19 + 71 + 79 + 97 = 283, a prime.

Of the twelve different three-digit integers that can be formed from the digits of 1979, eight are prime. These include two sets consisting of cyclic permutations. The sum of the eight, 197 + 971 + 719 + 199 + 991 + 919 + 179 + 997 = 5172 = 431 • 3 • 4, a palindromic arrangement. Two of the composite integers that are cyclic permutations have factors that are cyclic permutations; that is, 791 = 7 • 113 and 917 = 7 • 131.

Of the 4! permutations of the digits of 1979, five form prime integers: 1979, 1997, 7919, 9719, and 9791.

(B) Since 79 - 19 = 60, both 19 and 79 are members of eleven arithmetic progressions with common differences of d = 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, and 30, respectively. In eight of these, the square 49 is the middle term. Two of these progressions are worthy of note. In

19 31 43 55 67 79

only one term is not a prime, and it is the product of the alternate primes 5 and 11. The other progression

19 25 31 37 43 49 55 61 67 73 79