

Sieve of Prime Numbers Using Algorithms

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Abstract

This study suggests grouping of numbers that do not divide the number 3 and/or 5 in eight columns. Allocation results obtained from multiplication of numbers is based on column belonging to him. If in the Sieve of Eratosthenes the majority of multiplication of prime numbers result in a results devoid of practical benefit (numbers divisible by 2, 3 and/or 5), in the sieve of prime numbers using algorithms, each multiplication of prime number gives a result in a number not divisible to 2, 3 and/or 5.

Keywords: Column; Factor; Position; Sieve; Termination

Introduction

Sieve of prime numbers using algorithms

This paper deals with the study of odd numbers that cannot be divided with 3 and/or 5 by grouping them in eight columns, as follows:

The multiplication versions are in number of 36, their results being allocated according to columns, explained in Table 1.

Position Calculus

From the result of multiplying two numbers subtract the number assigned at position zero of the column namely one of the numbers $i(p_0)$: 7-11-13-17-19-23-29-31, the result is divided by 30. Integer obtained indicates the position of that number considering its column origin [1,2].

Formulas for determining the position

Position occupied by the result of the multiplication between

Col.1=Col.	1x8	2x4	3x5			6x7		
Col.2=Col.	1x6	2x8	3x4		5x7			
Col.3=Col.	1x5	2x6	3x8	4x7				
Col.4=Col.	1x2		3x7	4x8	5x6			
Col.5=Col.	1x1	2x7	3x3	4x4	5x8	6x6		
Col.6=Col.	1x7	2x3		4x5		6x8		
Col.7=Col.	1x4	2x5	3x6				7x8	
Col.8=Col.	1x3	2x2		4x6	5x5		7x7	8x8

Table 1: Multiplication versions are in number of 36.

Position	1	2	3	4	5	6	7	8
0	7	11	13	17	19	23	29	31
1	37	41	43	47	49	53	59	61
2	67	71	73	77	79	83	89	91
3	97	101	103	107	109	113	119	121

Table 2: Odd numbers that cannot be divided with 3 and/or 5.

7+31	5+23	4+19	2+11	1+7	6+29	3+17	2+13	+37n
6+17	11+31	8+23	2+7	10+29	4+13	6+19	3+11	+41n
8+19	7+17	13+31	12+29	5+13	4+11	9+23	2+7	+43n
6+11	7+13	16+29	17+31	9+17	10+19	3+7	12+23	+47n
8+13	18+29	4+7	14+23	19+31	10+17	6+11	11+19	+49n
22+29	5+7	8+11	14+19	17+23	23+31	9+13	12+17	+53n
22+23	18+19	16+17	12+13	10+11	6+7	29+31	27+29	+59n
7+7	11+11	13+13	17+17	19+19	23+23	29+29	31+31	+61n

Table 3: Position occupied p1 as a result of multiplication of numbers i.

7+31x2	5+23x2	4+19x2	2+11x2	1+7x2	6+29x2	3+17x2	2+13x2	+67n
6+17x2	11+31x2	8+23x2	2+7x2	10+29x2	4+13x2	6+19x2	3+11x2	+71n
8+19x2	7+17x2	13+31x2	12+29x2	5+13x2	4+11x2	9+23x2	2+7x2	+73n
6+11x2	7+13x2	16+29x2	17+31x2	9+17x2	10+19x2	3+7x2	12+23x2	+77n
8+13x2	18+29x2	4+7x2	14+23x2	19+31x2	10+17x2	6+11x2	11+19x2	+79n
22+29x2	5+7x2	8+11x2	14+19x2	17+23x2	23+31x2	9+13x2	12+17x2	+83n
22+23x2	18+19x2	16+17x2	12+13x2	10+11x2	6+7x2	29+31x2	27+29x2	+89n
7+7x2	11+11x2	13+13x2	17+17x2	19+19x2	23+23x2	29+29x2	31+31x2	+91n

Table 4: Positions of p1 are used to calculate p2, p3, p4.

1	2	3	4	5	6	7	8	9
7	5	4	2	1	6	3	2	+7n
6	11	8	2	10	4	6	3	+11n
8	7	13	12	5	4	9	2	+13n
6	7	16	17	9	10	3	12	+17n
8	18	4	14	19	10	6	11	+19n
22	5	8	14	17	23	9	12	+23n
22	18	16	12	10	6	29	27	+29n
7	11	13	17	19	23	29	31	+31n

Table 5: Position occupied p0 as a result of multiplication of numbers $i(p_0)$ and all the numbers.

numbers $i(p_0)$, $i(p_1)$, $i(p_2)$,..., $i(p_n)$, with all the numbers in Table 2. Position occupied p1 as a result of multiplication of numbers $i(p_1)$ and all the numbers in Table 3;

Positions of p1 are used to calculate p2, p3, p4,...., p_n multiplying $i(p_0)$, positions occupied p2 as a result of multiplication of numbers $i(p_2)$ and all the numbers in Table 4;

Calculation algorithm

- Fill in Table 1 with all the numbers to be tested if they are prime number;
- Write all numbers under test, in order of their increasing in column 9, as shown in Table 5;
- Fill p0 formulas in Table 5;

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- Mark all numbers divisible in Table 1 by the formulas of p0;
- Eliminates all the numbers in column 9 Table 2 that were marked in Table 1 according to the formulas of p0;
- Fill formulas of p1 Table 2; number 49 was removed according to Table 1 no longer consider;
- Repeat the operations made in step 4 and 5 according to the formulas p1;
- Fill formulas of p2 Table 2 and repeat the operations in step 4 and 5. Numbers not eliminated in column 9 Table 2 are prime numbers.

In column 9 we register numbers under test up to P (max). Maxim position calculation is the integer number of the maximum number being tested radical divided by 30 [2-4].

Formulas belonging composite numbers are omitted. The algorithm uses formulas primes numbers squared correlating $n=0,1,2,3,\dots$. With P_n .

Using the tables respecting the above algorithm complexity is much smaller, any multiple of prime number (which represents the number of position) has corresponding number is compound odd number and not divisible by 3 and/or 5.

Example: Determination of prime numbers up to $N=1001$.

In parentheses are the numbers corresponding to position past according to column.

Divisibility by 7:

- Col.1: $7+7n=7(217) - 14(427) - 21(637) - 28(847)$
- Col.2: $5+7n=5(161) - 12(371) - 19(581) - 26(791) - 33(1001)$
- Col.3: $4+7n=4(133) - 11(343) - 18(553) - 25(763) - 32(973)$
- Col.4: $2+7n=2(77) - 9(287) - 16(497) - 23(707) - 30(917)$
- Col.5: $1+7n=1(49) - 8(259) - 15(469) - 22(679) - 29(889)$
- Col.6: $6+7n=6(203) - 13(413) - 20(623) - 27(833)$
- Col.7: $3+7n=3(119) - 10(329) - 17(539) - 24(749) - 31(959)$
- Col.8: $2+7n=2(91) - 9(301) - 16(511) - 23(321) - 30(931)$

Divisibility by 11:

- Col.1: $6+11n=6(187) - 17(517) - 28(847)$
- Col.2: $11+11n=11(341) - 22(671) - 33(1001)$
- Col.3: $8+11n=8(253) - 19(583) - 30(913)$
- Col.4: $2+11n=2(77) - 13(407) - 24(737)$
- Col.5: $10+11n=10(319) - 21(649) - 32(979)$
- Col.6: $4+11n=4(143) - 15(473) - 26(803)$
- Col.7: $6+11n=6(209) - 17(539) - 28(869)$
- Col.8: $3+11n=3(121) - 14(451) - 25(781)$

Divisibility by 13:

Divisibility by 17:

- Col.1: $8+13n=8(247) - 21(637)$
- Col.1: $6+17n=6(187) - 23(697)$

- Col.2: $7+13n=7(221) - 20(611) - 33(1001)$
- Col.2: $7+17n=7(221) - 24(731)$
- Col.3: $13+13n=13(403) - 26(793)$
- Col.3: $16+17n=16(493)$
- Col.4: $12+13n=12(377) - 25(767)$
- Col.4: $17+17n=17(527)$
- Col.5: $5+13n=5(169) - 18(559) - 31(949)$
- Col.5: $9+17n=9(289) - 26(799)$
- Col.6: $4+13n=4(143) - 17(533) - 30(923)$
- Col.6: $10+17n=10(323) - 27(833)$

- Col.7: $9+13n=9(299) - 22(689)$
- Col.7: $3+17n=3(119) - 20(629)$

- Col.8: $2+13n=2(91) - 15(481) - 28(871)$
- Col.8: $12+17n=12(391) - 29(901)$

Divisibility by 19:
Divisibility by 23:

- Col.1: $8+19n=8(247) - 27(817)$
- Col.1: $22+23n=22(667)$

- Col.2: $18+19n=18(551)$
- Col.2: $5+23n=5(161) - 28(851)$

- Col.3: $4+19n=4(133) - 23(703)$
- Col.3: $8+23n=8(253) - 31(943)$

- Col.4: $14+19n=14(437)$
- Col.4: $14+23n=14(437)$

- Col.5: $19+19n=19(589)$
- Col.5: $17+23n=17(529)$

- Col.6: $10+19n=10(323) - 29(893)$
- Col.6: $23+23n=23(713)$

- Col.7: $6+19n=6(209) - 25(779)$
- Col.7: $9+23n=9(299) - 32(789)$

- Col.8: $11+19n=11(361) - 30(961)$
- Col.8: $12+23n=12(391)$

Divisibility By 29:
Divisibility by 31:

- Col.1: $22+29n=22(667)$
- Col.1: $7+31n=7(217)$

- Col.2: $18+29n=18(551)$
- Col.2: $11+31n=11(341)$

- Col.3: $16+29n=16(493)$
- Col.3: $13+31n=13(403)$

- Col.4: $12+29n=12(377)$
- Col.4: $17+31n=17(527)$

- Col.5: $10+29n=10(319)$
- Col.5: $19+31n=19(589)$

- Col.6: $6+29n=6(203)$
- Col.6: $23+31n=23(713)$

- Col.7: $29+29n=29(899)$
- Col.7: $29+31n=29(899)$

$$\text{Col.8}=27+29n=27(841)$$

$$\text{Col.8}=31+31n=31(961)$$

Numbers not eliminated are prime numbers

Application: The Factorial Multiplying or the Method of Determining if a Number is Prime up to a Given Number

The method of grouping odd numbers according to Table 1, allows checking whether a number is prime according to the last two or five digits of position the number.

For termination two digits

The calculation algorithm is:

Step 1: Determine the position number and column it belongs;

Step 2: Last two digits of the calculated number indicates the termination position of tested number;

Step 3: Determine factors for termination and column number tested. I have illustrated the calculation of factors termination 10, column 1. Once calculated these factors can be used to determine of any prime numbers that belongs to the column 1, termination 10.

Step 4: It performs testing divisibility of a number with multiples of 3 000 plus pairs of numbers factorial group to which it belongs termination corresponding column number tested.

We assign factorial group for multiplying operation positions from 0-99, as in Table 1, numbers between 7-3.001 grouped in columns. The position occupied by the result of the multiplication between any two numbers in the factorial group is a maximum six digit number. The last two digits of the number shows the termination, the rest of maximum four digits is the factor and which the position will be calculated for those termination belonging to specific column [5,6].

I1 and I2 are two numbers higher than the numbers belonging to factorial group.

Position obtained by multiplying the numbers is determined by formula:

$$P=n2 \times i1 (f)+n1 \times i2+F, \text{ followed by T}$$

$$\text{Or, } =n1 \times i2 (f)+n2 \times i1+F, \text{ followed by T}$$

Where:

n1, n2: represents multiples of 3000 corresponding of i1(f), respectively i2(f);

i1 (f), i2 (f): represents the corresponding numbers of i1 and i2 in factorial group;

F – Factor

T – Termination

$$\text{Be: } 32\,999 \times 32\,693=1\,078\,836\,307$$

$$P=(1\,078\,836\,307 - 7): 30=35\,961\,210 \text{ col.1 T}=10 \text{ p(without T)}=359\,612$$

Factor calculation and termination:

$$2\,999 \times 2\,693=(8\,076\,307 - 7): 30=269\,210; F=2\,692 \text{ T}=10$$

$$P=10 \times 2\,999+10 \times 32\,693+F, \text{ followed by T}$$

$$=10 \times 2\,693+10 \times 32\,999+F, \text{ followed by T}$$

We calculate all the factors column 1, termination 10. The four types of multiplication corresponding col. 1 between numbers belonging to factor group, generates 400 factors with T.10, as follows:

$$7 \times 901=2\,37 \times 1\,711=21\,67 \times 721=16$$

$$307 \times 3\,001=307\,337 \times 811=91\,367 \times 2\,821=345$$

$$607 \times 2\,101=425\,637 \times 2\,911=618\,667 \times 1\,921=427$$

$$2\,707 \times 1\,801=1\,625\,2\,737 \times 2\,611=2\,382\,2\,767 \times 1\,621=1\,495$$

$$97 \times 931=30\,127 \times 2\,341=99\,157 \times 1\,951=102$$

$$397 \times 31=4\,427 \times 1\,441=205\,457 \times 1\,051=160$$

$$697 \times 2\,131=495\,727 \times 541=131\,757 \times 151=38$$

$$2\,797 \times 1\,831=1\,707\,2\,827 \times 241=227\,2\,857 \times 2\,851=2\,715$$

$$187 \times 2\,761=172\,217 \times 1\,771=128\,247 \times 1\,981=163$$

$$487 \times 1\,861=302\,517 \times 871=150\,547 \times 1\,081=197$$

$$787 \times 961=252\,817 \times 2\,971=809\,847 \times 181=51$$

$$2\,887 \times 661=636\,2\,917 \times 2\,671=2\,597\,2\,947 \times 2\,881=2\,830$$

$$277 \times 391=36$$

$$577 \times 2\,491=476$$

$$877 \times 1\,591=465$$

$$2\,977 \times 1\,291=1\,281$$

Or,

$$11 \times 1\,937=7\,41 \times 227=3\,71 \times 2\,117=50$$

$$311 \times 2\,837=294\,341 \times 1\,127=128\,371 \times 17=2$$

$$611 \times 737=150\,641 \times 2\,027=433\,671 \times 917=205$$

$$2\,711 \times 1\,037=937\,2\,741 \times 2\,327=2\,126\,2\,771 \times 1\,217=1\,124$$

$$101 \times 1\,607=54\,131 \times 1\,697=74\,161 \times 2\,387=128$$

$$401 \times 2\,507=335\,431 \times 2\,597=374\,461 \times 287=44$$

$$701 \times 407=95\,731 \times 497=121\,761 \times 1\,187=3\,011$$

$$2\,801 \times 707=660\,2\,831 \times 797=752\,2\,861 \times 1\,487=1\,418$$

$$191 \times 677=43\,221 \times 2\,567=189\,251 \times 2\,057=172$$

$$491 \times 1\,577=258\,521 \times 467=81\,551 \times 2\,957=543$$

$$791 \times 2\,477=653\,821 \times 1\,367=374\,851 \times 857=243$$

$$2\,891 \times 2\,777=2\,676\,2\,921 \times 1\,667=1\,623\,2\,951 \times 1\,157=1\,138$$

$$281 \times 2\,147=201$$

$$581 \times 47=9$$

$$881 \times 947=278$$

$$2\,981 \times 1\,247=1\,239$$

Or,

$$19 \times 1\,753=11\,49 \times 1\,843=30\,79 \times 1\,333=35$$

$$319 \times 2\,653=282\,349 \times 2\,743=319\,379 \times 2\,233=282$$

$$619 \times 553=114\,649 \times 643=139\,679 \times 133=30$$

$2\ 719 \times 853=773\ 2\ 749 \times 943=864\ 2\ 779 \times 433=401$
 $109 \times 223=8\ 139 \times 1\ 513=70\ 169 \times 2\ 203=124$
 $409 \times 1\ 123=153\ 439 \times 2\ 413=353\ 469 \times 103=16$
 $709 \times 2\ 023=478\ 739 \times 313=7\ 769 \times 1\ 003=257$
 $2\ 809 \times 2\ 323=2\ 175\ 2\ 839 \times 613=580\ 2\ 869 \times 1\ 303=1\ 246$
 $199 \times 2\ 293=152\ 229 \times 1\ 783=136\ 259 \times 673=58$
 $499 \times 193=32\ 529 \times 2\ 683=473\ 559 \times 1\ 573=293$
 $799 \times 1\ 093=291\ 829 \times 583=161\ 859 \times 2\ 473=708$
 $2\ 899 \times 1\ 393=1\ 346\ 2\ 929 \times 883=862\ 2\ 959 \times 2\ 773=2\ 735$
 $289 \times 1\ 963=189$
 $589 \times 2\ 863=562$
 $889 \times 763=226$
 $2\ 989 \times 1\ 063=1\ 059$
 Or,
 $29 \times 2\ 183=21\ 59 \times 1\ 073=21\ 89 \times 2\ 363=70$
 $329 \times 83=9\ 359 \times 1\ 973=236\ 389 \times 263=34$
 $629 \times 983=206\ 659 \times 2\ 873=631\ 689 \times 1\ 163=267$
 $2\ 729 \times 1\ 283=1\ 167\ 2\ 759 \times 173=159\ 2\ 789 \times 1\ 463=1\ 360$
 $119 \times 53=2\ 149 \times 143=7\ 179 \times 2\ 633=157$
 $419 \times 953=133\ 449 \times 1\ 043=156\ 479 \times 533=85$
 $719 \times 1\ 853=444\ 749 \times 1\ 943=485\ 779 \times 1\ 433=372$
 $2\ 819 \times 2\ 153=2\ 023\ 2\ 849 \times 2\ 243=2\ 130\ 2\ 879 \times 1\ 733=1\ 663$
 $209 \times 1\ 523=106\ 239 \times 2\ 813=224\ 269 \times 503=45$
 $509 \times 2\ 423=411\ 539 \times 713=128\ 569 \times 1\ 403=266$
 $809 \times 323=87\ 839 \times 1\ 613=451\ 869 \times 2\ 303=667$
 $2\ 909 \times 623=604\ 2\ 939 \times 1\ 913=1\ 874\ 2\ 969 \times 2\ 603=2\ 576$
 $299 \times 593=59$
 $599 \times 1\ 493=298$
 $899 \times 2\ 393=717$
 $2\ 999 \times 2\ 693=2\ 692$

Grouping numbers from left of multiplying operation according to the above model, in this case numbers on the right have a constant growth rate, which allows for relatively simple determination of them. Perform tests to see if number N is prime or not, using position calculation formulas, as follows:

Divisibility by:

$$(3\ 000 \times n+7) \times (3\ 000 \times n+901) F=2$$

$7 \times n$; $901 \times n$; $901+3\ 007xn$; $901x2+6\ 007xn$; $901x3+9\ 007xn$;.....

$7xn$ correspond to: $7 \times (3\ 000 \times n+901)$; $901xn$ correspond to: $901 \times (3\ 000 \times n+7)$;

$901+3\ 007xn$ correspond to: $3\ 007 \times (3\ 000 \times n+901)$;

$901x2+6\ 007xn$ correspond to: $6\ 007 \times (3\ 000 \times n+901)$;

$901x3+9\ 007xn$ correspond to: $9\ 007 \times (3\ 000 \times n+901)$;

If not results indicate position of N decreased by the factor F=2, the number studied does not divide with multiples of 3000 plus pair of numbers 7-901

$$(3\ 000 \times n+307) \times (3\ 000 \times n+3001) F=307$$

$307 \times n$; $3\ 001 \times n$; $3\ 001+3\ 307xn$; $3\ 001x2+6\ 307xn$; $3\ 001x3+9\ 307xn$;.....

$307 \times n$ correspond to: $307 \times (3\ 000 \times n+3\ 001)$; $3\ 001 \times n$ correspond to: $3\ 001 \times (3\ 000 \times n+307)$;

$3\ 001+3\ 307 \times n$ correspond to: $3\ 307 \times (3\ 000 \times n+3\ 001)$;

$3\ 001x2+6\ 307xn$ correspond to: $6\ 307 \times (3\ 000 \times n+3\ 001)$;

$3\ 001x3+9\ 307xn$ correspond to: $9\ 307 \times (3\ 000 \times n+3\ 001)$;...

Extract factor F=307 out of the position number of N than check calculation above.

$$(3\ 000 \times n+607) \times (3\ 000 \times n+2\ 101) F=425$$

$607 \times n$; $2\ 101 \times n$; $2\ 101+3\ 607xn$; $2\ 101x2+6\ 607xn$; $2\ 101x3+9\ 607xn$;

Or,

$$(3\ 000 \times n+2\ 707) \times (3\ 000 \times n+1\ 801) F=1\ 625$$

$2\ 707 \times n$; $1\ 801 \times n$; $1\ 801+5\ 707xn$; $1\ 801x2+8\ 707xn$; $1\ 801x3+11\ 707xn$;

If none of the operations related to 400 factors do not give as results the position of studied number, this number is prime.

For this example ($p=359\ 612$) we check these calculations:

Divisibility by:

$$(3\ 000 \times n+7) \times (3\ 000 \times n+901) F=2\ P - F=359\ 610$$

$7 \times 51\ 372=359\ 604$ not divisible by $7 \times (3\ 000 \times n+901)$

$901 \times 399=359\ 499$ not divisible by $901 \times (3\ 000 \times n+7)$

$901+3\ 007x119=358\ 734$ -//- $3\ 007 \times (3\ 000 \times n+901)$

$901x2+6\ 007x59=356\ 215$ -//- $6\ 007 \times (3\ 000 \times n+901)$

$901x3+9\ 007x39=353\ 976$ -//- $9\ 007 \times (3\ 000 \times n+901)$

$901x4+12\ 007x29=351\ 807$ -//- $12\ 007 \times (3\ 000 \times n+901)$

$901x5+15\ 007x23=349\ 666$ -//- $15\ 007 \times (3\ 000 \times n+901)$

$901x6+18\ 007x20=365\ 546$ -//- $18\ 007 \times (3\ 000 \times n+901)$

$901x7+21\ 007x16=342\ 419$ -//- $21\ 007 \times (3\ 000 \times n+901)$

$901x8+24\ 007x14=343\ 306$ -//- $24\ 007 \times (3\ 000 \times n+901)$

$901x9+27\ 007x13=359\ 200$ -//- $27\ 007 \times (3\ 000 \times n+901)$

$901x10+30\ 007x11=339\ 087$ -//- $30\ 007 \times (3\ 000 \times n+901)$

$901x20+60\ 007x5=318\ 055$ -//- $60\ 007 \times (3\ 000 \times n+901)$

$901x30+90\ 007x3=297\ 054$ -//- $90\ 007 \times (3\ 000 \times n+901)$

$901x40+120\ 007x2=276\ 054$ -//- $120\ 007 \times (3\ 000 \times n+901)$

$901x50+150\ 007x2=345\ 064$ -//- $150\ 007 \times (3\ 000 \times n+901)$

$$901 \times 60 + 180 \ 007 \times 1 = 234 \ 067 \ \text{---} \ 180 \ 007 \times (3 \ 000 \times n + 901)$$

$$901 \times 92 + 276 \ 007 = 358 \ 899 \ \text{---} \ 276 \ 007 \times (3 \ 000 \times n + 901)$$

Last calculation can be performed.

Testing for number N continues with:

Divisibility by:

$$(3 \ 000 \times n + 37) \times (3 \ 000 \times n + 1 \ 711) \ F = 21 \ P - F = 359 \ 591$$

$$(3 \ 000 \times n + 67) \times (3 \ 000 \times n + 721) \ F = 16 \ P - F = 359 \ 596$$

Divisibility by:

$$(3 \ 000 \times n + 2999) \times (3 \ 000 \times n + 2693) \ F = 2 \ 692 \ P - F = 356 \ 920$$

$$2 \ 999 \times 119 = 356 \ 881 \ \text{---} \ 2 \ 999 \times (3 \ 000 \times n + 2 \ 693)$$

$$2 \ 693 \times 132 = 355 \ 476 \ \text{---} \ 2 \ 693 \times (3 \ 000 \times n + 2 \ 999)$$

$$2 \ 693 + 5 \ 999 \times 59 = 356 \ 634 \ \text{---} \ 5 \ 999 \times (3 \ 000 \times n + 2 \ 693)$$

$$2 \ 693 \times 2 + 8 \ 999 \times 39 = 356 \ 347 \ \text{---} \ 8 \ 999 \times (3 \ 000 \times n + 2 \ 693)$$

$$2 \ 693 \times 10 + 32 \ 999 \times 10 = 356 \ 920, \text{ number identical to } P - F,$$

So N is divisible by 32 999.

For termination five digits

The calculation algorithm is:

Pas.1: Determine the position number and column it belongs;

Pas.2: Last five digits of the calculated number indicates the termination position of tested number;

Pas 3: Determine factors for termination and column number tested. I have illustrated the calculation of factors termination 001 10, column 1;

Pas.4: We divisibility test the formulas for calculating factorial.

Positions calculated results do not contain termination 001 10

For pair of numbers 31 – 397

$$31 \times (3 \ 000 \ 000 \times n + 1 \ 161 \ 397) \ p = 12 + 31 \times n; \text{ divisibility by } 31$$

$$3 \ 031 \times (3 \ 000 \ 000 \times n + 1 \ 800 \ 397) \ p = 1 \ 819 + 3 \ 031 \times n \ \text{---} \ 3 \ 031$$

$$6 \ 031 \times (3 \ 000 \ 000 \times n + 2 \ 439 \ 397) \ p = 1 \ 819 + 3 \ 085 + 6 \ 031 \times n \ \text{---} \ 6 \ 031$$

$$9 \ 031 \times (3 \ 000 \ 000 \times n + 3 \ 078 \ 397) \ p = 1 \ 819 + 3 \ 085 \times 2 + 1 \ 278 + 9 \ 031 \times n \ \text{---} \ 9 \ 031$$

$$12 \ 031 \times (3 \ 000 \ 000 \times n + 3 \ 717 \ 397) \ p = 1 \ 819 + 3 \ 085 \times 3 + 1 \ 278 \times (2)! + 12 \ 031 \times n \ \text{---} \ 12 \ 031$$

$$15 \ 031 \times (3 \ 000 \ 000 \times n + 4 \ 356 \ 379) \ p = 1 \ 819 + 3 \ 085 \times 4 + 1 \ 278 \times (3)! + 15 \ 031 \times n \ \text{---} \ 15 \ 031$$

$$18 \ 031 \times (3 \ 000 \ 000 \times n + 4 \ 995 \ 379) \ p = 1 \ 819 + 3 \ 085 \times 5 + 1 \ 278 \times (4)! + 18 \ 031 \times n \ \text{---} \ 18 \ 031$$

$$2 \ 997 \ 031 \times (3 \ 000 \ 000 \times n + 639 \ 522 \ 379) \ p = 1 \ 819 + 3 \ 085 \times 998 + 1 \ 278 \times (997)! + 2 \ 997 \ 031 \times n \text{ divisibility by } 2 \ 997 \ 031$$

$$3 \ 000 \ 031 \times (3 \ 000 \ 000 \times n + 640 \ 161 \ 379) \ p = 1 \ 819 + 3 \ 085 \times 999 + 1 \ 278 \times (998)! + 3 \ 000 \ 031 \times n \text{ divisibility by } 3 \ 000 \ 031$$

$$3 \ 003 \ 031 \times (3 \ 000 \ 000 \times n + 640 \ 800 \ 379) \ p = 1 \ 819 + 3 \ 085 \times 1 \ 000 + 1 \ 278 \times (999)! + 3 \ 003 \ 031 \times n \text{ divisibility by } 3 \ 003 \ 031$$

And,

$$397 \times (3 \ 000 \ 000 \times n + 2 \ 403 \ 031) \ p = 318 + 397 \times n \text{ divisibility by } 397$$

$$3 \ 397 \times (3 \ 000 \ 000 \times n + 234 \ 031) \ p = 265 + 3 \ 397 \times n \ \text{---} \ 3 \ 397$$

$$6 \ 397 \times (3 \ 000 \ 000 \times n + 1 \ 065 \ 031) \ p = 265 + 2 \ 006 + 6 \ 397 \times n \ \text{---} \ 6 \ 397$$

$$9 \ 397 \times (3 \ 000 \ 000 \times n + 1 \ 896 \ 031) \ p = 265 + 2006 \times 2 + 1 \ 662 + 9 \ 397 \times n \ \text{---} \ 9 \ 397$$

$$12 \ 397 \times (3 \ 000 \ 000 \times n + 2 \ 727 \ 031) \ p = 265 + 2006 \times 3 + 1 \ 662 \times (2)! + 12 \ 397 \times n \ \text{---} \ 12 \ 397$$

$$15 \ 397 \times (3 \ 000 \ 000 \times n + 3 \ 558 \ 031) \ p = 265 + 2 \ 006 \times 4 + 1 \ 662 \times (3)! + 15 \ 397 \times n \ \text{---} \ 15 \ 397$$

$$18 \ 397 \times (3 \ 000 \ 000 \times n + 4 \ 389 \ 031) \ p = 265 + 2 \ 006 \times 5 + 1 \ 662 \times (4)! + 18 \ 397 \times n \ \text{---} \ 18 \ 397$$

$$2 \ 997 \ 397 \times (3 \ 000 \ 000 \times n + 829 \ 572 \ 031) \ p = 265 + 2 \ 006 \times 998 + 1 \ 662 \times (997)! + 2 \ 997 \ 397 \times n \text{ divisibility by } 2 \ 997 \ 397$$

$$3 \ 000 \ 397 \times (3 \ 000 \ 000 \times n + 830 \ 403 \ 031) \ p = 265 + 2 \ 006 \times 999 + 1 \ 662 \times (998)! + 3 \ 000 \ 397 \times n \text{ divisibility by } 3 \ 000 \ 397$$

$$3 \ 003 \ 397 \times (3 \ 000 \ 000 \times n + 831 \ 234 \ 031) \ p = 265 + 2 \ 006 \times 1 \ 000 + 1 \ 662 \times (999)! + 3 \ 003 \ 397 \times n \text{ divisibility by } 3 \ 003 \ 397$$

Or, pair of numbers 331 – 1 297

$$331 \times (3 \ 000 \ 000 \times n + 2 \ 755 \ 297) \ p = 304 + 331 \times n \text{ divisibility by } 331$$

$$3 \ 331 \times (3 \ 000 \ 000 \times n + 994 \ 297) \ p = 1 \ 104 + 3 \ 331 \times n \ \text{---} \ 3 \ 331$$

$$6 \ 331 \times (3 \ 000 \ 000 \times n + 2 \ 233 \ 297) \ p = 1 \ 104 + 3 \ 609 + 6 \ 331 \times n \ \text{---} \ 6 \ 331$$

$$9 \ 331 \times (3 \ 000 \ 000 \times n + 3 \ 472 \ 297) \ p = 1 \ 104 + 3 \ 609 \times 2 + 2 \ 478 + 9 \ 331 \times n \ \text{---} \ 9 \ 331$$

$$12 \ 331 \times (3 \ 000 \ 000 \times n + 4 \ 711 \ 297) \ p = 1 \ 104 + 3 \ 609 \times 3 + 2 \ 478 \times (2)! + 12 \ 331 \times n \ \text{---} \ 12 \ 331$$

$$15 \ 331 \times (3 \ 000 \ 000 \times n + 5 \ 950 \ 297) \ p = 1 \ 104 + 3 \ 609 \times 4 + 2 \ 478 \times (3)! + 15 \ 331 \times n \ \text{---} \ 15 \ 331$$

$$18 \ 331 \times (3 \ 000 \ 000 \times n + 7 \ 189 \ 297) \ p = 1 \ 104 + 3 \ 609 \times 5 + 2 \ 478 \times (4)! + 18 \ 331 \times n \ \text{---} \ 18 \ 331$$

And,

$$1 \ 297 \times (3 \ 000 \ 000 \times n + 342 \ 331) \ p = 148 + 1 \ 297 \times n \text{ divisibility by } 1 \ 297$$

$$4 \ 297 \times (3 \ 000 \ 000 \times n + 1 \ 773 \ 331) \ p = 2 \ 540 + 4 \ 297 \times n \ \text{---} \ 4 \ 297$$

$$7 \ 297 \times (3 \ 000 \ 000 \times n + 3 \ 204 \ 331) \ p = 2 \ 540 + 5 \ 254 + 7 \ 297 \times n \ \text{---} \ 7 \ 297$$

$$10 \ 297 \times (3 \ 000 \ 000 \times n + 4 \ 635 \ 331) \ p = 2 \ 540 + 5 \ 254 \times 2 + 2 \ 862 + 10 \ 297 \times n \ \text{---} \ 10 \ 297$$

$$13 \ 297 \times (3 \ 000 \ 000 \times n + 6 \ 066 \ 331) \ p = 2 \ 540 + 5 \ 254 \times 3 + 2 \ 862 \times (2)! + 13 \ 297 \times n \ \text{---} \ 13 \ 297$$

$$16 \ 297 \times (3 \ 000 \ 000 \times n + 7 \ 497 \ 331) \ p = 2 \ 540 + 5 \ 254 \times 4 + 2 \ 862 \times (3)! + 16 \ 297 \times n \ \text{---} \ 16 \ 297$$

$$19 \ 297 \times (3 \ 000 \ 000 \times n + 8 \ 928 \ 331) \ p = 2 \ 540 + 5 \ 254 \times 5 + 2 \ 862 \times (4)! + 19 \ 297 \times n \ \text{---} \ 19 \ 297$$

Conclusion

Number testing is done with all the 400 pairs of numbers in the

group factorial. Factorial multiplication process has as principle of calculation pairs of numbers that belong to the factorial group unique to each termination and column.

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