ORDER OF INTEGER NUMBERS AND STRUCTURE OF PRIME NUMBERS

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ABSTRACT

There are many theories and trials exist to find a structure for identification and prediction of prime numbers. The famous one is the Riemann Hypothesis. Beside this, there are running competitions to identify the prime numbers for enormous range of numbers with high performance computers. The idea to identify a structure in prime numbers is developed from an interview of Dr.Peter Plichta where he spoke on his book "Das Primzahlenkreuz". Following is given a scheme that uses steps of separation to generate an order, which allows simple elimination steps to identify and predict prime numbers.

KEYWORDS

Number Theory, Prime Numbers

1. INTRODUCTION

Based on a simple partition technique all the two and three divisible numbers appear in separate columns whereas column 1 shows with prime numbers. The three columns are penetrated with the multiples of five and seven in repetitive structures. This ascending order allows endless generation or identification of affiliation to the three columns or classes. This steps are showing the correlations, who allows to identify, generate and predict all prime numbers.

2. SCHEME OF NATURAL NUMBERS AND ELIMINATION OF PRIME NUMBERS

2.1. Steps for Separation

First natural numbers are separated in ascending fashion in three columns with given rule. The natural numbers 1, 2 and 3 are the header for three main-columns. To build up, it is useful to start with the column 3 where all three-divisible numbers are placed. In column 2, all two-divisible numbers are found and eventually column 1 results all prime numbers. In every second line is to find the conventional order of natural numbers. The successive numbers can be separate endless adequate to the properties and allows another view to the structure of the natural and also integer numbers.

Table 1. Cutout of separation natural numbers at three columns with 1, 2 and 3 as head.

1	**2**	**3**
5	4	6
7	8	9
11	10	12
13	14	15
17	16	18
…	…	…

2.2. Steps for Elimination

All columns contain multiples of 5 and 7 whose structure is visible with this representation, see table 1 and 2. The table 2 is showing the structure of quotients of five and seven related to the numbers of column 1. In both, the quotients are able to appear as double helices with defined distances and correspond in pattern. To recognize helices, the first double helices are marked in orange. For the multiples 5 and 7 exists in the three columns equidistant elimination steps.

Table 2. Cutout of all quotients to five and seven in the three columns – separated.

Column 1	All multiples of 5 in the three columns			All multiples of 7 in the three columns		
	1	2	3	1	2	3
1						
5	1					
7				1		
11		2				
13			3		2	
17						
19		4				3
23						
25	5					
29			6		4	
31						
35	7			5		
37						
41		8				6
43			9			
47						
49		10		7		
53						
55	11				8	
59			12			
61						9

2.3. Generation and Prediction of Prime Numbers

The kernel periodicity of column 1 allows to identify the affiliation of a random number to column 1, whose endless recursive generation rule for the sphere of natural numbers is:

$a_1 = 1$	<u>In general:</u>
$a_2 = a_1+2^2$	$a_1 = 1$
$a_3 = a_2+2$	$a_{n+1} = a_n + 2^k$, $n\in N$
$a_4 = a_3+2^2$	for $n+1 \in 2n$, $k=2$
…	for $n+1 \in 2n+1$, $k=1$

After divide all numbers of column 1 by 9, find a high periodicity in every outcome of decimal numbers and also in the sequence, see table 3. There growing occur with addition of 2 to sequential number. Of course the periodicity is also valid for the negative integers and adequate generation rules are possible. In combination with elimination pattern for multiples of 5 and 7 this base allows to generate and predict all prime numbers.

Table 3: Periodicity in column 1 after divided by 9

Numbers of column 1 divided by 9
0,11111111
0,55555555
0,77777777
1,22222222
1,44444444
1,88888888
….

The following elimination of multiples by 5 and 7 is used like a cutting-form. In order to identify the pattern of cutting, the quotient of 35 has to be considered where 5 and 7 divisible numbers are combined. For column 1 depending on the distance between two quotients of 35 the repeatable cutting-form is formed and the prime numbers will be left over. In this quotient, structure of 35 is to find the sequential regularity like column 1 inclusive all multiples of 5 and7, where 4/2 is the answer of the question to the distances.

Table 4: Cutout of elimination pattern for multiples of 5 and 7 in column1 to start at any multiple of 35 depending on the distance to the next multiple of 35

Quotients of 35 from column 1	Distance between quotients	All multiples of 5 and 7 are to eliminate start from any quotient of 35 depending on distance to the next	
		Next to cut multiple of 5:	Next to cut multiple of 7:
1		next 7^{th} than next 3^{th},7^{th},3^{th}…	next 5^{th} than next 9^{th}…
	4		
5		next 3^{th} than next 7^{th}, 3^{th},7^{th} …	next 9^{th} than next 5^{th}...
	2		
7		…	…

2.4. Example

<u>Task:</u> Identify the prime numbers between 1001 and 1100

1. Separate (after divide 9) or generate the numbers as stated in table 3 following increasing order between 111.**2** and 222.**2** as section of column 1.
   111.**2**, 111.**4**, 111.**8**, 112.**1**, 112.**5**, 112.**7**, 113.**2**, 113.**4**, 113.**8**, 114.**1**, 114.**5**, 114.**7** …
2. Find out in the resulting original numbers the neighboring multiples of 35, e.g. like 1017 and 1085. Check the distance to the next quotient, e.g. for 29 to 31 it is 2.
3. As stated in table 4, use the cutout pattern to eliminate the multiples of 5 and 7. Start from one of the multiples of 35 with given form of removal increments.
   1003, 1007, 1009, 1013, 1019, 1021, 1027, 1031, 1033, 1037, 1039, 1049, 1051, 1061, 1063, 1067, 1069, 1073, 1079, 1081, 1087, 1091, 1093, 1097
   All prime numbers are identified in a variable section of numbers.

3. CONCLUSIONS

The separation approach of all natural numbers in three classes with different properties allows identifying one class with prime numbers. This class contains a structure of the prime numbers whereby additional included multiples of five and seven. Simple cut off steps to eliminate all the multiples of five and seven are usable for all three classes in their ascending order. View these classes as columns allowed the endless editing. The properties of the three columns are multidimensional and regular, also apply to negative integers. Any prime number at arbitrary range is to generate with sequential structure of column or to separate. To identify and to generate prime numbers is possible infinitely.

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