Let‘s calculate primes! Part I - Representation of times tables

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Fri 29 Dec 2017 in Math, Carolin Zöbelein

Some days ago, I had several nice ideas for calculating primes recursively, which I want to share with you in a small series of posts.

I will use some insights of my work https://github.com/Samdney/primescalc and assume you already know they. If not, please read it sidewise to the following posts.

We have given our already known equation

$$x_{i,j} = 2x_ix_j + x_i + x_j = (2x_j + 1)\,x_i + x_j = (2x_i + 1)\,x_j + x_i$$

with $x_i, x_j \in \mathbb{N}$. Remember that this equation gives us all $x_{i,j}$ for which $2x_{i,j} + 1$ is an integer divisible number.

So let‘s look, for example on the numbers of $x_i = 1$, which are

$$x_{1,j} = 4, 7, 10, 13, 16, 19, 22, 25, 28, \ldots$$

.

Now we will choose a simple way of representation of this numbers. Be given the general form of a number in decimal representation:

$$\sum_{k=0}^{n} 10^k$$

with $n+1$, $n \in \mathbb{N}$, digits. Now assume, in our example, the number 4 is represented by the number 1, at the $4+1$ digit, the number 7 by the number 1, at the $7+1$ digit and so on. So we can write (read from right to left) as represenation for $x_{1,j}$:

$$\sum_{x_j} 10^{(2x_i+1)x_j+x_i} = \sum_{x_j} 10^{3x_j+1}$$

and

$$\ldots 10010010010010010010010010000$$

In this way, we can write every of our times tables which are given by $x_{i,j} = (2x_i + 1)\,x_j + x_i$.

If we finally calculate this sum, we receive

$$\sum_{x_j=l}^{u} 10^{(2x_i+1)x_j+x_i} = -\frac{10^{(2x_i+1)l+x_i} - 10^{(2x_i+1)(u+1)+x_i}}{10^{2x_i+1} - 1}$$

. See also wolframalpha.com.

But what can we do with this, now?
In the next post we will look at the intersection of times tables with this kind of representation.