# Function for Prime Numbers: Searching for Consecutive Prime Numbers with Billions of Digits

Massimo Russo
LinkedIn
YouTube

Abstract:

With the right equipment and a specially developed algorithm, I believe that my function could potentially find the largest prime number ever, even one with billions of digits. It might even be possible to find two or more consecutive prime numbers each with billions of digits.

**You can find my paper "Function for Prime Numbers" at this link on viXra.: Function for Prime Number**

The idea I started with:

My research began by trying to find a connection between the first prime number, 2, and all the others. I imagined that starting from the first prime number, it would be possible to determine all the others, much like when we start counting: naturally, we begin with 1.

The connection between 2 and the other prime numbers is quite simple to understand. I divided the first few prime numbers by 2:

2/2 = 1
3/2 = 1,5
5/2 = 2,5
7/2 = 3,5

These equations can also be written in another way:

$2 = 1 * 2$
$3 = 1,5 * 2$
$5 = 2,5 * 2$
$7 = 3,5 * 2$

By highlighting the 2, the perspective changes:

$2 = 2 * 1$
$3 = 2 * 1,5$
$5 = 2 * 2,5$
$7 = 2 * 3,5$

Numbers with decimals can also be written differently:

$1,5 = 1 + 0,5 = 1 + 1/2$
$2,5 = 2 + 0,5 = 2 + 1/2$
$3,5 = 3 + 0,5 = 3 + 1/2$

Therefore, by substituting the equivalences, we obtain:

$2 = 2 * 1$
$3 = 2 * (1 + 1/2)$
$5 = 2 * (2 + 1/2)$
$7 = 2 * (3 + 1/2)$

We notice that now the number 2 is much more prominent than before, and there's an exception: the number 3. But as we know:

$3 = 2 + 1$

And furthermore:

$1 = 2^0$

By substituting, we obtain:

$2 = 2 * 1$
$3 = 2 * (2^0 + 1/2)$
$5 = 2 * (2 + 1/2)$
$7 = 2 * (2 + 2^0 + 1/2)$

By factoring out 1/2 from inside the parentheses, we obtain a cleaner formula:

$2 = 2 * 1$
$3 = 2 * (2^0 + 1/2) \quad = 2 * (2^0) + 1 \quad = 1 + 2 * (2^0)$
$5 = 2 * (2 + 1/2) \quad = 2 * (2) + 1 \quad = 1 + 2 * (2)$

$7 = 2 * (2 + 2^0 + 1/2) \quad = 2 * (2 + 2^0) + 1 \quad = 1 + 2 * (2 + 2^0)$

Now the 2 is much more visible in each expression. Checking for the other prime numbers, we obtain:

$2 = 2 * 2^0$
$3 = 2 * \ (2^0 + 1/2)$
$5 = 2 * \ (2 + 1/2)$
$7 = 2 * \ [(2^1 + 2^0) + 1/2]$
$11 = 2 * [(2^2+2^0) + 1/2]$
$13 = 2 * [(2^2+2^1) + 1/2]$
$17 = 2 * [(2^2+2^2) + 1/2]$
$19 = 2 * [(2^2+2^2+2^0) + 1/2]$
$23 = 2 * [(2^2+2^2+2^1+2^0) + 1/2]$
$29 = 2 * [(2^2+2^2+2^2+2^1) + 1/2]$
$31 = 2 * [(2^2+2^2+2^2+2^1+2^0) + 1/2]$
$37 = 2 * [(2^2+2^2+2^2+2^2+2^1) + 1/2]$
$41 = 2 * [(2^2+2^2+2^2+2^2+2^2) + 1/2]$
$43 = 2 * [(2^2+2^2+2^2+2^2+2^2+2^0) + 1/2]$
$47 = 2 * [(2^2+2^2+2^2+2^2+2^2 +2^1+2^0) + 1/2]$
$53 = 2 * [(2^2+2^2+2^2+2^2+2^2 +2^2+2^1) + 1/2]$
$57 = 2 * [(2^2+2^2+2^2+2^2+2^2 +2^2+2^2) + 1/2]$
$59 = 2 * [(2^2+2^2+2^2+2^2+2^2 +2^2+2^2+2^0) + 1/2]$
$61 = 2 * [(2^2+2^2+2^2+2^2+2^2 +2^2+2^2+2^1) + 1/2]$
$67 = 2 * [(2^2+2^2+2^2+2^2+2^2 +2^2+2^2+2^2+2^0) + 1/2]$

Simplifying:

$2 = \quad 2 * 2^0$
$3 = \quad 1 + 2*[0(2^2) + 2^0]$
$5 = \quad 1 + 2*[0(2^2) + 2^1]$
$7 = \quad 1 + 2*[0(2^2) + 2^1 + 2^0]$
$11 = \quad 1 + 2*[1(2^2) \qquad +2^0]$
$13 = \quad 1 + 2*[1(2^2) + 2^1]$
$17 = \quad 1 + 2*[2(2^2)]$
$19 = \quad 1 + 2*[2(2^2) \qquad +2^0]$
$23 = \quad 1 + 2*[2(2^2) +2^1 +2^0)]$
$29 = \quad 1 + 2*[3(2^2) +2^1]$
$31 = \quad 1 + 2*[3(2^2) +2^1 + 2^0]$
$37 = \quad 1 + 2*[4(2^2) +2^1]$
$41 = \quad 1 + 2*[5(2^2)]$
$43 = \quad 1 + 2*[5(2^2) \qquad +2^0]$
$47 = \quad 1 + 2*[5(2^2) +2^1 +2^0]$
$53 = \quad 1 + 2*[6(2^2) +2^1]$
$57 = \quad 1 + 2*[7(2^2)]$
$59 = \quad 1 + 2*[7(2^2) \qquad +2^0]$
$61 = \quad 1 + 2*[7(2^2) +2^1]$
$67 = \quad 1 + 2*[8(2^2) \qquad +2^0]$

$71 = 1 + 2*[8(2^2) + 2^1 + 2^0]$
$73 = 1 + 2*[9(2^2)]$
$79 = 1 + 2*[9(2^2) + 2^1 + 2^0]$
$83 = 1 + 2*[10(2^2) \quad + 2^0]$
$89 = 1 + 2*[11(2^2)]$
$97 = 1 + 2*[12(2^2)]$
$101 = 1 + 2*[12(2^2) + 2^1]$
$103 = 1 + 2*[12(2^2) + 2^1 + 2^0]$
$107 = 1 + 2*[13(2^2) \quad + 2^0]$
$109 = 1 + 2*[13(2^2) + 2^1]$
$113 = 1 + 2*[14(2^2)]$
$127 = 1 + 2*[15(2^2) + 2^1 + 2^0]$
$131 = 1 + 2*[16(2^2) \quad + 2^0]$
$137 = 1 + 2*[17(2^2)]$
$139 = 1 + 2*[17(2^2) \quad + 2^0]$
$149 = 1 + 2*[18(2^2) + 2^1]$
$151 = 1 + 2*[18(2^2) + 2^1 + 2^0]$
$159 = 1 + 2*[19(2^2) + 2^1]$
$163 = 1 + 2*[20(2^2) \quad + 2^0]$
$167 = 1 + 2*[20(2^2) + 2^1 + 2^0]$
$173 = 1 + 2*[21(2^2) + 2^1]$
$179 = 1 + 2*[22(2^2) \quad + 2^0]$
$181 = 1 + 2*[22(2^2) + 2^1]$
$191 = 1 + 2*[23(2^2) + 2^1 + 2^0]$
$193 = 1 + 2*[24(2^2)]$
$197 = 1 + 2*[24(2^2) + 2^1]$
$199 = 1 + 2*[24(2^2) + 2^1 + 2^0]$
$211 = 1 + 2*[26(2^2) \quad + 2^0]$
.
.
.
$919 = 1 + 2*[114(2^2) + 2^1 + 2^0]$
.
.
.
$8923 = 1 + 2*[1115(2^2) \quad + 2^0]$

In general:

$$N = 1 + 2*[x(2^2) + 2^0] = 1 + 2*[x(2^2) + 1]$$

It therefore becomes clear that there is a specific pattern through which prime numbers can be found. However, the function described above, while fascinating, is quite inefficient and does not lead to any significant result, except for the fact that every prime number can be calculated by multiplying a given number by 2 and adding or subtracting 1, 2, 3, and so on. In conclusion, with the function:

$1 + 2*[x(2^2) + 1]$

it is not possible to detect any pattern capable of determining prime numbers.

From this result, I moved forward, even though it might not seem very sensible, yet it still follows its own logic.

Indeed:

$1 + 2*[x(2^2) + 1]$

can be written in this way:

$2*[x(2^2) + 1] + 1$

thus, considering that $(2^2) = 4$:

$2*[4x + 1] + 1$

by factoring out the 4, we obtain another way to write the function:

$8*[x + 1/4] + 1$

At this point, I tried a new line of reasoning, however absurd and illogical it might have been, just to see what could happen. Instead of trying to find prime numbers towards infinity, assigned by attributing any real number to x, I thought about whether they might be found towards zero. I then analyzed the new formula created, assuming x took the place of 4:

$8*[1 + 1/x] + 1$

and more generally:

$A*[1 + 1/x] + 1$

From this point on, everything changed.

After various experiments, which began by assigning the value of 2 to A and any natural number to x, it is possible to determine fractional results N/d where, most of the time, N is a prime number, or d is a prime number, or even both values N and d are prime numbers. Remarkably, if assigning the value of N to x does not yield any prime numbers, at some point a prime number will be found.

$2*(1+1/1) +1 = \mathbf{5}$

$2*(1+1/2) +1 = 4$ $\quad$ $2*(1+1/4) +1 = \mathbf{7}/2$

$2*(1+1/3) +1 = \mathbf{11}/3$
$2*(1+1/4) +1 = \mathbf{7}/2$
$2*(1+1/5) +1 = \mathbf{17}/5$

| | | |
|---|---|---|
| | 2*(1+1/6) +1 = 10/3 | 2*(1+1/10) +1 = 16/5 |
| | | 2*(1+1/16) +1 = 25/8 |
| | | 2*(1+1/25) +1 = 77/25 |
| | | 2*(1+1/77) +1 = **233**/77 |
| 2*(1+1/7) +1 = **23**/7 | | |
| 2*(1+1/8) +1 = **13**/4 | | |
| 2*(1+1/9) +1 = **29**/9 | | |
| | 2*(1+1/10) +1 = 16/5 | 2*(1+1/16) +1 = 25/8 |
| | | 2*(1+1/25) +1 = 77/25 |
| | | 2*(1+1/77) +1 = **233**/77 |
| | 2*(1+1/11) +1 = 35/11 | 2*(1+1/35) +1 = **107**/35 |
| 2*(1+1/12) +1 = **19**/6 | | |
| 2*(1+1/13) +1 = **41**/13 | | |
| | 2*(1+1/14) +1 = 22/7 | 2*(1+1/22) +1 = 34/11 |
| | | 2*(1+1/34) +1 = 52/17 |
| | | 2*(1+1/52) +1 = **79**/26 |
| 2*(1+1/15) +1 = **47**/15 | | |
| | 2*(1+1/16) +1 = 25/8 | 2*(1+1/25) +1 = 77/25 |
| | | 2*(1+1/77) +1 = **233**/77 |
| 2*(1+1/17) +1 = **53**/17 | | |
| | 2*(1+1/18) +1 = 28/9 | 2*(1+1/28) +1 = **43**/14 |
| 2*(1+1/19) +1 = **59**/19 | | |
| 2*(1+1/20) +1 = **31**/10 | | |
| | 2*(1+1/21) +1 = 65/21 | 2*(1+1/65) +1 = **197**/65 |
| | 2*(1+1/22) +1 = 34/11 | 2*(1+1/34) +1 = 52/17 |
| | | 2*(1+1/52) +1 = **79**/26 |
| 2*(1+1/23) +1 = **71**/23 | | |
| 2*(1+1/24) +1 = **37**/12 | | |
| | 2*(1+1/25) +1 = 77/25 | 2*(1+1/77) +1 = **233**/77 |
| | 2*(1+1/26) +1 = 40/13 | 2*(1+1/40) +1 = **61**/20 |
| 2*(1+1/27) +1 = **83**/27 | | |
| 2*(1+1/28) +1 = **43**/14 | | |
| 2*(1+1/29) +1 = **89**/29 | | |
| | 2*(1+1/30) +1 = 46/15 | 2*(1+1/46) +1 = 70/23 |
| | | 2*(1+1/70) +1 = 106/35 |
| | | 2*(1+1/106) +1 = 160/53 |
| | | 2*(1+1/160) +1 = **241**/80 |
| | 2*(1+1/31) +1 = 95/31 | 2*(1+1/95) +1 = 287/95 |
| | | 2*(1+1/287) +1 = **863**/287 |
| | 2*(1+1/32) +1 = 49/16 | 2*(1+1/49) +1 = **149**/49 |
| 2*(1+1/33) +1 = **101**/33 | | |
| | 2*(1+1/34) +1 = 52/17 | 2*(1+1/52) +1 = **79**/26 |

2*(1+1/35) +1 = **107**/35
2*(1+1/36) +1 = 55/18 2*(1+1/55) +1 = **167**/55
2*(1+1/37) +1 = **113**/37
2*(1+1/38) +1 = 58/19 2*(1+1/58) +1 = 88/29
2*(1+1/88) +1 = 133/44
2*(1+1/133) +1 = **401**/133
2*(1+1/39) +1 = **119**/39
2*(1+1/40) +1 = **61**/20
2*(1+1/41) +1 = 125/41 2*(1+1/125) +1 = 377/125
2*(1+1/377) +1 = 1133/377
2*(1+1/1133) +1 = 3401/1133
2*(1+1/3401) +1 = 10205/3401
2*(1+1/10205) +1 = 30617/10205
2*(1+1/30617) +1 = 91853/30617
2*(1+1/91853) +1 = 275561/91853
2*(1+1/275561) +1 = 826685/275561
2*(1+1/826685) +1 = **2480057**/826685

2*(1+1/42) +1 = 64/21 2*(1+1/64) +1 = **97**/32
2*(1+1/43) +1 = **131**/43
2*(1+1/44) +1 = **67**/22

Clearly, these types of results, although intriguing, are not satisfying in any way because they do not lead to anything particularly groundbreaking. However, the percentage of prime numbers found is not so low.

What fascinates me most about this function is the fact that, while so far any function has sought prime numbers towards infinity, if we find a very large number, we have a corresponding denominator that results in N/d, which tends toward a specific integer corresponding to A+1.

Indeed, this is due to the value of x tending towards infinity. Consequently, 1/x tends to 0, which means that the result of the function tends towards A+1.

The larger the prime numbers we find, the more the result of the function tends towards A+1, even though it will never actually be equal to A+1. Moreover, by subtracting A+1 from every result obtained for increasingly greater values of N/d, we would get a number tending towards ZERO. We could almost say, in a very philosophical way, that very large prime numbers are found right on the edge of ZERO...

I didn't stop at these results but continued by assigning other values to A, particularly focusing on  su A = 5, and assigning increasingly higher natural numbers to x. With these values, the function identifies several consecutive prime numbers.

5*(1+1/1) +1 = **11**
5*(1+1/2) +1 = **17**/2
5*(1+1/3) +1 = **23**/3

| | | |
|---|---|---|
| 5*(1+1/4) +1 = **29**/4 | | |
| 5*(1+1/5) +1 = **7** | | |
| 5*(1+1/6) +1 = **41**/6 | | |
| 5*(1+1/7) +1 = **47**/7 | | |
| 5*(1+1/8) +1 = **53**/8 | | |
| 5*(1+1/9) +1 = **59**/9 | | |
| 5*(1+1/10) +1 = **13**/2 | | |
| 5*(1+1/11) +1 = **71**/11 | | |
| | 5*(1+1/12) +1 = 77/12 | 5*(1+1/77) +1 = **467**/77 |
| 5*(1+1/13) +1 = **83**/13 | | |
| 5*(1+1/14) +1 = **89**/14 | | |
| 5*(1+1/15) +1 = **19**/3 | | |
| 5*(1+1/16) +1 = **101**/16 | | |
| 5*(1+1/17) +1 = **107**/17 | | |
| 5*(1+1/18) +1 = **113**/18 | | |
| | 5*(1+1/19) +1 = 119/19 | 5*(1+1/119) +1 = **719**/19 |
| | 5*(1+1/20) +1 = 25/4 | 5*(1+1/25) +1 = **31**/5 |
| 5*(1+1/21) +1 = **131**/21 | | |
| 5*(1+1/22) +1 = **137**/22 | | |
| | 5*(1+1/23) +1 = 143/23 | 5*(1+1/143) +1 = **89**/4 |
| 5*(1+1/24) +1 = 1**49**/24 | | |
| 5*(1+1/25) +1 = **31**/5 | | |
| | 5*(1+1/26) +1 = 161/26 | 5*(1+1/161) +1 = **971**/26 |
| 5*(1+1/27) +1 = **167**/27 | | |
| 5*(1+1/28) +1 = **173**/28 | | |
| 5*(1+1/29) +1 = **179**/29 | | |
| 5*(1+1/30) +1 = **37**/6 | | |
| 5*(1+1/31) +1 = **191**/31 | | |
| 5*(1+1/32) +1 = **197**/32 | | |
| | 5*(1+1/33) +1 = 203/33 | 5*(1+1/203) +1 = **1223**/26 |
| | 5*(1+1/34) +1 = 209/34 | 5*(1+1/209) +1 = **1259**/26 |
| 5*(1+1/35) +1 = **43**/7 | | |
| | 5*(1+1/36) +1 = 221/36 | 5*(1+1/221) +1 = 1331/221 |
| | | 5*(1+1/1331) +1 = 7991/1331 |
| | | 5*(1+1/7991) +1 = **47951**/7991 |
| 5*(1+1/37) +1 = **227**/37 | | |
| 5*(1+1/38) +1 = **233**/38 | | |

Another example: assigning any value to x in the function will find the corresponding value of N, whether prime or not. Assigning the value of N to x, the function will eventually find a prime number. Here are some examples, with completely random numbers:

x = 677686786868678678

5*(1+1/677686786868678678) +1 = 4066120721212072073/677686786868678678
5*(1+1/4066120721212072073) +1 = 24396724327272432443/4066120721212072073
5*(1+1/24396724327272432443) +1 =
146380345963634594663/24396724327272432443
5*(1+1/146380345963634594663) +1 =
878282075781807567983/146380345963634594663
5*(1+1/878282075781807567983) +1 =
**5269692454690845407903**/878282075781807567983

**5269692454690845407903 is a Prime Number.**

Assigning to x a value equal to the prime number just found:

x = 5269692454690845407903

we will find a prime number after 28 new calculations using the same function. More precisely, the value of N is **32360876852257729603248251719294288096395263**.

Other examples:

x = 5269692454690845407904
after 8 calculations N is Prime Number = **885105976197801900064376447 9**

x = 908890235262
after 2 calculations N is Prime Number = **32720048469467**

x = 1346235263
after 9 calculations N is Prime Number = **1356694973507177**

In spite of having reached this point, I was still not entirely satisfied because I knew there was something else that would take me a little further.

So I searched, and found, a logical sequence of numbers to assign to x that allowed me to determine 42 consecutive prime numbers, making only 29 calculations.

This is the path that led me to the function indicated in my paper, which can be found on viXra: Function for Prime Number

I want to emphasize that the most well-known function capable of finding consecutive prime numbers to date is Euler's function, which produces 40 consecutive primes. Therefore, my function determines 2 more consecutive primes.

For values of x with 11 digits and for values of n within a range of only 100 natural numbers, the function determines 35% of prime numbers and even consecutive prime numbers.

This allows me to hypothesize that within any interval of values for n consisting of only 100 numbers, the function is capable of determining a significant number of prime numbers, even for very large numbers.

Although I cannot currently prove it, as I require computational power greater than what I have at my disposal, I can hypothesize that with my function, there would be many more opportunities to find prime numbers than with any other existing function, possibly by at least 20%. That is, out of every 100 operations, at least 20 numbers could be prime. Or, even better, out of every 5 operations, at least one prime number could be found. Furthermore, it might even be possible to find consecutive prime numbers for numbers with hundreds, thousands, or millions of digits.

My function also determines twin prime numbers, even by assigning the corresponding negative value -x to x, as indicated in my paper. It's another of the fascinating aspects of this study that has taken some time.

With the right instrumentation and a specially developed algorithm, I believe my function would be capable of finding the largest prime number ever, even with billions of digits. And even consecutive prime numbers with billions of digits.

Massimo Russo
LinkedIn
YouTube