Primeness Test {Version 5.0}

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Abstract

In this research investigation, the author presents a '*Primeness Test*' which can be used to test if any given number is Prime.

Theory

Given any number p_n, usually written in Base 10 as

$p_n = a_k a_{k-1} a_{k-2} .... a_3 a_2 a_1 a_0$ where

$$a_k a_{k-1} a_{k-2} .... a_3 a_2 a_1 a_0 = \sum_{i=0}^{k} (a_i)(10)^i$$

which can be written as

$$\sum_{i=0}^{k} (a_i)(10)^i = a_0 + (p_n - a_0)$$

Letting $(p_n - a_0) = z$ we note that z is a multiple of10.

If p_n is to be Prime, then the values of a_0 cannot be Even, i.e., it must be Odd. This implies that z must be Even. Also, a_0 can possibly take the values of 1, 3,7 and 9 only as it being 5 implies that p_n is divisible by 5. If p_n is not a Prime, we can write it as

$p_n = a_0 + z = r$ and/ or

$p_n = a_0 + z = 3s$ and/ or

$p_n = a_0 + z = 7t$ and/ or

$p_n = a_0 + z = 9u$

For the case of Divisibility by 3, we write

$$r = \frac{a_0}{3} + \frac{z}{3}$$

Since z is a multiple of 10, we can check if it is multiple of 3 by checking if

$z = 3(10)^{m_{10}}$ for $m_{10} = 1$ to g such that $3(10)^{g_{m_{10}}+1} > z$

Also, since z is a multiple of 10, we can check if it is multiple of 3 by checking if

$z = 3(20)^{m_{20}}$ for $m_{20} = 1$ to g such that $3(20)^{g_{m_{20}}+1} > z$

We repeat this procedure, so on, so forth until

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$z = 3(80)^{m_{80}}$ for $m_{80} = 1$ to g such that $3(80)^{g_{m_{80}}+1} > z$ and

$z = 3(90)^{m_{90}}$ for $m_{90} = 1$ to g such that $3(90)^{g_{m_{90}}+1} > z$

If z is divisible by 3, and since a_0 can take values of 0 and 3 only, therefore,

p_n is divisible by 3.

If z is not divisible by 3, and since a_0 can take values of 0 and 3 only, p_n will be lacking and/ or in excess by 1+3 unit or 2+3 units in order to be divisible by 3.

We now present the analysis as follows:

Divisibility by 3		
a_0	z is divisible by 3	z is not divisible by 3
1	$a_0 + z$ is not divisible by 3	When z is not divisible by 3, it is either lacking and/ or in excess by ± 1 gives $\pm 1 + 1 = 2, 0$ Hence, $a_0 + z$ is not divisible by 3 for the case of $+1$ (lacking and/ or in excess by) but is divisible by 3 for the case of -1 (lacking and/ or in excess by) ± 2 gives $\pm 2 + 1 = 3, -1$ Hence, $a_0 + z$ is divisible

		by 3 for the case of $+2$ (lacking and/ or in excess by) but is not divisible by 3 for the case of -2 (lacking and/ or in excess by)

a_0	z is divisible by 3	z is not divisible by 3
3	a_0+z is divisible by 3	When z is not divisible by 3, it is either lacking and/ or in excess by
		± 1 gives $\pm 1+3=4,2$ Hence, a_0+z is not divisible by 3
		± 2 gives $\pm 2+3=5,1$ Hence, a_0+z is not divisible by 3

a_0	z is divisible by 3	z is not divisible by 3
7	a_0+z is not divisible by 3	When z is not divisible by 3, it is either lacking and/ or in excess by
		± 1 gives $\pm 1+7=8,6$ Hence, a_0+z is not divisible by 3 for the case of $+1$ (lacking and/ or in excess by) but is divisible by 3 for the case of -1 (lacking and/ or in excess by)
		± 2 gives $\pm 2+7=9,5$ Hence, a_0+z is divisible by 3 for the case of $+2$ (lacking and/ or in excess by) but is not divisible by 3 for the case of -2 (lacking and/ or in excess by)

a_0	z is divisible by 3	z is not divisible by 3
9	a_0+z is divisible by 3	When z is not divisible by 3, it is either lacking and/ or in excess by
		± 1 gives $\pm 1+9=10,8$ Hence, a_0+z is not divisible by 3

		± 2 gives $\pm 2+9=11,7$ Hence, a_0+z is not divisible by 3

We repeat the same procedural analysis for

a_0

equal to 7 and 9.

From the above all cases, we can infer if

p_n

is Prime or not.

We can note that this test so far cannot ascertain the Primeness of a number ending with 1.

For such numbers, we present the following scheme of ascertaining their Primeness.

In this case, we write

p_n

as

$p_n = b_0 - 9$

where

b_0

is a multiple of 10.

We now follow a similar scheme as detailed already to ascertain if

p_n

is Prime or not.

Moral

Fulfillment of Righteous Promise Is The Highest Virtue.

References

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Dedication

*All of the aforementioned Research Works, inclusive of this One are **Dedicated to Lord Shiva**.*