Primeness Test {Version IV}

January 2011 through March 14th 2016 Anno Domini

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White Paper One {TRL120 Version IV}
of
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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 of 10.

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 $3(90)^{g_{m_{90}}+1} > z$

We now present the analysis as follows:

<table>
<tr><th colspan="3">Divisibility by 3</th></tr>
<tr><th>a_0</th><th>z is divisible by 3</th><th>z is not divisible by 3</th></tr>
<tr><td>1</td><td>$a_0 + z$ is not divisible by 3</td><td>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)</td></tr>
</table>

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.

Moral

Fulfillment of Righteous Promise Is The Highest Virtue.

References

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Acknowledgements

The author would like to express his deepest gratitude to all the members of his loving family, respectable teachers, en-dear-able friends, inspiring Social Figures, highly esteemed Professors, reverence deserving Deities that have deeply contributed in the formation of the necessary scientific temperament and the social and personal outlook of the author that has resulted in the conception, preparation and authoring of this research manuscript document.

Tribute

The author pays his sincere tribute to all those dedicated and sincere folk of academia, industry and elsewhere who have sacrificed a lot of their structured leisure time and have painstakingly authored treatises on Science, Engineering, Mathematics, Art and Philosophy covering all the developments from time immemorial until then, in their supreme works. It is standing on such treasure of foundation of knowledge, aided with an iota of personal god-gifted creativity that the *author bases his foray of wild excursions into the understanding of natural phenomenon and forms new premises and scientifically surmises plausible laws. The author strongly reiterates his sense of gratitude and infinite indebtedness to all such '**Philosophical Statesmen**' that are evergreen personal librarians of Science, Art, Mathematics and Philosophy.*

Dedication

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