HG- Primes

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Abstract: *In this article I am going to introduce a prime number with a peculiar property.*

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I. INTRODUCTION

A **HG-Prime** is a prime which satisfies the following conditions

1. Sum of its digits is a prime
2. Product of its digits is a prime
3. Every permutation of digits is also primes

For example: 113 is HG-prime because

1. Sum of its digits 1 + 1 + 3 = 5 is prime
2. Product of its digits 1 x 1 x 3 = 3 is prime
3. And every permutation of digits 113, 131, 311 is also prime.

So **113** is **HG prime**.

[Of course 311, 131 are also HG primes but as they are the arrangements of digits of 113 only, we need not consider as the separate HG-Primes]

There is no another such prime up to 10^{42}.
[As on 18th Sept 2016]

On the careful observation I made following conclusions on HG-Primes.

1. HG-Prime doesn't contain any even digit in any place of it.
2. HG- Prime doesn't contain the digit 5, as 5 in unit place is not a prime.
3. HG-Prime doesn't contain the digit 9 as the product of digits contains 3 as a factor.
4. HG-Prime should contain only one either 3 or 7 grouped with even number of 1's.

i.e. A **HG-Prime** is of the form

$\underbrace{11\ldots\ldots\ldots\ldots}_{(2n)\ 1's}113$ or $11\underbrace{\ldots\ldots\ldots\ldots}_{(2n)\ 1's}117$

Where 2n+3 and 2n+7 should be primes. And every permutation of digits above should be a prime.

Testing Conditions of HG-Primes:

To check the given prime whether **HG-Prime** or not.

Preliminary test for HG - Primes:

1. It should be in any of the above mentioned form.
2. In first form $10^{(2n+1)} + 17$ should contain a factor other than 9.
3. In second form $10^{(2n+1)} + 53$ should contain a factor other than 9.

Main test for HG-Primes:

If any prime clear the above tests, then it has to pass (2n+1) steps of primality test for it's (2n+1) arrangements of digits.

Conclusion Remarks:

Probably there won't another such prime. This would be a new challenge to everyone to search for such primes.

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