

# Re: n-ary representation and divisibility

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  - *Date:* Mon, 30 May 2005 15:43:21 GMT
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On 30 May 2005 06:44:52 -0700, "krill" <[krillqill@xxxxxxxxxxxx](mailto:krillqill@xxxxxxxxxxxx)> wrote:

>  
>Recently I have an observation about algorithms on divisibility of  
>integers by prime numbers. People have developed many of these, e.g.  
>  
>(1)For p=3: add up all digits and see if the sum divides by 3.  
>  
>(2)(...)  
>(3)(...)  
>  
>But we perform all these algorithms mostly under decimal representation  
>of the integer. What about for different n-ary representation?  
>  
>I find that: For integer a and fixed prime p, if we write a into m-ary  
>representation, where m and 10 are congruent mod p, then the same  
>algorithm that works under decimal representation, could still applies  
>for m-ary representation of a. I've checked tens of numbers and the  
>first several primes, and the conclusion goes true, but i dont know how  
>to prove it or disprove it.  
>  
>Could anyone help me?  
>  
As you present it, the proof will have to be made separately for each  
rule, but you should be able to imitate from the simplest case (above)

The reason why a number in decimal form is divisible by 3 iff the sum  
of its digits is divisible by 3 is that: 10 is congruent to 1 mod 3,  
therefore all powers of 10 are congruent to 1 mod 3, therefore  
replacing  $a_i * 10^i$  in a decimal number " $a_n \dots a_i \dots a_2 a_1 a_0$ "  
i.e.  $a_0 + a_1 * 10 + a_2 * 10^2 + \dots + a_i * 10^i + \dots + a_n * 10^n$   
by  $a_i$  (in this sum) will not change (the class of) the number mod. 3

The same rule will be valid for any number base m congruent to 1 mod 3  
which is the same as congruent to 10 mod 3.

(The primality of p=3 is not essential. The same is done with p'=9.)

You can get more such results in bases different from 10 if you find

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out the reason of such a rule and generalize the reasoning, e.g.

A hexadecimal number (base 16) is divisible by 5 iff the sum of its digits is divisible by 5 (because 16 is congruent mod 5 to 1)

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- **References:**

- ◆ ***n-ary representation and divisibility***

- ◆ *From:* krill

- Prev by Date: ***Re: analytic continuation of prime number function***

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