

Test for divisibility by 7

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Abstract- Normally, it becomes hard to check whether a large number is **divisible by 7** ex. 757,344. It takes a lot of time to perform actual division and checking the result. A divisibility rule called **6-9 method** is designed to verify whether a given number is divisible by 7. This method examines the digits in a number and checks whether it is divisible by 7 without performing actual division operation.

Index Terms-

- (a) Black numbers
- (b) Division
- (c) Divisibility
- (d) Extensions of 6-9 method
- (e) Irreducible numbers
- (f) Integer
- (g) Pohlman-Mass method for divisibility by 7
- (h) Unit digit



INTRODUCTION

6-9 method is a divisibility rule that checks whether a given number is divisible by 7 or not without performing actual division. The number $N \in \{n: n \text{ is an integer}\}$.

A number N can be tested by following these steps as given below:-

- 1) The unit digit of the number was made 9 times.
- 2) Rest of the digits of that given number was made 6 times.
- 3) 9 times the unit digit of that given number was added to 6 times the rest of the digits.
- 4) The sum obtained was checked if it is a multiple of 7. If it is a multiple of 7 then the original number is divisible by 7. If not, then the number is not divisible by 7.
- 5) Step 4 can be repeated as many number of times until you get a small number (sum obtained) to verify.

EXISTING TECHNIQUES-

Pohlman-mass method:

In this technique for checking the divisibility of number by 7 certain steps are followed like, the unit digit of a number is twiced and subtracted from the rest digits. The difference calculated is checked whether it is a multiple of 7 or not. If multiple then original number is divisible by 7 else not.

PROCEDURE

Method description and verification

6-9 method can be verified by taking some examples and how it is satisfied.

Example -1

91 can be verified that it is divisible by 7 as given below:-

$$1*9+9*6$$

$$=54+9$$

$$=63$$

63 is a multiple of 7, hence it is verified that 91 is divisible by 7.

Example-2

448 can be verified that it is divisible by 7 as given below:-

$$8*9+44*6$$

$$=72+264$$

$$=336$$

Applying step 5 we proceed for 336 like

$$6 \cdot 9 + 33 \cdot 6$$

$$= 54 + 198$$

$$= 252$$

Applying step 5 we proceed for 252 like

$$2 \cdot 9 + 25 \cdot 6$$

$$= 18 + 150$$

$$= 168$$

Proceeding 168 we get

$$8 \cdot 9 + 16 \cdot 6$$

$$= 72 + 96$$

$$= 168$$

168 is a multiple of 7, hence 448 is a divisible by 7.

Example-3

4879 can be verified that it is divisible by 7 as given below:-

$$487 \cdot 6 + 9 \cdot 9$$

$$= 3003$$

Applying step 5 to 3003 we get

$$300 \cdot 6 + 3 \cdot 9$$

$$= 1800 + 27$$

$$= 1827$$

Applying step 5 to 1827 we get

$$182 \cdot 6 + 7 \cdot 9$$

$$= 1155$$

Applying step 5 to 1155 we get

$$115 \cdot 6 + 5 \cdot 9$$

$$= 735$$

Applying step 5 to 735 we get

$$73 \cdot 6 + 5 \cdot 9$$

$$= 483$$

Applying step 5 to 483 we get

$$48 \cdot 6 + 3 \cdot 9$$

$$= 315$$

Applying step 5 to 315 we get

$$31 \cdot 6 + 5 \cdot 9$$

$$= 186 + 45$$

$$= 231$$

Applying step 5 to 231 we get

$$23 \cdot 6 + 1 \cdot 9$$

$$= 139 + 9$$

$$= 147$$

Applying step 5 to 147 we get

$$14 \cdot 6 + 7 \cdot 9$$

$$= 147$$

147 is a multiple of 7, hence 4879 is divisible by 7.

Example-4

121 can be verified that it is not divisible by 7 as given below:-

$$12 \cdot 6 + 1 \cdot 9$$

$$= 72 + 9$$

$$= 81$$

Applying step 5 to 81 we get

$$8 \cdot 6 + 1 \cdot 9$$

$$= 48 + 9$$

$$= 57$$

57 is not a multiple of 7, hence 121 is not divisible by 7.

RESULT

Extensions of 6-9 method:

It was experimented by 6-9 method that there are certain numbers those are divisible by 7 but are not reducible to smaller numbers.

Example

189 can be verified like

$$9 \times 9 + 18 \times 6$$

$$= 189$$

105 can be verified like

$$9 \times 5 + 10 \times 6$$

$$= 105$$

After applying 6-9 method to such numbers it was found that these numbers remains constant and are irreducible. Such numbers those are not reducible by 6-9 method to smaller numbers are called **black numbers**.

Only specific numbers like **7,21,42,63,84,105,126,147,168,189** are black numbers. These are irreducible after applying 6-9 method. These numbers can be used as multiples of 7 to verify whether a given number is divisible by 7 or not.

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CONCLUSION

This 6-9 method can be used for all integer numbers to test for divisibility by 7.

REFERENCES

(a) **Pohlman–Mass method** of divisibility by 7

(b) Web reference:

http://en.wikipedia.org/wiki/Divisibility_rule

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