The relation of primitive root and cyclic deciminal

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July 22, 2016

Abstract

We prove Artin's conjecture.This paper consists 2 example and prove the conjecture.

1

We begin

$$\frac{1}{7} = 0.14285714857\cdots$$

$10 = 3 + 7$ is devided by 7 as 1 and the rest is 3.30 is devided by 7 as 4 and the rest is 2.20 is devided by 7 as 2 and the rest is 6. This is correspond to $3 \to 2 \to 6$.So,that 3 is the primitive root of 7 equals to recurring decimal of $\frac{1}{7}$.General case is not so easy

$17 + 7 = 24$ case,we calculate 24 numeration. 24 is devided by 17 as 1 and the rest is $7.7 \times 24 = 168.168$ is devided by 7 as 9 and the rest is 15.

$$7 \to 15 \to 3 \to 4 \to 11 \to 9 \to 12 \to 16 \to 10 \to 2 \to 14 \to 13 \to 6$$

$$\to 8 \to 5 \to 1 \cdots$$

In this case,7 is primitive root of 17.So recurring decimal in 24 numeration is repeat 16.

conjecture
p is prime and more than 5.10 is primitive root of p is equal to $\frac{1}{p}$'s repeating decimal length is $p-1$

proof. We see next case.

$$\frac{1}{17} = 0.0588235294117647\cdots$$

$p = 17$ case,10 is the primitive root. First,$10 - 17 = -7$.Usually,in this case degit is increase 1. $100/17 = 5$ and the rest is $15 \equiv (-7)^2 = 49 (mod\ 17)$。 $150/17 = 8$ and the rest $14 \equiv (-7)^3 = -343 (mod\ 17)$ We got the $p - 1 = 16$ cycle.

□