

There exist a solution iff $\gcd(10, k) = 1$.

1. brute force. by pigeonhole principle, the length is $O(k)$.

2. this is a linear iterative equation, we can use baby-step-giant-step. $O(\sqrt{k})$.

3. see [Project Euler #129: Repunit divisibility](#). Assume $n = 111 \dots 1 = \frac{10^x - 1}{9}$, we want to find the minimum x s.t. $10^x \equiv 1 \pmod{9k}$. By Euler's formula, x is a factor of $\varphi(9k)$. Reduce to integer factorization.

References