原问题

"problem": "When $1 + 7 + 7^2 + \cdots + 7^{2004}$ is divided by 1000, a remainder of N is obtained. Determine the value of N.\n", "level": "Level 5", "type": "Number Theory", "solution": "By the geometric series formula, $1 + 7 + 7^2 + \cdots + 7^{2004} = \frac{7^{2005}-1}{7-1} = \frac{7^{2005}-1}{6}$. Since $\varphi(1000) = 400$, by Fermat-Euler's Theorem, this is equivalent to finding $\frac{7^{400 \cdot 5 + 5} - 1}{6} \equiv \frac{7^5 - 1}{6} \equiv \boxed{801} \pmod{1000}$."

extract knowledge version2

["Geometric Series Formula", "Summation of a Geometric Series", "Exponentiation", "Simplification", "Modular Arithmetic", "Euler's Totient Function", "Fermat-Euler's Theorem", "Modular Exponentiation", "Reduction of Exponents Modulo Euler's Totient Function Value", "Calculation of Modulo"]

iter1

try 1

evolve knowledge method 1 version 2

["Geometric Series Formula", "Summation of an Infinite Geometric Series", "Exponentiation", "Simplification", "Modular Arithmetic", "Euler's Totient Function", "Fermat-Euler's Theorem", "Modular Exponentiation", "Reduction of Exponents Modulo Euler's Totient Function Value", "Calculation of Modulo"]

- try 有点失败

["Geometric Series Formula", "Summation of a Geometric Series", "Exponentiation", "Simplification", "Modular Arithmetic", "Euler's Totient Function", "Fermat-Euler's Theorem", "Modular Exponentiation", "Application of Lagrange's Theorem in Modular Arithmetic", "Calculation of Modulo"]

- try 有点失败
- 最终测试，这个问题4o都会回答错误，但目前的设计能够让GPT-4有一定程度上接近答案。

generation version3