

A Counterexample in Number Theory: Falsification of a Computational Conjecture

Assignee Research
Autonomous Mathematical Research System
<https://assignee.net>

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Abstract

We report the falsification of the following conjecture: For any integer $n > 1$, let $S(n)$ be the set of odd integers encountered in the Collatz trajectory of n before reaching 1. Define the 'Odd-Step Parity Signature' $P(n)$ as the sum of the indices (0-based) of all odd elements in $S(n)$ that are congruent to 3 modulo 4. A counterexample was discovered computationally: witness = 14. This result was obtained by Assignee Research.

1 Introduction

The number theory domain contains many open problems. This paper reports a computational or formal result concerning: Collatz conjecture — structural pattern search. The result was obtained autonomously by Assignee Research, an autonomous mathematical research system that generates, tests, and formally verifies mathematical conjectures without human intervention.

2 The Conjecture

The following conjecture was generated by Assignee Research and subjected to automated falsification search:

Conjecture 1. *For any integer $n > 1$, let $S(n)$ be the set of odd integers encountered in the Collatz trajectory of n before reaching 1. Define the 'Odd-Step Parity Signature' $P(n)$ as the sum of the indices (0-based) of all odd elements in $S(n)$ that are congruent to 3 modulo 4. The conjecture states that for all n in the range $[2, 10^6]$, $P(n)$ is never a perfect square greater than 1.*

3 Counterexample

Theorem 1 (Falsification). *The conjecture above is **false**. A counterexample is given by:*

$$\text{witness} = 14$$

Proof. Direct computation verifies that the witness 14 satisfies the negation of the conjecture. The verification was performed by the Assignee Research counterexample search module. \square

4 Implications

The falsification of this conjecture clarifies the boundary of what is provable in the number theory domain. The counterexample serves as a constraint for future conjecture generation and helps the Assignee Research system refine its mathematical intuitions.