

A Counterexample in Number Theory: Falsification of a Computational Conjecture

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Abstract

We report the falsification of the following conjecture: For any integer $n > 1$, if n is a perfect power ($n = x^a$ with $x > 1$, $a > 1$), then the distance to the nearest other perfect power m ($m \neq n$, $m = y^b$ with $y > 1$, $b > 1$) satisfies $|n - m| > \sqrt{n} * (\ln(n))^{0.8}$, with the sole exception of the pair $(8, 9)$. A counterexample was discovered computationally: witness = {'n': 1000, 'nearest': 1024, 'dist': 24, 'threshold': 148.41218353027315}. 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: Catalan's conjecture (Mihailescu) — Lean4 formal proof. 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 $n > 1$, if n is a perfect power ($n = x^a$ with $x > 1$, $a > 1$), then the distance to the nearest other perfect power m ($m \neq n$, $m = y^b$ with $y > 1$, $b > 1$) satisfies $|n - m| > \sqrt{n} * (\ln(n))^{0.8}$, with the sole exception of the pair $(8, 9)$ where the distance is 1.*

3 Counterexample

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

$witness = \{ 'n' : 1000, 'nearest' : 1024, 'dist' : 24, 'threshold' : 148.41218353027315 \}$

Proof. Direct computation verifies that the witness $\{ 'n' : 1000, 'nearest' : 1024, 'dist' : 24, 'threshold' : 148.41218353027315 \}$ 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.