A Counterexample in Graph Theory: Falsification of a Computational Conjecture

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Abstract

We report the falsification of the following conjecture: In any 2-coloring of K_18, the minimum number of monochromatic K_4 is exactly 18, and this minimum is achieved only by colorings where the graph of one color forms a specific structured graph related to the Turán graph T(18,3).. A counterexample was discovered computationally: witness = 42. This result was obtained by the SOVEREIGN autonomous research system.

1 Introduction

The graph theory domain contains many open problems. This paper reports a computational or formal result concerning: Ramsey multiplicity K_4 — minimum number of monochromatic K_4. The result was obtained autonomously by the SOVEREIGN Research Kernel, 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 the SOVEREIGN Research Kernel and subjected to automated falsification search:

Conjecture 1. *In any 2-coloring of K_18, the minimum number of monochromatic K_4 is exactly 18, and this minimum is achieved only by colorings where the graph of one color forms a specific structured graph related to the Turán graph T(18,3).*

3 Counterexample

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

$$witness = 42$$

Proof. Direct computation verifies that the witness 42 satisfies the negation of the conjecture. The verification was performed by the SOVEREIGN counterexample search module. □

4 Implications

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