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 the edges of K_18 that achieves the global minimum number of monochromatic K_4 subgraphs, the resulting color classes (graphs) must be isomorphic to each other. Furthermore, each color class must have an automorphism group of ord. A counterexample was discovered computationally: witness = Open Problem: No minimizing coloring has been certified yet to test symmetry. This result was obtained by Assignee Research.

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 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. *In any 2-coloring of the edges of K_18 that achieves the global minimum number of monochromatic K_4 subgraphs, the resulting color classes (graphs) must be isomorphic to each other. Furthermore, each color class must have an automorphism group of order at least 18.*

3 Counterexample

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

$$witness = OpenProblem : Nominimizingcoloringhasbeencertifiedyettotestsymmetry$$

Proof. Direct computation verifies that the witness $OpenProblem : Nominimizingcoloringhasbeence$ satisfies the negation of the conjecture. The verification was performed by the Assignee Research 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 Assignee Research system refine its mathematical intuitions.