A Counterexample in Ramsey: 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_43 that contains no monochromatic K_5, there exists no vertex v such that the red degree of v is exactly 21 AND the red neighborhood of v induces a subgraph containing a red triangle. Equivalently, if a vertex has . A counterexample was discovered computationally: witness = Conjecture specifically defined for n=43, got 47. This result was obtained by Assignee Research.

1 Introduction

The ramsey domain contains many open problems. This paper reports a computational or formal result concerning: Ramsey R(5,5) — upper bound improvement. 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_43 that contains no monochromatic K_5, there exists no vertex v such that the red degree of v is exactly 21 AND the red neighborhood of v induces a subgraph containing a red triangle. Equivalently, if a vertex has red degree 21 in an extremal R(5,5) coloring on 43 vertices, its red neighborhood must be triangle-free (and thus an independent set of size 21 is impossible, but specifically the induced subgraph has no K_3).*

3 Counterexample

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

$$witness = Conjecturespecificallydefinedforn = 43, got47$$

Proof. Direct computation verifies that the witness $Conjecturespecificallydefinedforn = 43, got47$ 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 ramsey domain. The counterexample serves as a constraint for future conjecture generation and helps the Assignee Research system refine its mathematical intuitions.