Rubik's Cube Solvability Classes

Tulba-Lecu Theodor-Gabriel
Dragomir Ioan
email: [REDACTED]
Institute: [REDACTED]

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Abstract

blah blah cube blah blah maths blah blah stupid.

Contents

1 Introduction

1.1 History

1.2 Notation

blah blah F F' and so on

1.3 Motivation

The motivation for this research came when the we were playing around with a Rubik's Cube. At some point, one edge piece flew away, and we put it back in the wrong orientation. Nevertheless we continued to solve the cube and observed that it was impossible to solve the cube.

We then asked ourselves the following question: *If we define a transition from one cube state to another, using only valid moves, an equivalence realtion, how many equivalence classes are there?*
We quickly amde some assumptions and worte some code to bruteforce all the states *add refference here*. We saw quite fast that the answer was 12, a result which corresponded both with our intuition and with other results *add refferences*. But where did this number come from? how does the answer change if we change the size of the cube?

The purpose of this paper is to answer those questions.

2 Solving the 3x3x3 Rubik's

blah blah summary of the aproach

2.1 Reduction to last-layer

blah blah proof by contradiction and deterministic solution

2.2 Searchspace bruteforce result

blah blah only code here

2.3 Giving an answer

2.3.1 Corner orientation

3

2.3.2 Edge orientation

2

2.3.3 Edge position

2

2.3.4 Final independence

3*2*2=12

3 Solving 4x4x4

blah blah analyse differences from 3x3x3

3.1 Generalizing theorems

easy to say, hard to do

3.2 Solving the symmetry problem

blah blah parity blah blah symmetric slices from the center

3.3 Solve the geometric invariant

blah blah probably said something dumb here

3.4 Results for 4x4x4

Hmmm...

4 Solving NxNxN

blah blah why not take it further

4.1 Prove independece of non-symmetric layers

probably true

4.2 Reduce to 3x3x3 and 4x4x4 cases

not to hard, maybe induction

4.3 Flex with vector spaces to calculate the answer

lol, mathy boiiiis

5 Generalizing to cuboids

blah blah even crazier idea

6 Solve the problem for other platonic solids

lol what is this even.