Northeastern University researchers solve Rubik's Cube in 26 moves

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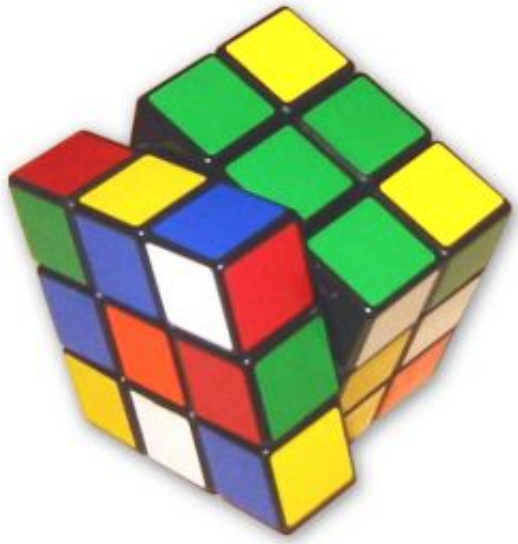

It’s a toy that most kids have played with at one time or another, but the findings of Northeastern University Computer Science professor Gene Cooperman and graduate student Dan Kunkle are not child’s play. The two have proven that 26 moves suffice to solve any configuration of a Rubik's cube – a new record. Historically the best that had been proved was 27 moves.

Why the fascination with the popular puzzle? “The Rubik's cube is a

testing ground for problems of search and enumeration," says Cooperman. "Search and enumeration is a large research area encompassing many researchers working in different disciplines – from artificial intelligence to operations. The Rubik's cube allows researchers from different disciplines to compare their methods on a single, well-known problem."

Cooperman and Kunkle were able to accomplish this new record through two primary techniques: They used 7 terabytes of distributed disk as an extension to RAM, in order to hold some large tables and developed a new, "faster faster" way of computing moves, and even whole groups of moves, by using mathematical group theory.

Cooperman and Kunkle put all of the configurations of a Rubik's cube in a family of sets of configurations (called a family of cosets in mathematical group theory). They then looked at the result of applying a single move to all of the configurations of a coset at once. They simulated this on a computer at a rate of 100,000,000 times per second, using a new technique in mathematical group theory.

In May 1997, U.C.L.A. computer science Professor Richard Korf announced that he had found the first optimal solutions to Rubik's Cube. His research showed that the median optimal solution was 18 moves, and he believed any cube could be solved in no more than 20 moves. However, he was unable to prove this, and no one has ever been able to prove that it could be solved in less than 27 moves.

"Korf had written a program that spends a long time to find optimal solutions for single states of the Rubik's cube," says Kunkle. "Our program first does a large pre-computation and then it very quickly - in about a second - finds a solution in 26 moves or less for any state of Rubik's cube.

Cooperman and Kunkle used computers at Teragrid (teragrid.org) and at Northeastern, part of the first node from a $200,000 grant Cooperman and colleagues received from the National Science Foundation in 2006 to obtain 20 terabytes of storage.

Rubik's Cube, invented in the late 1970s by Erno Rubik of Hungary, is perhaps the most famous combinatorial puzzle of its time. Its packaging boasts billions of combinations, which is actually an understatement. In fact, there are more than 43 quintillion (4.3252 x 10**19) different states that can be reached from any given configuration.

Source: Northeastern University