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NOTES ON

RUBIK'S MAGIC CUBE

by

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B
U
R
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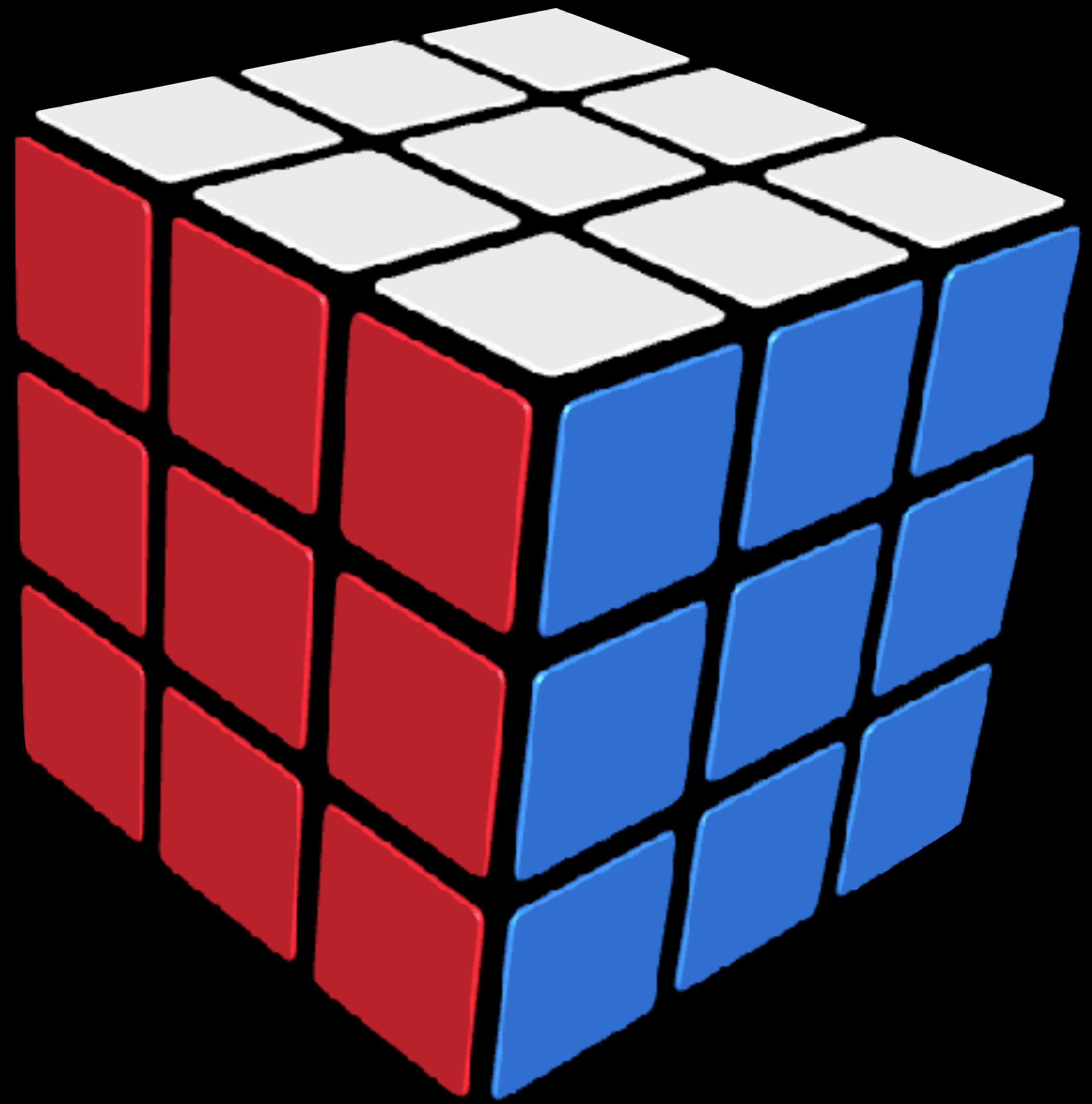
F
D

$UR^2DL'F$

+

=



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Group theory

From Wikipedia, the free encyclopedia

This article covers advanced notions. For basic topics, see Group (mathematics).
For group theory in social sciences, see social group.

In mathematics and abstract algebra, **group theory** studies the algebraic structures known as groups. The concept of a group is central to abstract algebra: other well-known algebraic structures, such as rings, fields, and vector spaces, can all be seen as groups endowed with additional operations and axioms. Groups recur throughout mathematics, and the methods of group theory have influenced many parts of algebra. Linear algebraic groups and Lie groups are two branches of group theory that have experienced advances and have become subject areas in their own right.

The popular puzzle Rubik's cube invented in 1974 by Ernő Rubik has been used as an illustration of permutation groups.

Various physical systems, such as crystals and the hydrogen atom, may be modelled by symmetry groups. Thus group theory and the closely related representation theory have many important applications in physics, chemistry, and materials science. Group theory is also central to public key cryptography.

Algebraic structure → Group theory

43,252,003,274,
489,856,000

7. FURTHER PROBLEMS.

A. The Supergroup.

Consider the centres of the faces. Though these never move, they are turned. The total turn of R in a process (measured in units of quarter turns or 90°) is just the sum of the exponents of R throughout the process. This sum must be considered (mod 4) since 4 turns is the same as none. E.g. for $P_1 = (F^2R^2)^3$, R has turned 6 units, which is the same as 2 units.

How does considering the centre turns affect the group? One can consider replacing the colour patterns on faces at START by some pictures so that the centre squares must also be restored to their correct orientations for correct pictures.

B. The Three Generator Groups.

What are the subgroups generated by three of the basic moves? There are two types, e.g. <F, U, R> and <F, U, B>. In both cases, some pieces are never moved. What if we take the squares of three basic moves?

C. The Four Generator Groups.

There are again two types, e.g. <F, U, R, D> and <F, L, B, R>. The first never moves LB. The second can never flip two edge pieces. Hence neither is the whole group. What if we take the squares of these basic moves?

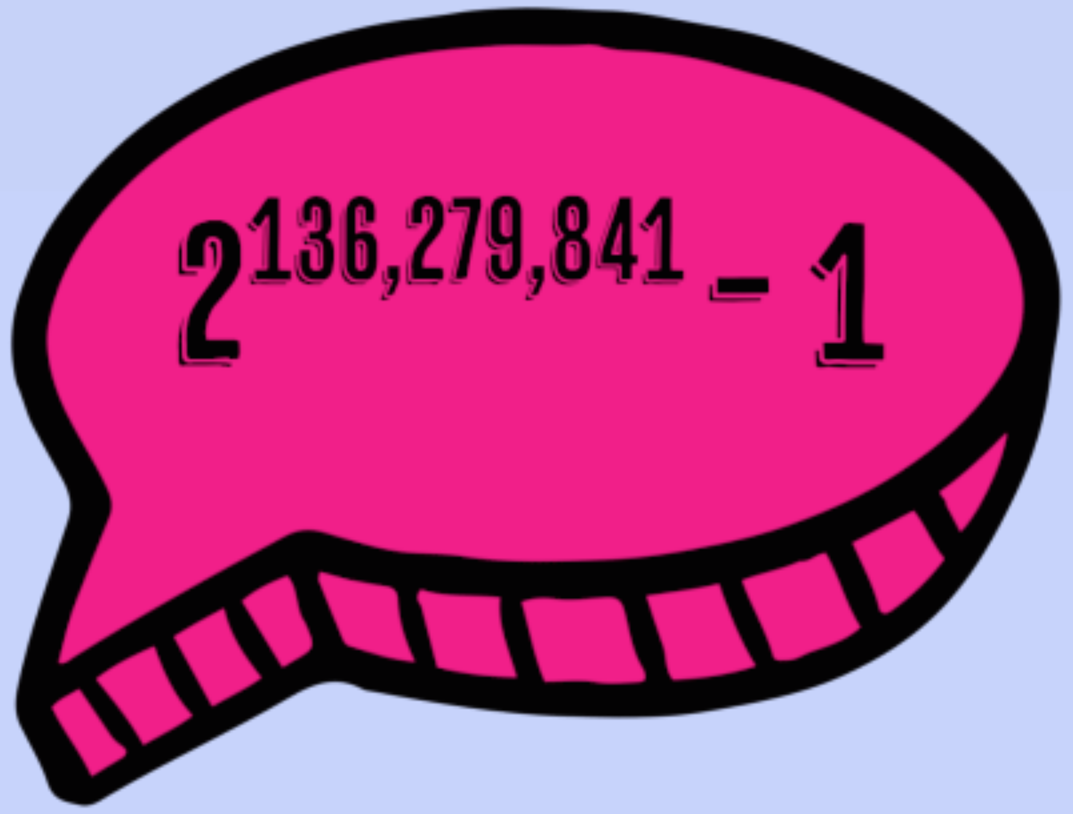
D. The Five Generator Group.

R. Penrose has shown that one generator can be ignored and we still get the whole group. I have been told that he has a 28 move process to produce the effect of one turn, using only the 5 other turns.

E. The Square Group.

$$RLF^2B^2R'L'URLF^2B^2R'L'$$
$$= D$$

CAN HUMANS SAY THE LARGEST PRIME NUMBER BEFORE WE FIND THE NEXT ONE?



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