proceedings

Abstract

Obvious and Hidden Symmetries of Mathematical Objects †

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† Presented at Symmetry 2017—The First International Conference on Symmetry, Barcelona, Spain, 16–18 October 2017.

Published: 9 January 2018

Abstract: One of the core concepts essential to understanding natural phenomena and the dynamics of social systems is the concept of "relation". Social and interconnection networks, traffic systems, chemical structures, etc. can be expressed as relational structures. Furthermore, scientists rely on relational structures with high levels of symmetry because of their optimal behavior and high performance. A mathematical model capturing the essence of this situation is a graph exhibiting a high level of symmetry. The underlying mathematical discipline is algebraic graph theory involving a wide range of methods from combinatorics, algebra, algorithms, geometry, topology, etc. While some symmetries are obvious, certain additional symmetries remain hidden or difficult to grasp. Knowing the full (or as near as possible) set of symmetries of an object is important because it provides the most complete description of that object's structure. This brings us to the crucial question: given a graph or more general a discrete mathematical object, are there any symmetries beyond the obvious ones, and, if yes, how can one determine the full set? In this talk I will present some recent developments with regards to this question together with some applications within mathematics as well as other scientific disciplines.