When Theoretical Results and Computer Power Join Forces*

Primož Šparl*

Pedagoška fakulteta, Univerza v Ljubljani, Slovenia

Abstract

In graph theory we are often interested in a given property (such as being distance-regular or vertex-transitive) and we want to classify all members of a certain class of graphs that have this property. Usually, the class of graphs under consideration is infinite, and so one cannot simply use a computer to run through all the examples and test for the given property. Instead, one usually first studies "small" examples in the class, makes conjectures and then tries to prove them. One of the first problems that can occur while trying to follow this strategy is that the number of "small" members of the class that a computer can handle brute force is too small to allow for good conjectures. In such cases one tries to obtain theoretical results that either considerably reduce the search space within the class of studied graphs or makes the search over members of the class considerably faster. The next problem we often encounter is that one either finds no "small" examples and then conjectures that there are no other examples in the studied class, or finds that (at least for small orders) all examples seem to be of a "certain kind". How do we then prove that this is indeed the case?

In this talk we will consider at least two examples of such situations. In the first one we will see that brute force search is so hopeless that there is no way one can make any reasonable conjectures. We will then show a nice theoretical argument that drastically reduces the search space in a very efficient way. In the second example we will see that a brute force computer search seems to indicate that there are no examples with the studied property within the given class of graphs. We will then indicate how to combine the forces of a computer search and known theoretical results to show that this is indeed the case.

ITAT'23: Information technologies – Applications and Theory, September 22–26, 2023, Tatranské Matliare, Slovakia

*Corresponding author.