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Two applications of variable neighborhood search in data mining

Many problems can be expressed as global or combinatorial optimization problems, however due the vast increase in the availability of data bases, realistically sized instances cannot be solved in reasonable time. Therefore, one must be often content with approximate solutions obtained by heuristics. These heuristics can be studied systematically by some general frameworks or metaheuristics (genetic search, tabu search, simulated annealing, neuron networks, ant colonies and others). Variable Neighborhood Search (VNS) proceeds by systematic change of neighborhood in the descent phase towards a local minimum and in a perturbation phase to get out of the corresponding valley. VNS heuristics have been developed for many classical problems such as TSP, quadratic assignment, p-median, and others. Instances of the latter problem with 89600 entities in the Euclidean plane have been solved with an ex-post error not larger than 3%. In the last two decades, several discovery systems for graph theory have been proposed (Cvetkovic's Graph; Fajtlowicz's Graffiti; Caporossi and Hansen's AutoGraphiX (AGX)). AGX uses VNS to find systematically extremal graphs for many conjectures judged to be of interest. Aouchiche systematically studied relations between 20 graph invariants taken by pairs, considering the four basic operations (-, +, /, x). Conjectures were found in about 700 out of 1520 cases. A majority of these 1520 cases were easy and solved automatically by AGX. Examination of the extremal graphs found suggests open conjectures to be solved by graph theoretical means. This led to several tens of papers by various authors mainly from Serbia and from China.

Biography

Pierre Hansen is a Professor of Operations Research in the Department of Decision Sciences of HEC Montréal. His research is focused on "Combinatorial optimization, metaheuristics and graph theory". With Nenad Mladenovic, he has developed the Variable Neighborhood Search metaheuristic, a general framework for building heuristics for a variety of combinatorial optimization and graph theory problems. He has received EURO Gold Medal in 1986 as well as other prizes. He is a member of Royal Society of Canada and author or co-author of 400 scientific papers. His first paper on VNS was cited almost 3000 times.

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