Algorithms for Finding a Minimum Dominating Set

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A *dominating set* for a graph G is a subset S of the vertices of G with the property that every vertex v is either in S or has at least one neighbour that is in S. A search for "dominating set" on Mathscinet yields 3,528 hits. But unlike several other computationally difficult problems such as clique, coloring, satisfiability, or the travelling salesman problem, there has not been a lot of work done developing and analysing practical algorithms for finding minimum dominating sets for graphs. Practical algorithms can help both in solving real world problems and also can inspire progress on open research questions. The ultimate goal of this talk is to inspire the audience to collaborate in the collection of benchmark instances and algorithms for the Dominating Set problem.

The vertices of a dimension k *Queen graph* correspond to cells of a k by k chess board. Two vertices are adjacent if they lie on a common row, column, or diagonal of the chess board. The talk explains how a Java Queen game program we developed inspired a new dominating set algorithm that was fast enough to determine the answer for the three smallest open cases for Queen graphs. In 2008, Slater and Sinko introduced the problem of finding minumum dominating sets for Queen graphs that use only cells on the border. With a small modification, the same algorithm gave new computational results for the border queen problem and revealed patterns that inspired new constructions for small border dominating sets.

This talk is joint work with William Bird. The work on algorithms has involved numerous students in my recent classes. The talk is dedicated to the memory of Peter Slater who was always very interested in dominating sets.

Keywords: Dominating sets, algorithms for the dominating set problem, Queen graphs.