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TITLE: Algorithms for Bohemian Matrices

ABSTRACT: A "Bohemian" matrix family is a set of matrices with elements drawn from the same population---typically a fixed discrete set, usually integers, and often just the numbers $\{-1, 0, 1\}$. The mnemonic comes from BOunded HEight Matrix of Integers (BOHEMI). These objects are studied in many places, but not until recently under that name: they occur in graph theory (of course), compressive sensing, optimization, mathematical biology, and many more areas. My own original interest was sparked (at EACA 2004 in Santander) by simple software testing, and indeed by using these we have uncovered bugs in several major software packages. But there are some interesting open mathematical questions that have arisen when considering Bohemian matrices as objects of study in their own right, including combinatorial conjectures now listed in the Online Encyclopedia of Integer Sequences (oeis.org). In this talk I will discuss some algorithmic changes that arise on contemplating "brute force" attacks on Bohemian Eigenvalue problems: the typical numerical algorithms that are so valuable for computing eigenvalues of a few large matrices become noticeably less attractive when the problem is instead to compute or count distinct eigenvalues of very many (indeed exascale many) small matrices. This leads to the Characteristic Polynomial Database and its uses.

This is joint work with Steven E. Thornton and the other members of the Bohemian Eigenvalue Project, including Eunice Y. S. Chan, Laureano Gonzalez-Vega, J. Rafael Sendra, and Juana Sendra.