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1. Computing invariants of matrices

Invariants of matrices with entries in various rings — especially the ring of integers — play a central role in many parts of mathematics.

The basic problem is to reduce matrices to equivalent standard or canonical forms from which the invariants can be obtained easily. The origins of this go back to work of Gauss, HJS Smith, Hermite and W. Jordan. Much more recent work is concerned with studying both practical and theoretical issues related to algorithms for these reductions.

A search of MathSciNet will show the nature and extent of recent work.

What is needed is a good survey of this work.

2. Extracting information from finite presentations for groups and other algebraic structures.

Groups and other algebraic structures, such as associative and Lie algebras, arise in many parts of mathematics and related disciplines. One of the most common forms in which they arise is via an abstract description using generators and relations. A central problem is to extract information about the algebraic structure from such a description. This is part art and part science. A significant feature in recent years has been the use of computers.

The aim of the project would be to come to grips with the process and possibly extend what can be automated.