

Renovating the Mathematics Curriculum: Exemplary Galois Theory / Final Report

John R. Swallow / Department of Mathematics / Davidson College / joswallow@davidson.edu

Outcome

The ACS-funded portion of the *Exploratory Galois Theory* project, to finish the development of the package `AlgFields`, is complete. `AlgFields` is a user-friendly set of functions implementing basic algorithms for Galois-theoretic computation within number fields. Designed for both of the standard symbolic computation systems [Mathematica](#) (Wolfram Research) and [Maple](#) (Waterloo Maple Software), the package is now available for use by ACS instructors and students. On-line materials include instructions for package installation, downloadable package files, descriptions of each function in the package, as well as sample output from each symbolic computation system. These electronic materials, together with a draft of the associated textbook (*Exploratory Galois Theory*), have been circulated to evaluators for feedback and ongoing assessment, and I am receiving comments and suggestions during the spring of 2003. I anticipate that, with the textbook reaching a publisher, the *Exploratory Galois Theory* project will be complete during 2003, and at that point the text and software materials will become nationally available.

Access for ACS Faculty

As of January 2003, `AlgFields` is in beta version. The package is free for educational use, and ACS faculty and students may download the latest version from the website

<http://www.davidson.edu/math/swallow/AlgFieldsWeb/index.htm> .

ACS faculty and students interested in a copy of the most recent draft of the *Exploratory Galois Theory* text are encouraged to contact me at the email address above.

Pedagogical Use and Instruction

While `AlgFields` was developed in conjunction within a larger book project, the package may nevertheless be used without that text, either to support an extended computational project within a more traditional course in Galois theory, or to provide a computational means of discovery for a student pursuing an independent study or reading course.

I am considering developing a mini-course for instructors on teaching Galois theory to undergraduates and, in particular, on using these materials. Such a mini-course might be presented at either regional or national meetings or at ACS institutions themselves. ACS

faculty interested in attending or hosting such a mini-course are encouraged to contact me.

Technical Details of Improvements

During the summer, the content of some of the AlgFields functions was revamped and the naming conventions were improved. All functions were translated from *Mathematica* to *Maple*. A number of technical issues concerning the differences between *Mathematica* and *Maple* were resolved, and sample output of both software system for each function was compared to ensure correctness and consistency. A website was created, and the package and sample output, together with recently written documentation, were posted to this website. The exposition in the *Exploratory Galois Theory* text related to these technology materials was modified to reflect changes in the package.

I also evaluated [webMathematica](#), a package from Wolfram Research providing tools for implementing *Mathematica* functions using a web interface, for use in the project. After some conversations with Wolfram Research, I determined that the restrictions placed on the use of non-commercial installations of *webMathematica* preclude making the functionality of AlgFields available to institutions that have not already purchased *Mathematica*. As a result, I did not pursue a *webMathematica* version of AlgFields.