Calculus and Abstract Algebra with Sage

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MTH 412. Introduction to Algebraic Systems

- *Course Description—Introduction to the study of algebraic systems with particular emphasis on concrete examples of the basic algebraic structures, groups, rings, integral domains, and fields.*
- *Prerequisites—Discrete Structures (MTH 311) and Linear Algebra (MTH 317).*
- *The Students—Junior and senior math majors, especially preservice teachers.*

MTH 412 Topics

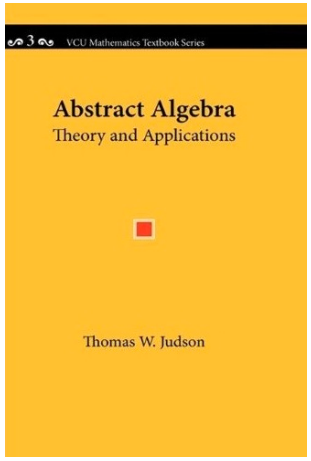
- *Sets and functions*
- *The integers*
- *Groups, including cyclic groups, permutation groups, cosets and Lagrange's Theorem, isomorphisms, normal subgroups and factor groups, and homomorphisms.*
- *Rings, including polynomial rings and integral domains.*
- *Fields, including a review of vector spaces, algebraic extensions, and the field of constructible numbers.*

The Structure of the Course

- *MTH 412 met MWF each week (50 minute class periods).*
- *One in-class exam and two take-home exams. The final exam had an in-class part as well as a take-home part.*
- *Students kept a homework notebook that was handed at the end of each week.*
- *There were eleven Sage assignments.*
- *Students were asked to present homework solutions in class.*

The Textbook

- *Abstract Algebra: Theory and Applications was published by PWS in 1994.*
- *There was no second edition, and I obtained the copyright in 1997.*
- *AATA became open-source under the GDFL in 2008 and is now available as a Sage worksheet.*



Class Meetings

- *The plan was to introduce something new about Sage each class period for at least the first month.*
- *Most classes consisted of lectures with time at the end for students to present solutions to homework problems.*

What Went Right

- *The notebooks forced students to write their solutions more carefully. They had a week to submit corrections.*
- *Having students present at the board was a good method of formative assessment.*
- *Take home exams provided an opportunity to ask more in depth questions.*
- *Graded Sage assignments was a good incentive to get students to use Sage.*

What Needs to Be Improved

- *There needs to be a better mechanism for managing Sage assignments on the Sage server.*
- *Regular one-on-one meetings with students need to be scheduled outside of class.*
- *Students need to better understand fundamental examples.*

What did the students think?

- *Sage makes everything easier. I like Sage a lot better than Mathematica.*
- *Prefer working with applications in sage more than anything else in the course. The initial quirks in sage make the learning curve rougher, but I prefer using sage.*
- *Difficult to understand*
- *Work with sage simplifies the process because for some problems it would take hours to work by hand, while sage computes instantly. Sage is great because all you need is the internet to access it.*
- *For repetitive computations or cumbersome calculations SAGE is certainly preferred. I prefer SAGE because the built in functionality along with PYTHON programmable cells make it both useful and versatile.*
- *its a little difficult for me to figure out the programming language so its just about as difficult as working out problems by hand. like sage way better than Mathematica.*

How easy was it to learn how to use Sage?

- *Moderately*
- *Once learning it's structure, relatively easy*
- *At first it was hard for me but after a while it became easy.*
- *Personally it wasn't an issue. I think people without programming experience would find certain aspects difficult however.*
- *For me it is rather difficult but not near as difficult as learning java.*

How important is it to you that Sage is free?

- *Very important*
- *Free is definitely a big plus.*
- *Doesn't matter*
- *The best things in life are free.*
- *reasonably important.*
- *Since its required for this class, pretty important.*

How do you intend to use Sage after or outside of this class?

- *Depends on what is needed.*
- *For complex calculations*
- *Cumbersome computations*
- *PYTHON programming*
- *unless my job requires me to program I may not use it anymore.*

Calculus Labs at SFA

- *Computer algebra labs have been a part of Calculus I (MTH 233), Calculus II (MTH 234), and Calculus III (MTH 333) for several years.*
- *These were originally Mathematica labs; however, we are converting all of our labs to Sage.*
- *One of the original purposes of the labs was to cover more computational topics such as the Newton-Raphson algorithm in lab as opposed to the classroom.*

What the Faculty Said

- *Server issues were better in the spring than the fall.*
- *We need to have better control over publishing and sharing so that students cannot copy from each other.*
- *Folders are essential.*
- *Documentation is not as good as Mathematica. More student friendly, especially to those who are not programmers. Basic and more advanced examples need to be identified as such.*
- *Reference that shows how to make a generic table. More generic examples.*

Contact Information

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- *Mth 412 Course page: http://faculty.sfasu.edu/judsontw/math412/index.html*