

AMAT 587 (9529)

Modern Computing for Mathematicians

William F. Hammond

Spring Semester 2009

Tues. & Thurs. 4:15–5:35 p.m. in ES 143

Contemporary mathematicians use computing in two principal ways:

- for symbolic computation
- for generating mathematical text

Symbolic computation

Most symbolic computing involves the use of specialized mathematical software.

This course in Spring 2009 will examine general purpose computer algebra systems by taking an introductory look at the proprietary program *Maple* and at the free programs *Maxima* and *SAGE*.

In addition to general purpose computer algebra systems there are systems suited to specialized areas of mathematics. The course will examine one of these, the free program *Pari* that is used for algebra and number theory.

Mathematical text

This segment of the course will begin with a quick examination of the structured typesetting language \LaTeX .

While a great many mathematicians, physicists, economists, and others whose work uses mathematics became familiar with \LaTeX during the 1980's, it became clear during the 1990's that there were severe challenges (that are still with us) for translating \LaTeX documents to modern web languages.

A mathematical author should be able to generate both paper and web forms of mathematical text from a single source. The course will explore the usefulness of authoring languages based on the World Wide Web Consortium's XML standard with attention to the metaphor for such languages provided by category theory and will discuss how such a language need not be very different from \LaTeX .

Incorporating semantics in mathematical text

In the years ahead one will want to have the ability to import mathematical text found in electronic documents such as, for example, the function definition

$$f(x) = \begin{cases} x^2 + x + 1 & \text{if } x \geq 0 \\ 1 - x & \text{otherwise} \end{cases}$$

into systems for computation. The course topics of (1) symbolic computation and (2) mathematical text are related by the need to provide content in documents that has sufficient semantic richness to make such transfer possible.

The course will undertake to compare symbolic computation system input languages with mathematical text authoring languages holding an eye toward the future development of minimal perturbations of \LaTeX that permit authors to incorporate mathematical semantics as needed.

Prerequisite

Familiarity with undergraduate mathematics and some ability with “computer code”.