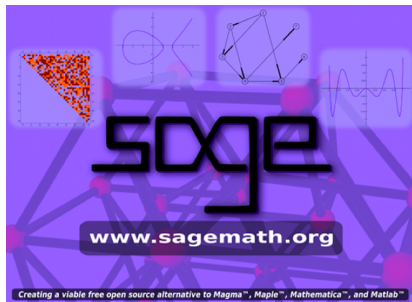


A Short Introduction to Sage

William Stein



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The Sage Project

Mission Statement

Create a viable free open source alternative to Magma, Maple, Mathematica, and Matlab

A “viable free alternative” will have...

- The *mathematical features* of Magma, Maple, Mathematica, and Matlab with *comparable speed*.
- Beautiful interactive 2d and 3d graphics.
- A notebook interface and an IDE.
- Many books.
- A web application interface.
- Be completely free and open: support by *grants*, *volunteer work*, and *fund raising* instead of user license fees.

SAGE

Software for Arithmetic Geometry Experimentation

- I needed an *open source* alternative to Magma. David Joyner (coding theorist) had similar concerns.
- SAGE in 2005 – number theory (PARI) and coding theory (GAP) – no symbolic calculus or numerical computation.

Number theory & Coding theory: started out very technical

```
sage: E = EllipticCurve('389a'); E
Elliptic Curve defined by  $y^2 + y = x^3 + x^2 - 2x$ 
sage: E.gens()
[(-1 : 1 : 1), (0 : -1 : 1)]
sage: G = matrix(GF(5), 4, 7, [1,1,1,0,0,0,0,1,0,0,1,1,...
sage: C = LinearCode(G); C
Linear code of length 7, dimension 4 over Finite Field ...
sage: C.minimum_distance()
3
```

Why not Magma/Mathematica/Matlab/Maple?

- 1 **Commercial:** Expensive for my collaborators and students (“third world discount” = 3 months salary)
- 2 **Copy protection:** all the Ma’s have it; prevents sharing.
- 3 **Closed:** Implementation of algorithms often secret
- 4 **Language:** Special purpose mathematics only language
- 5 **Developer community:** Tight central control of development
- 6 **Bugs:** No public list of all known bugs
- 7 **Compiler:** No compiler (nothing like Cython)

What is Sage?



- 1 **A self-contained distribution** of around 100 open source packages that is easy to build from source.
- 2 **Interfaces** that smoothly tie together all these libraries and packages.
- 3 **A new library** that implements novel algorithms. About a half million lines of code written by a worldwide community of several hundred people over the last 6 years.
<http://sagemath.org/development-map.html>

Sage Days

- 1 Over 30 workshops over the last few years.
- 2 Next one is at Univ of Washington next month!

`http://wiki.sagemath.org/days31`

Quick Tour of Website

<http://www.sagemath.org>

A Demo...

`http://flask.sagenb.org/home/pub/53/`

(this is running 100% on a remote webserver, not my laptop!)

Questions?

HOMEWORK: **Compute $2 + 3$ using**
`http://flask.sagemb.org`.