Can Sage Replace Maple and Mathematica?

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slides available at

`http://www.calvin.edu/~rpruim/talks/`

What is Sage?

According to `http://sagemath.org`:

> *Sage is a free open-source mathematics software system licensed under the GPL. It combines the power of many existing open-source packages into a common Python-based interface.*

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Other features:

- Web browser interface
- Kernel can be installed locally (independence), or accessed via public servers (zero set-up time)
- Integrates with LaTeX

Questions and Answers

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Q. Should Sage replace Maple and Mathematica?

A. That depends on what is important to you.

Some Evidence

We'll look at a few examples that demonstrate some of Sage's strengths:

- Ubiquity
- Conformity
- Community
- Universality

Ubiquity

Because sage is

- free, and
- available via a web browser,

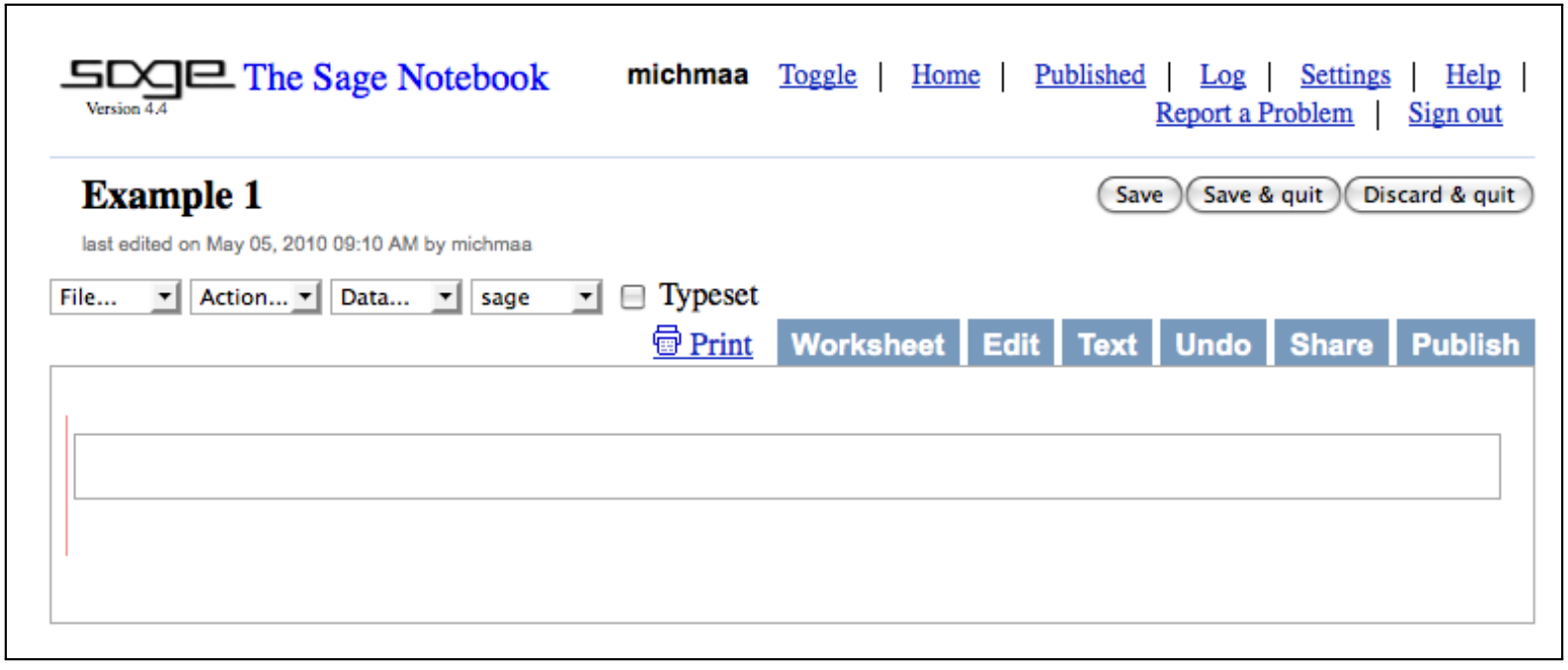
there is almost no start-up cost in using Sage.

In particular, students can use Sage any time on any machine with a web browser and internet connection.

We can set up a new account at `http://sagemath.org` in a few seconds and then get to work.

Sage Worksheets in your Browser

This simplest way to start with Sage is via the online worksheet interface at `sagemath.org`.



Can also be accessed at `http://localhost:8000/`

Conformity

Sage pulls together open source utilities from a number of different origins and brings them together into one (mostly) coherent system.

Sage is built on the python programming language.

- Sage skills transfer to Python
- Python skills transfer to Sage

Python

- comprehensive, high level programming language
- light syntax
- good for scripting, prototyping
- interpreted
- libraries of utilities for the sciences

Community

Like most open source projects, Sage is community-supported.

- Sage notebooks can be published, making them available to anyone.
- Published notebooks can be searched.
- If you have a great idea for Sage, you can submit it. If it passes quality control, the core development team will add it to the next release of Sage.
  - Calvin student Ethan VanAndel just found out that some utilities he developed will be included in the next release.
- Excellent LaTeX support.

Sage and LaTeX

The latest version of Sage includes the `sagetex.sty` style for LaTeX.

output

The sum of $1 + 2 + \sqrt{3} = \sqrt{3} + 3 = 4.7321$.

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LaTeX code

```
The sum of $1+2+\sqrt{3}
= \sage{1+2+sqrt(3)}
= \sage{round(1+2+sqrt(3),4)}$
```

Workflow

LaTeX, Sage, LaTeX

- works with `pdflatex`, custom rules exist for `latexmk`

Sage and LaTeX

Of course, Sage has many fancier things, too.

output

There are

$$625542347387943217255115334717978795312568 2826$$

integer partitions of 2010.

LaTeX code

```
There are \[\sage{number_of_partitions(2010)}\]

integer partitions of 2010.
```

Sage and LaTeX

Let $f(x) = e^x \sin(2x)$, then the second derivative of f is

$$\frac{\mathrm{d}^2}{\mathrm{d}x^2} e^x \sin(2x) = -3\, e^x \sin(2x) + 4\, e^x \cos(2x).$$

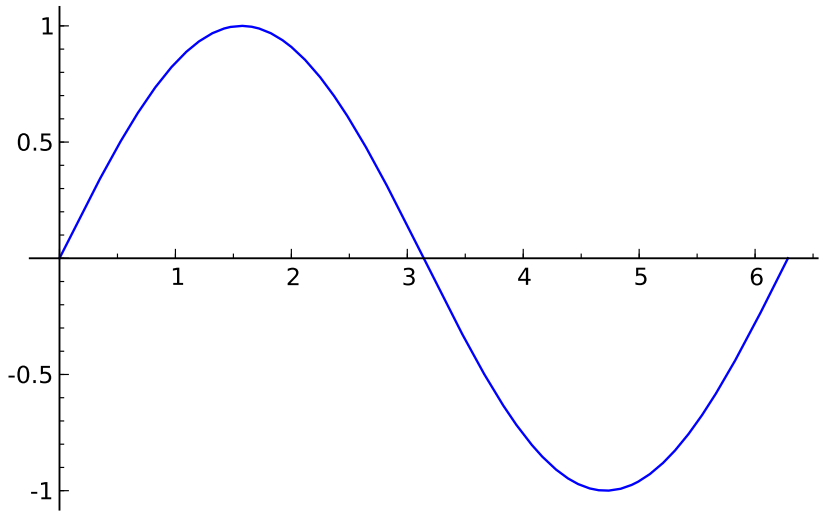
Code

```
\begin{sagesilent}
f(x) = exp(x) * sin(2*x) \end{sagesilent},

Let $f(x) = \sage{f(x)}$, then
the second derivative of $f$ is
\[
  \frac{\mathrm{d}^{2}}{\mathrm{d}x^{2}} \sage{f(x)} =
    \sage{diff(f, x, 2)(x)}.
\]
```

Sage and LaTeX (plots)

Plotting works, too.



code

```
\sageplot{plot(sin(x), x, 0, 2*pi)}
```

Universality

From `sagemath.org`:

> *Mission: Creating a viable free open source alternative to Magma, Maple, Mathematica and Matlab.*

The Goal: To be your one-stop mathematical environment

- First application area was elliptic curves (GP/pari)
- Maxima and numpy/scipy form core elements of the engine
- Can interface with Maple and Mathematica if they are installed
- Provides interface to R (incomplete?)

Links

http://www.calvin.edu/~rpruim/talks/

http://sagemath.org/

http://localhost:8000/

http://www.python.org/