

Exemple d'intégration de LyX à Sage

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1 Présentation

Sage (<http://sagemath.org>) is an open source computer algebra system that integrates a wide variety of open source mathematics software, with the mission of "creating a viable free open source alternative to Magma, Maple, Mathematica, and Matlab." Sage uses Python as the glue for integrating nearly 100 open source packages for mathematics, programming, and visualization. Sage speaks L^AT_EX and can be used for literate programming that mixes normal text with Sage instructions, directly including results in PS/PDF files. The `sagetex.sty` package allows the input of Sage instructions in a L^AT_EX file (in a manner similar to Sweave and R-Project).

The file `sage.module` provides the following SageT_EX elements in LyX:

- `sageblock` and `sagesilent` environments for blocks of code made visible or invisible in the final document, respectively
- `sageplot` and `sageplotcenter`¹ environments that can be used for plotting code inside a Figure float
- `sagecommand` and `sageinline` insets² that can be used inline, where results of the latter appear in math mode
- `sagedisplay` environment, whose results appear in display math mode³

The SageT_EX commands `\sage` and `\sageplot`, along with other custom commands defined in `sage.module`, can also be used as ERT. This can be useful in math mode when results from Sage should be combined seamlessly with other equation components. Note that LyX's special handling of math mode formatting can cause problems for some Sage input: for this reason, it may be necessary to assign a result to a named variable using a `sagesilent` environment and include the variable by name in ERT where the result should appear.

¹a customized call to `sageplot` defined in the `sage.module` file; you can define similar environments with different options to conveniently generate multiple plots of different styles

²accessible via the menu item Insert >> Custom Insets

³you can define similar environments in `sage.module` to support other math environments

When a SageTeX document `mydocument.tex` is compiled with (pdf)latex, it automatically generates a Sage file `mydocument.sage` that can be run through Sage using the command `sage mydocument.sage`. This compiles the results of the Sage instructions and a supplementary run through (pdf)latex includes these results (computations, plots, etc.) in the final document. The files included with this example provide a basic capability to combine this functionality with L^AT_EX, which you can extend to meet your specific needs.

Using this module, to compile a document with embedded Sage code one must view the output as “PDF (pdflatex+sagetex)”, located by default under “Other Formats.” To update only the L^AT_EX without updating any results from Sage, one can use the default output format “PDF (pdflatex)”. This default can be changed in the included `preferences` file.

If you are working under GNU/Linux, the included shell script `setup.sh` can be customized to place the necessary components where they belong. This assumes you have already installed and tested L^AT_EX and Sage independently, and includes the necessary commands to include SageTeX in a common L^AT_EX installation.⁴ After establishing the configuration, you will need to run Tools >> Reconfigure from the L^AT_EX menu. This configuration has been successfully tested using the following setup:

- Ubuntu 11.10 x86_64
- L^AT_EX 2.0.0 with T_EXLive 2009-13 (but should work with L^AT_EX 1.6+)
- Sage 4.8 [2012-01-20]

Note that in earlier versions of Sage, SageTeX may produce files with extension `.sage` rather than `.sagetex.sage`. You may need to modify the `preferences` and `compile-pdf-sage.sh` files accordingly.

2 Exemples

Sage peut faire du L^AT_EX: $\begin{pmatrix} 7 & 10 \\ 15 & 22 \end{pmatrix}$

SageTeX peut inclure des blocks pour définir et calculer des éléments. Dans ce cas, les blocks ne sont mis en forme dans le document, puisqu’on utilise `sagesilent` environment. On déclare x comme variable et $y = x^2 + 5x + 2$.

On peut maintenant calculer une équation avec une inconnue x : la racine de l’équation $x^2 + 5x + 2$ est obtenue alors par le calcul avec Sage :

$$\left[x = -\frac{1}{2}\sqrt{17} - \frac{5}{2}, x = \frac{1}{2}\sqrt{17} - \frac{5}{2} \right]$$

Another equation, third degree of x this time: roots of $x^3 - 10$ are:

$$\left[x = \frac{1}{2}i \cdot 10^{\frac{1}{3}}\sqrt{3} - \frac{1}{2} \cdot 10^{\frac{1}{3}}, x = -\frac{1}{2}i \cdot 10^{\frac{1}{3}}\sqrt{3} - \frac{1}{2} \cdot 10^{\frac{1}{3}}, x = 10^{\frac{1}{3}} \right]$$

⁴based on <http://www.sagemath.org/doc/installation/sagetex.html>

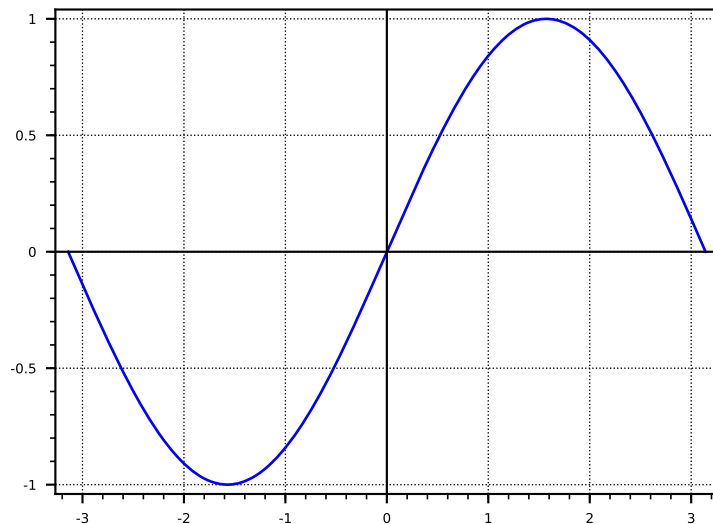


FIGURE 1 : Fonction sinus

A system of two equations:

```
x,y=var('x y')
z=solve([x+y==6,x-y==4],x,y)
```

The roots of the system

$$\begin{aligned} x + y &= 6 \\ x - y &= 4 \end{aligned}$$

are given by :

$$[[x = 5, y = 1]]$$

Sage can do differentiation:

```
y=sin(x^2)
```

$$\frac{\partial^4 y}{\partial x^4} = 16x^4 \sin(x^2) - 48x^2 \cos(x^2) - 12 \sin(x^2)$$

Sage can also do integrals:

$$\int_0^1 \frac{x}{x^2 + 1}$$

is given by $\frac{1}{2} \log(2)$.

Sage can solve differential equations: we declare a variable t , a function of t , $x(t)$ and a differential equation

$$\frac{dx}{dt} + x - 1 = 0$$

```
t = var('t')
x = function('x')(t)
DE = diff(x, t) + x - 1
```

We can now solve the equation:

$$x(t) = (C + e^t)e^{(-t)}$$

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