

# SageMath: an introduction

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# SageMath in a few words

**SageMath** (*nickname: Sage*) is a **free open-source** computer algebra system

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- 1 everybody can use it, by downloading it from <https://www.sagemath.org>
- 2 everybody can examine the source code and improve it

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## SageMath is based on Python

- no need to learn any specific syntax to use it
- Python is a powerful *object oriented language*, with a neat syntax
- SageMath benefits from the Python ecosystem (**Jupyter**, **Jupyterlab**, **NumPy**, **Matplotlib**, **SciPy**, **SymPy**, etc.)

# SageMath history

- SageMath has been created in 2005 by **William Stein** (Univ. California, San Diego, then Univ. Washington, Seattle)
- From the beginning, SageMath has been devised to provide a **Python interface** to many non-Python open-source math systems: **Maxima, GSL, Singular, GAP, PARI/GP, FLINT, etc.**
- In addition to this, SageMath has its **own Python (and Cython) code**, under **continuous development**
- SageMath has been supported by European Union via the open-math project **OpenDreamKit** (2015-2019, within the Horizon 2020 program)
- Currently,  $\sim 100$  developers, forming an **enthusiastic community** and welcoming newcomers

# Installing SageMath on your computer (1/2)

## Linux

- SageMath is packaged in all major Linux distributions
- up-to-date version (9.5) easily installable from sources, see [https://sagemanifolds.obspm.fr/install\\_ubuntu.html](https://sagemanifolds.obspm.fr/install_ubuntu.html)

## macOS

Signed and notarized macOS binaries for SageMath 9.5 available at [https://github.com/3-manifolds/Sage\\_macOS/releases](https://github.com/3-manifolds/Sage_macOS/releases)

## Windows

- Binaries for SageMath 9.3 available at <https://github.com/sagemath/sage-windows/releases>
- up-to-date version (9.5) installable from source via Windows Subsystem for Linux (WSL):  
<https://doc.sagemath.org/html/en/installation/source.html>

# Installing SageMath on your computer (2/2)

## Docker

Docker image for SageMath 9.5 available at

<https://hub.docker.com/r/sagemath/sagemath>

## Conda

Installation from the conda-forge channel:

<https://doc.sagemath.org/html/en/installation/conda.html>

# Running SageMath without installing it

## SageMathCell

For small pieces of code:

<https://sagecell.sagemath.org/>

## CoCalc

Cloud system for collaborative calculation and data science

Runs SageMath, Python, R, LaTeX, Julia, Octave, etc.

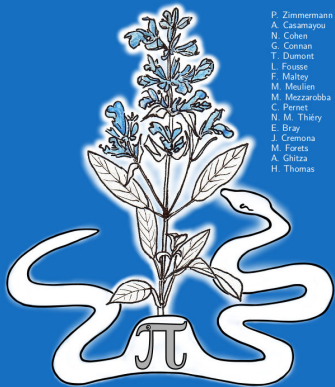
<https://cocalc.com/>





## Computational Mathematics with SageMath

P. Zimmermann  
A. Casamayou  
N. Cohen  
G. Connan  
T. Dumont  
L. Fousse  
F. Maltey  
M. Meulien  
M. Mezzarobba  
C. Pernet  
N.M. Thiéry  
E. Bray  
J. Cremona  
M. Forets  
A. Ghitza  
H. Thomas



by P. Zimmermann, A. Casamayou,  
N. Cohen, G. Connan, T. Dumont, L. Fousse,  
F. Maltey, M. Meulien, M. Mezzarobba,  
C. Pernet, N.M. Thiéry, E. Bray, J. Cremona,  
M. Forets, A. Ghitza & H. Thomas (2018)

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Freely downloadable from

[https://www.sagemath.org/sagebook/  
english.html](https://www.sagemath.org/sagebook/english.html)

en français (2013) : [https://www.  
sagemath.org/sagebook/french.html](https://www.sagemath.org/sagebook/french.html)

- SageMath documentation (reference manual, tutorials, etc):  
<https://doc.sagemath.org/>
- Any question regarding SageMath installation:  
<https://groups.google.com/g/sage-support>
- Any question regarding the use of SageMath:  
<https://ask.sagemath.org>

# Let us dive into it!

- First contact: [https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/first\\_contact.ipynb](https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/first_contact.ipynb)
- 2D plots: [https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/plot\\_tour\\_2D.ipynb](https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/plot_tour_2D.ipynb)
- 3D plots: [https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/plot\\_tour\\_3D.ipynb](https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/plot_tour_3D.ipynb)
- Solving equations: [https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/solve\\_tour.ipynb](https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/solve_tour.ipynb)
- Solving partial differential equations:  
[https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/diff\\_solve\\_tour.ipynb](https://nbviewer.org/github/egourgoulhon/SageMathTour/blob/master/Notebooks/diff_solve_tour.ipynb)

Download all notebooks at once:

```
git clone https://github.com/egourgoulhon/SageMathTour.git
```