

OpenDreamKit

Open Digital Research Environment Toolkit
for the Advancement of Mathematics

A project funded by the Horizon 2020
European Research Infrastructures Work Programme

October 19, 2017

OpenDreamKit.org
@OpenDreamKit

Context

Emergence in the last decade(s) of a vibrant ecosystem of open source software for pure mathematics

- Specialized libraries: GAP, Linbox, Pari/GP, MPIR, Singular, ...
- General purpose systems: Sage, ...
- Online databases: LMFDB, ...
- Interactive computing environments:
IPython/Jupyter, CoCalc, ...
- Together with the wider Scientific Python ecosystem

Context

Emergence in the last decade(s) of a vibrant ecosystem of open source software for pure mathematics

- Specialized libraries: GAP, Linbox, Pari/GP, MPIR, Singular, ...
- General purpose systems: Sage, ...
- Online databases: LMFDB, ...
- Interactive computing environments:
IPython/Jupyter, CoCalc, ...
- Together with the wider Scientific Python ecosystem

Viable open source alternatives to Maple, Mathematica, Matlab, Magma, ...

- Research
- Education (in France: lycée \rightarrow agrégation, ...)
- Industry?

A successful development model ...

- By users, for users
- Indirect funding via research grants
- Large international developer communities (300 for Sage)

A successful development model ...

- By users, for users
- Indirect funding via research grants
- Large international developer communities (300 for Sage)

... with some limitations

- Some highly technical tasks are lagging behind:
 - Hard to justify work on them for a researcher
 - Hard to justify work on them on a research grant
- Impeding the wide adoption of those systems

A successful development model ...

- By users, for users
- Indirect funding via research grants
- Large international developer communities (300 for Sage)

... with some limitations

- Some highly technical tasks are lagging behind:
 - Hard to justify work on them for a researcher
 - Hard to justify work on them on a research grant
- Impeding the wide adoption of those systems

A need for funding for:

- A few full time developers
- Training and development workshops, developer meetings, ...

OpenDreamKit (2015-2019)

Open Digital Research Environment Toolkit for the Advancement of Mathematics

- H2020 European Research Infrastructures Work Programme
Call: Virtual Research Environments
- Budget: 7.6 million euros
- 15 sites
- 50 participants

The OpenDreamKit partners

- France: Bordeaux  CNRS, Grenoble (UJF), Paris 
Logilab, Versailles Saint-Quentin  UNIVERSITÉ DE
VERSAILLES
ST-QUENTIN-EN-YVELINES
UNIVERSITÉ PARIS-SACLAY
- Germany: Bremen  JACOBS
UNIVERSITY, Kaiserslautern
- Great Britain: Oxford  UNIVERSITY OF
OXFORD, Sheffield, Southampton
 UNIVERSITY OF
Southampton, St Andrews  University of
St Andrews, Warwick
- Norway: Oslo [*simula*. research laboratory]
- by thinking constantly about it
- Poland: University of Silesia 
- Switzerland: Zürich Universität

In close collaboration with the international community!

OpenDreamKit (2015-2019)

Aims

- Foster the ecosystem of open source software for pure mathematics and beyond
- Deliver a flexible Virtual Research Environment toolkit supporting collaborative work of soft, data, and knowledge

Main tasks

- Modularization and interfaces between systems
- Build, documentation, tests systems
- Portability, distribution, deployment
- High Performance
- Interactive collaborative computing environments
- Mathematical databases
- Research on social aspects of math soft development
- Community building and training

OpenDreamKit (2015-2019)

Aims

- Foster the ecosystem of open source software for pure mathematics and beyond
- Deliver a flexible Virtual Research Environment toolkit supporting collaborative work of soft, data, and knowledge

Main tasks

- Modularization and interfaces between systems
- Build, documentation, tests systems
- Portability, distribution, deployment
- High Performance
- Interactive collaborative computing environments
- Mathematical databases
- Research on social aspects of math soft development
- Community building and training

Portability, distribution, deployment

→ A native Sage distribution on windows

Interactive collaborative computing environments

The Jupyter notebook

Show example

A short and incomplete history of Notebooks

- The i-python console interface
- The Sage console uses i-python
- The sage notebook and i-python notebook
- The Jupyter notebook

The role of OpenDreamKit

We continue the good work...

- 3 full time developers working on Jupyter (Jupyter lab, improving the interface, interactive widgets, 3d visualization)
- Developing new kernels (Sage, Gap)
- Exploring document interactive formats (a workshop going on right now)
- Exploring and developing solutions for collaborative online work (CoCalc, Jupyter Hub)

Online collaborative environment

CoCalc (formerly SageMathCloud)

- An online platform run by a private company offering free (or paying) access to much scientific software such as Sage and Jupyter.
- The platform runs a **open source** software which can be installed on any server.

Jupyter Hub

- A software which can be installed on a server to give multiple users access to Jupyter.

Our role in OpenDreamKit

Explore, develop, document, and improve so that every university can have an easy and accessible access to those technologies corresponding to their needs and means.

Impact for teaching?

This is where those technologies are massively used!

OpenDreamKit and CoCalc

- Tutorial "Teaching with CoCalc" written by Mike Croucher
- Technical CoCalc documentation written by Erik Bray
- Using CoCalc for teaching in Upsud and Sheffield
- Exploring single machine installations, running servers and so on (One server running CoCalc in Zurich)

Our Upsud teaching projects

Sage on CoCalc

Since 2015: a multidisciplinary project class on computer science and math or first year students. (Run 3 times on about 30 students each time)

Our Upsud teaching projects

Python on CoCalc

Since 2016: an algorithmic class for students in engineering school:
3rd times this year, about 25 students.

C++ on Jupyter Hub

- Installed a Jupyterhub server along with the "xseus C++11" kernel for interpreted C++ on Jupyter
- Installed Jupyter and xseus kernel on all our student machines
- Still going on: running a 300 first year students class of introduction to programming using Jupyter and xseus C++