Some highlights on OpenDreamKit

Nicolas M. Thiéry

October 30, 2018
ODK’s interviews

https://opendreamkit.org/
ODK’s use cases

https://opendreamkit.org/tag/use-case
Aims

Aim 1 Improve the productivity of researchers in pure mathematics and applications by further promoting collaborations on Data, Knowledge, and Software

Aim 2 Make it easy for teams of researchers of any size to set up custom, collaborative Virtual Research Environments tailored to their specific needs, resources and workflows

Aim 3 Support the entire life-cycle of computational work in mathematical research, from initial exploration to publication, teaching, and outreach

Aim 4 Maximise sustainability and impact in mathematics, neighbouring fields, and scientific computing.
Challenge: a rich variety of objects

- Numbers: 42, 7, I + \sqrt{3}, \pi, 2.71828182845904523536028747...
- Matrices:
  - \begin{pmatrix} 4 & -1 & 1 \\ -1 & 2 & -1 \\ -1 & 0 & 5 & 1 & 3 \end{pmatrix}
  - \begin{pmatrix} 1.000 & 0.500 & 0.333 \\ 0.500 & 0.333 & 0.250 \\ 0.333 & 0.250 & 0.200 \end{pmatrix}
- Polynomials:
  - \(-9x^8 + x^7 + x^6 - 13x^5 - x^3 - 3x^2 - 8x + 4\)
- Series: \(1 + \frac{x}{2} + \frac{x^2}{12} + \frac{x^3}{24} + \frac{x^4}{120} + \cdots\)
- Symbolic expressions, equations:
  - \(\cos(x^2) + \sin(x^2) = 1\)
- Finite fields, algebraic extensions, elliptic curves, ...

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Challenge: a rich variety of objects

Numbers: 42, $\frac{7}{9}$, $\frac{1+\sqrt{3}}{2}$, $\pi$, 2.71828182845904523536028747?
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Polynomials: $-9x^8 + x^7 + x^6 - 13x^5 - x^3 - 3x^2 - 8x + 4$
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Polynomials: $-9x^8 + x^7 + x^6 - 13x^5 - x^3 - 3x^2 - 8x + 4$

Series: $1 + 1x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \frac{1}{120}x^5 + \cdots$
Challenge: a rich variety of objects

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Symbolic expressions, equations: $\cos(x)^2 + \sin(x)^2 == 1$
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Symbolic expressions, equations: $\cos(x)^2 + \sin(x)^2 \equiv 1$

Finite fields, algebraic extensions, elliptic curves, ...
Combinatorial objects

\[
\begin{array}{cccc}
1 & 3 & 4 & 7 \\
2 & 5 & 6 \\
8
\end{array}
\]

010010100100101001010010010100101001010010 \cdots

\[
\frac{1}{6} q^2 - \frac{1}{6} q \\
\frac{q^2}{q^5 + 2q^4 + 3q^3 + 3q^2 + 2q + 1} + \\
\frac{q^2}{q^5 + 2q^4 + 3q^3 + 3q^2 + 2q + 1} + \\
\frac{\frac{1}{2} q}{q^4 + q^3 + 2q^2 + q + 1}
\]

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Geometric objects
Challenge: a rich hierarchy of concepts

sets

magnas

unital magnas

semigroups

inverse unital magnas

monoids

groups
Challenge: a rich hierarchy of concepts
Challenge: a rich hierarchy of concepts
Challenge: a large variety of use cases

No one-size-fits-all VRE
OpenDreamKit’s proposal

Deliver a **VRE Toolkit for Mathematics**...
OpenDreamKit’s proposal

Deliver a **VRE Toolkit for Mathematics**...

from the ecosystem of open source software for mathematics ...
Deliver a **VRE Toolkit for Mathematics**...

from the ecosystem of open source software for mathematics ...

and the Jupyter interactive computing environment
OpenDreamKit’s proposal

Knowledge
- Scientific journals
- Teaching resource repositories
- Wikis
- Blogs
- MathOverflow.net
- Collaborative help centers
- Mailing lists

Researcher Communities
- User interfaces (Jupyter notebook, ...)
- Collaborative workspaces (JupyterHub, ...)

Software
- Issue trackers
- Code repositories
- Continuous integration tools
- Computational components
- Software Forges

Data
- Online databases
- Preprint servers (arxiv.org, oeis.org, lmfdb.org, findstat.org)
- Databases

Storage resources (local, shared folder, cloud)   Computational resources (local, super computer, cloud)
What has happened since last review

- We were able to recruit high profile people
- Most technologies we have bet upon (Jupyter, containers, ...) have blossomed;
- VREs based on our toolkit are being deployed at all scales (e.g. EGI)
- The toolkit approach is proving its value: impact and adoption
- We reached, trained, and got feedback from many users

Risks mitigation!

- Lack of predictability for tasks that are pursued jointly with the community
- Recruitment of high profile staff (competition from industry!)
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Project admin situation