



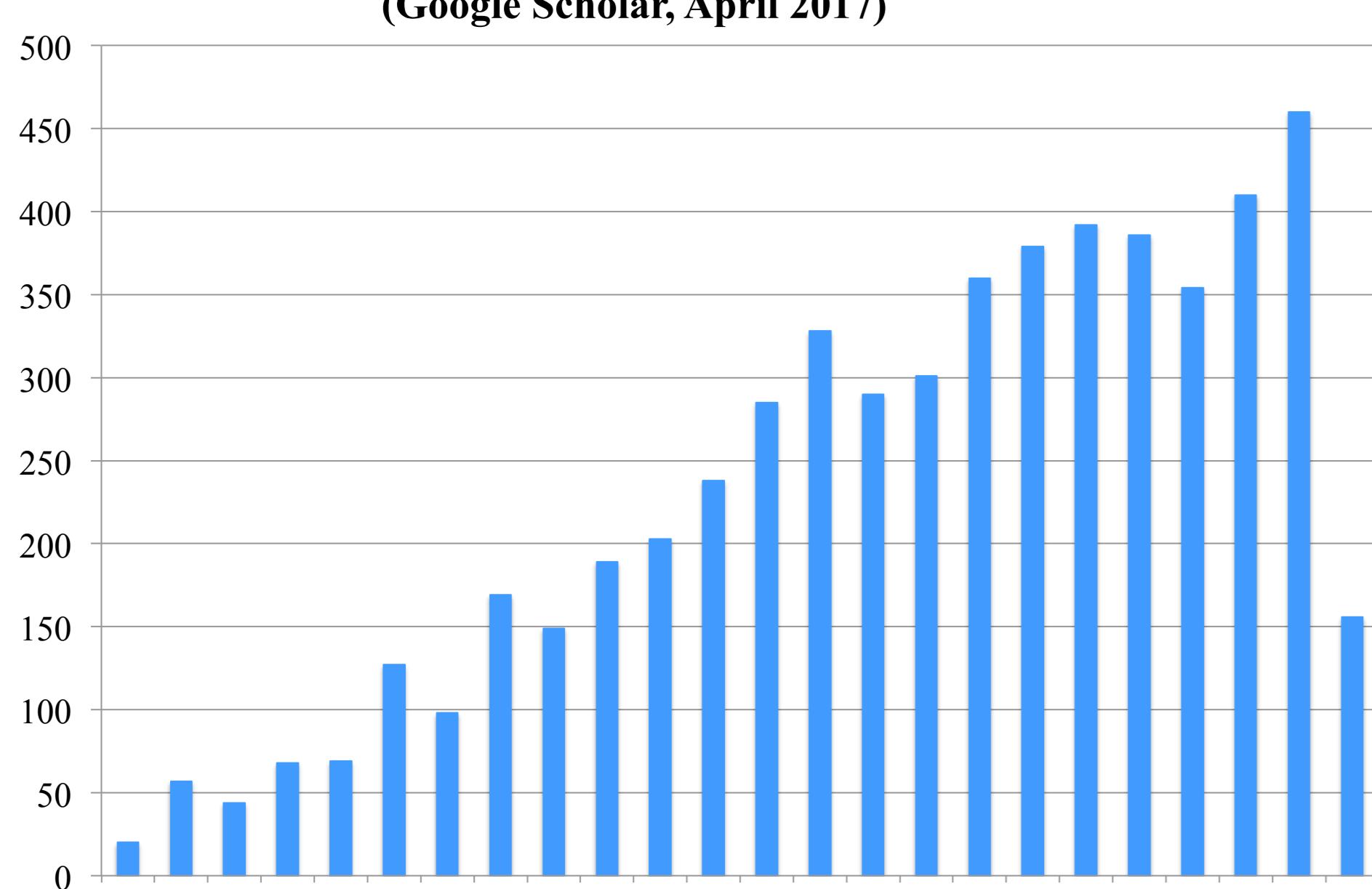
OPEN
DREAMKIT

Our software

GAP (Groups, Algorithms and Programming) is a software system for discrete computational algebra with an emphasis on computational group theory. It provides a language called GAP, a library of mathematical algorithms implemented in this language and various libraries of mathematical objects, such as, for example, the 423 164 062 groups of order not greater than 2000, (excluding 49 487 365 422 groups of order 1024).

GAP (<http://gap-system.org>, @gap_system on Twitter) is an open-source project, started in RWTH Aachen in late 80s. Since 1997 its development has been coordinated by CIRCA (the Centre for Interdisciplinary Research in Computational Algebra) at the University of St Andrews. GAP is used for research and teaching at several thousands universities and research institutions worldwide and has been cited in several thousand research publications.

Citations per year for GAP and some of its packages
(Google Scholar, April 2017)



GAP has a wide user base, including researchers, educators and students, and has a mechanism for user contributions in the form of packages, which may be submitted for refereeing and for the redistribution with GAP. In particular, the latest GAP release, 4.8.7 (March 2017) contains 132 package.

There are many areas where GAP users face a need for larger and more sophisticated computations, for example, computational homological algebra, direct computations in the Monster simple group and in infinite matrix groups.

Interfaces to other systems - WP3

- Support of SCSCP (Symbolic Computation Software Composability Protocol)
- Interaction with clients/servers representing other SCSCP-compliant software (computer algebra systems, Python applications, etc.)
- A GAP SCSCP server can be started using local GAP installation or the GAP Docker container: <https://hub.docker.com/r/gapsystem/gap-docker/>
- Prototype of GAP as a shared library for easy integration into other systems, inspired by SageMath's libGAP

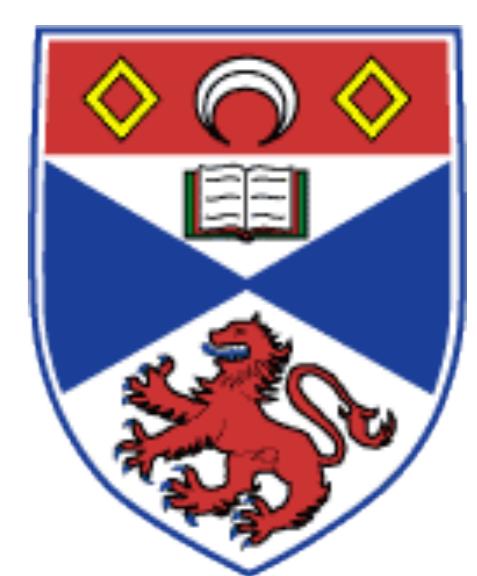
GAP – Groups, Algorithms, Programming

Better Mathematical Software For Better Mathematical Research

Recent developments relevant to OpenDreamKit



CENTRE FOR INTERDISCIPLINARY RESEARCH
IN COMPUTATIONAL ALGEBRA



University of St Andrews, St Andrews, Fife, KY16 9SX

<http://www-circa.mcs.st-and.ac.uk/>, Twitter: @CIRCA_StAndrews

Jupyter kernel for GAP - WP3

- A Jupyter kernel for GAP is available via PyPI: <https://pypi.python.org/pypi/jupyter-kernel-gap>
- Compatible with the latest public GAP release of GAP 4.8.7 (March 2017)

```
jupyter demo-gap Last Checkpoint: a few seconds ago (autosaved)
File Edit View Insert Cell Kernel Widgets Help
Logout GAP O
In [14]: G := AlternatingGroup(6);
Out[14]: 6t1 ... 6t1
In [15]: ?AutomorphismGroup
Reference: AutomorphismGroup
Reference: AutomorphismGroup for groups with prop
In [16]: a := AutomorphismGroup(G);
Out[16]: <AutomorphismGroup of AlternatingGroup(6)>
In [17]: S := SemidirectProduct(G, a);
Out[17]: <SemidirectProduct of AlternatingGroup(6), AutomorphismGroup of AlternatingGroup(6)>
In [18]: s := AutomorphismGroup(SolvableGroup(<group>));
Out[18]: <group>
In [19]: Order(s);
Out[19]: 32
In [20]: IdGroup(s);
Out[20]: [ 32, 49 ]
In [21]: List(LowerCentralSeries(s), Order);
Out[21]: [ 32, 4, 2, 1 ]
In [22]:
```

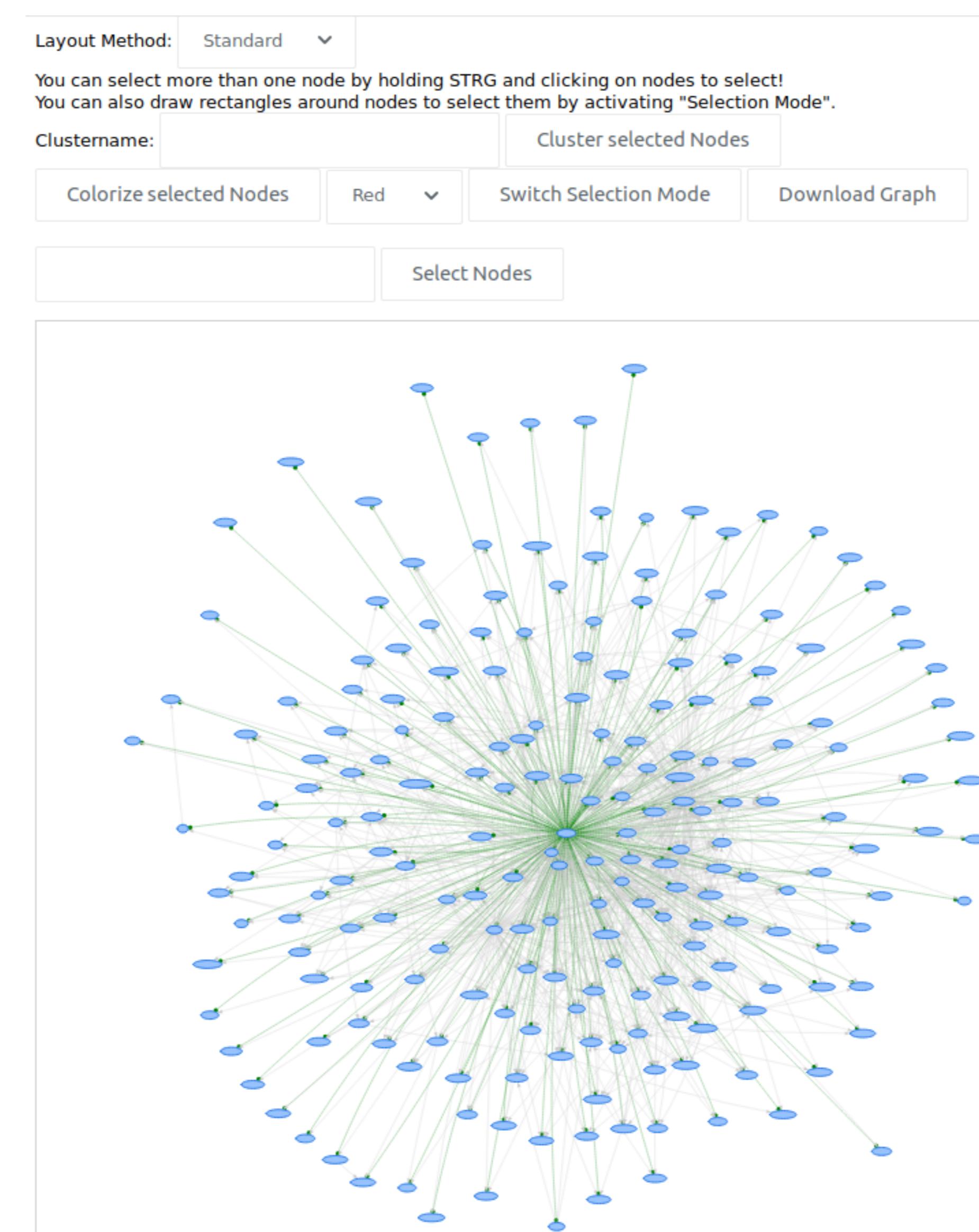
- Also available as a Docker image from <https://hub.docker.com/r/gapsystem/gap-docker-jupyter/>

High-performance computing - WP4

- Integrating the experimental HPC-GAP variant into the main GAP codebase
- Improving portability and reliability of the system
- Started work on integrating high-performance Meataxe64 linear algebra system into GAP to work with very large matrices over small finite fields
- Many performance enhancements throughout the system

Mathematical knowledge Management - WP6

- Tools to explore GAP type system:
 - with human-readable output for GAP users and developers
 - with machine-readable output to be used by other software



Training and networking - WP2

- 1st GAP-SageMath Days (St Andrews, Jan. 2016)
- “Computational Mathematics with Jupyter” workshop (ICMS Edinburgh, Jan. 2017)
- SageMath-GAP Days 85 (Cernay, Mar. 2017)

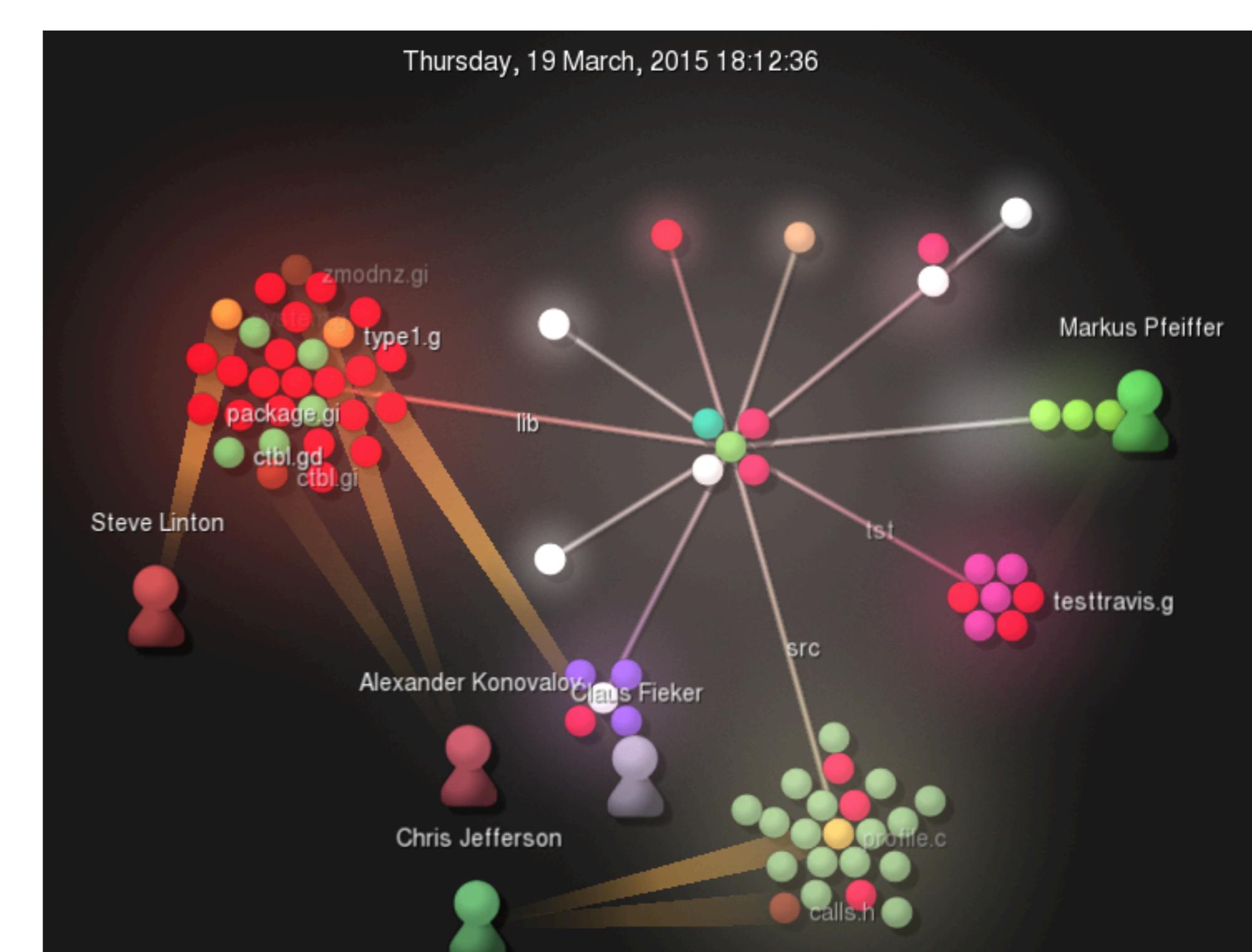


We welcome contributors



Find us on GitHub:

- <https://github.com/gap-system>
- <https://github.com/gap-packages>



A moment of collaborative work at 2nd GAP Days (visualised using Gource)

Current support

- OpenDreamKit Horizon 2020 European Research Infrastructures project (#676541), 2015-2019
- CoDiMa - Collaborative Computational Project in the area of Computational Discrete Mathematics (EP/M022641/1), 2015-2020
- DFG project "Symbolic Tools in Mathematics and their Application" (SFB-TRR 195), 2017-2020



Computational
Discrete
Mathematics



Engineering and Physical Sciences
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