Sage–Combinat
Free and Practical Software
for Algebraic Combinatorics

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1   Description

`Sage` [S⁺09] (`http://www.sagemath.org`) is a free open-source mathematics software system licensed under the GPL. It combines the power of many existing open-source packages (GAP [GAP99], Linbox, Singular [GPS98] to name a few) into a common Python-based interface.

The mission of `Sage-Combinat` itself (`http://wiki.sagemath.org/combinat/`) is to improve `Sage` as an extensible toolbox for computer exploration in combinatorics and algebraic combinatorics, and to foster code sharing between researchers in this area. As such, `Sage-Combinat` and its predecessor `MuPAD-Combinat` played an essential role in more than 50 publications.

In practice, `Sage-Combinat` takes the form of a collection of experimental extensions (patches), developed jointly by a growing community of researchers[i], worldwide. Those extensions are intended to have a short life cycle, and to be merged into the `Sage` library as soon as they are mature enough. Hence, in a matter of months, most new features are made available to all `Sage` users. Those interested in the bleeding edge features can further download the experimental extensions by simply running `Sage` as `sage -combinat install`.

2   Software demonstration

During the software demonstration at FPSAC'09, we will present the prominent features of `Sage` for combinatorics and algebraic combinatorics, and discuss its design and development model. Afterward, we will run some informal tutorials during the evenings. For those interested in learning more or getting involved, there will also be a satellite workshop around `Sage-Combinat` and sister projects:

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3   Short history of *-Combinat

`Sage-Combinat` started in 2000, under the name `MuPAD-Combinat` [HT04], as an open source library for the computer algebra system `MuPAD` [The96]. It took its roots in the projects `ACE` [Vei98], μ-`EC` [Pro99], `PerMuVAR` [Thi], and progressively integrated `CS` [DDZ98], `Symmetrica` [KKL] `Nauty` [McK90] and `lrcalc`. The `MuPAD` platform was technically sound, and played its role very well for the first seven years. However, and as it was clear from the beginning, it suffered from not being open source. In particular, this hindered its dissemination, and the growth opportunities for both the users and developers community. This motivated our decision, in June 2008, to migrate the project to `Sage`, once this platform became mature enough, and despite the large overhead (100k lines of code to migrate). This migration allowed to almost double the community, in particular thanks to joining our efforts with the combinatorics on words project `Sage-words`.

The migration is on its way, and it is expected that, by FPSAC'09, most of the combinatorics code will be migrated, as well as part of the algebraic code.

4   Features

From `http://www.sagemath.org/tour.html`:

`Sage` can be used to study general and advanced, pure and applied mathematics. This comprises a wide range of mathematics, including algebra, calculus, elementary to very advanced number theory, cryptography, numerical computation, commutative algebra, group theory, combinatorics, graph theory, exact linear algebra and much more. It combines various software packages and seamlessly integrates their functionality into a common experience. It is well suited for education, studying and research. The interface is a notebook in a web-browser or the command-line. Using the notebook, Sage connects either locally to your own Sage installation or to a Sage server on the network. Inside the Sage notebook you can create embedded graphics, beautifully typeset mathematical expressions, add and delete input, and share your work across the network.

Here are some of the features of `Sage` that are developed specifically by the `Sage-Combinat` project:

- Basic combinatorial classes: permutations, tableaux, ...

- Decomposable objects / Species

- Root systems and crystals

- Combinatorics on words

- (Non commutative) symmetric functions and related combinatorial (Hopf) algebras

- Easy definitions of new combinatorial (Hopf) algebras

Other `Sage` features related to combinatorics include graphs (in particular via `NetworkX`), groups (via `GAP`), etc.

5   Hardware requirements

`Sage` can be installed on most platforms, including `Linux`, `Mac OS X`, and `Windows`.

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