polymake 2.12 (and beyond)
GTS 2012

Michael Joswig
w/ Ewgenij Gawrilow and many others

TU Darmstadt

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The polymake System

- software for research in:
  - geometric combinatorics: convex polytopes
  - algebraic geometry
  - linear/combinatorial optimization
  - ...

- open source, GNU Public License
  - supported platforms: Linux, FreeBSD, MacOS X
  - more than 100,000 uloc (Perl, C++, C, Java)

- co-authored (since 1996) w/ Ewgenij Gawrilow [now TomTom]
  - contributions by many people

www.polymake.org
convex polytopes, polyhedra and fans
  - convex hulls: cdd, lrs, beneath-and-beyond
  - Voronoi diagrams, Delone decompositions
  - face lattices: Kaibel–Pfetsch (including variations)
  - lattice polytopes/toric varieties

simplicial complexes
  - simplicial (co-)homology, cup- and cap-products
  - Björner–Lutz heuristics to recognize spheres

tropical geometry
  - tropical polytopes
  - tropical hypersurfaces

graphs, matroids, ...
Algorithm Overview (Selection)

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switch to “first steps” of demo
Technical Aspects

- Hybrid design: Perl (interpreted) and C++ (compiled)
  - Perl: Server side (= organization/communication)
  - C++: Client side (= computation)
- Shell type user interface
  - (extension of) Perl as language
- Technical features include:
  - C++ template library
    - extends STL, based on template meta-programming
  - shared memory communication between client/server, transaction safe
  - whole system can be used as a C++ library (since 2.12)
- prototype: pypolymake [Burcin Erocal]
- interfaces to polymake in the making:
  - Singular, GAP, Sage
Objects and Properties

- hierarchy of **big object types** (modelling mathematical concepts)
  - e.g., polytopes, simplicial complexes, graphs, . . .
  - under control of client/server system
  - with templates

- **properties** as class members (functions or data)
  - strongly typed
  - a type is a built-in Perl type, a C++ class type, or a big object type
  - immutable

- new big object types and properties to a given big object type *can be added at will*

- big object types grouped into **applications** (≈ name spaces)
switch back to demo