GRÖBNER:
A Library for Computing Gröbner Bases based on SACLIB

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Structure of the talk

1. Virtual domains, virtual types, virtual operations
2. Available domains in GRÖBNER
3. Interplay between domains and available virtual domains via coercion units
4. Additional possibilities of adjusting the library

Example: Implementation of Monomials

Monomials over Rational Numbers and Integer Exponent Lists

product_mon_rn_iel((c_1, pp_1), (c_2, pp_2))

$c = \text{product\_rn}(\ c_1,\ c_2)$

$pp = \text{product\_iel}(\ pp_1,\ pp_2)$

return (c, pp)

Monomials over Finite Fields and Gödel Exponents

product_mon_ff_ge((c_1, pp_1), (c_2, pp_2))

$c = \text{product\_ff}(\ c_1,\ c_2)$

$pp = \text{product\_ge}(\ pp_1,\ pp_2)$

return (c, pp)

Instead

product_mon((c_1, pp_1), (c_2, pp_2))

c = product_coef(c_1, c_2)

pp = product_pp(pp_1, pp_2)

return (c, pp)

where the function calls "product_coef" and "product_pp" will be renamed appropriately during the preprocessing phase by `#define` instructions to the C-preprocessor.

Available Domains

- ◇ Integers
- ◇ Rational Numbers
- ◇ Rational Functions
- ◇ Finite Fields
- ◇ Exponent Lists
- ◇ Monomials
- ◇ Distributive Polynomials in List Representation
- ◇ Polynomials with Cofactors
- ◇ (Labeled Polynomials)
- ◇ Lists of Polynomials
- ◇ Polynomial Pairs
- ◇ Sets of Polynomial Pairs
- ◇ (Syzygies)

Available Virtual Domains

- ◇ Coefficients
- ◇ Power Products
- ◇ Polynomials
  - ⋆ Structure of Polynomials
  - ⋆ Representation of Pure Polynomials
- ◇ Polynomial Sets

Further Adjustments

1. Term Ordering
   - ◇ Purely Lexical
   - ◇ Total Degree
   - ◇ Total Degree Inverse
   - ◇ Matrix
2. Pair Ordering
3. Normal Form Algorithm
   - ◇ Partial Normal Form
   - ◇ Complete Normal Form

Gröbner bases algorithm Variants

- ◇ Crude Version
- ◇ Application of Criteria immediately before computation of S-polynomial
- ◇ Application of Criteria when pair set is created/updated
- ◇ "Reduce All"