

New ways of using



<http://cocoa.dima.unige.it/>

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- 1 CoCoA-4: the current system
- 2 CoCoA & CoCoAServer: a step into the future (demo)
- 3 CoCoALib: the C++ library
- 4 CoCoA-5: sneak preview!

Web page: <http://cocoa.dima.unige.it>

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What is CoCoA?

The **CoCoA** project started in 1988

- for doing **C**omputations in **C**ommutative **A**lgebra
- for computer-scared mathematicians

1 Familiar notation and mathematical feel

```
[ X In 1..100 | IsPrime(X) ];  
P ::= QQ[x,y,z];
```

2 No declaration of variables, dynamic typing

```
A := 1234;  
A := x + A;  
A := Ideal(x^2-y, A);
```

3 Robust

What is $\gcd(0, 0)$?

What is the degree of 0?

What is the sum of the empty list?

What is $1/2 * x$? ... and $1 / 2*x$?

(Run **CoCoA Demo**)

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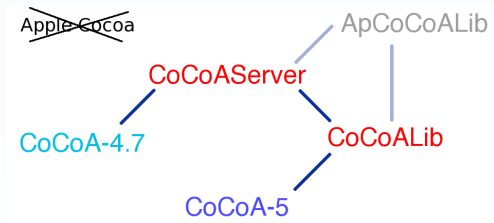
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(Run **CoCoA Demo**)

What are 4, Lib, Server, and 5?

- **CoCoA-4** current system (in C) has some intrinsic limitations → rewrite!
 - ... pure mathematicians like easy programming language
 - ... some computer algebraists want to work in C/Java
 - ... software developers want to access (GPL/free) libraries
- **CoCoALib** C++ library (in C++)
- **CoCoAServer** “server program” (coupled with **CoCoA-4**) extensible
- **CoCoA-5** future system whose core is **CoCoALib** (alpha)



ApCoCoALib is built on top of **CoCoALib** (<http://www.apcocoa.org>)

CoCoA 5: a brand new system

CoCoALib is the mathematical core of CoCoA-5:

- programming language: extension of current CoCoALanguage (with G. Lagorio)
- parser/interpreter (by G. Lagorio)
- graphical interface (by G. Lagorio)

(Run *CoCoA 5*)

(Run *(Qt) Graphical interface and CoCoALanguage debugger*)

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CoCoA 5: current state

- integer/rationals
- strings
- lists/records
- for/while/if/...
- function/procedure definitions
- rings
- polynomials
....growing fast!

Follow the progress at: <http://cocoa.dima.unige.it/cocoalib>

Beta version will be released by June 2011 ([CoCoASchool](#), Passau)

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Design Philosophy behind CoCoALib

Basic goals of the design: the code must...

- be **easy and natural** to use
- have **firm mathematical basis** (Kreuzer-Robbiano book)
- exhibit **good run-time performance**
- be **well documented** (for users & maintainers)
- be clean and **portable**

Prerequisites

- the GMP library
- download **CoCoALib** from <http://cocoa.dima.unige.it/cocoalib/>
`./configure; make`
- some knowledge of basic C (C++) programming

Examples and documentation: <http://cocoa.dima.unige.it/cocoalib>

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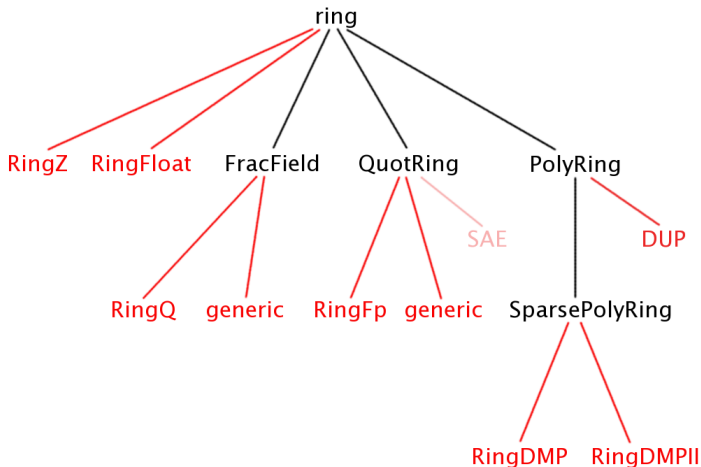
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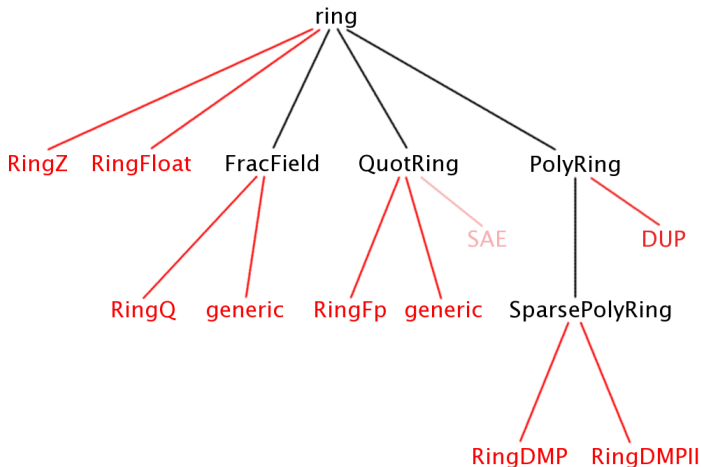
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Ring Inheritance Diagram



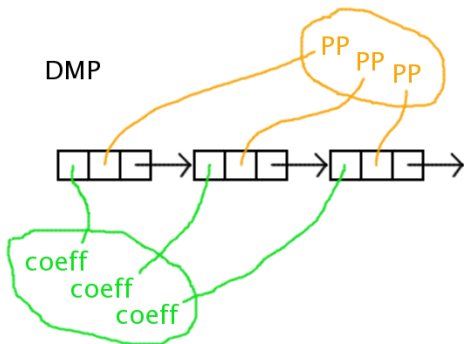
(Run *examples/ex-PolyRing1.C*)

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Polynomials and Power Products



- + clean, easy to maintain, completely general
- poor locality, slow over F_q

DMPII (in some special cases)



+ good locality, fast

- less clean, harder to maintain

New worlds

New mathematical objects:

- Ring extensions
- Approximate ideal of points
- (Optimized) Square free monomials
- TwinFloats for exact computations
- Weyl Algebras
- ...

(Run *examples/ex-RingWeyl1.C*)

Moreover: easily extensible by *non-authors*

- Mayer-Vietoris trees and mapping cone by Eduardo Saenz de Cabezón
- ??? by Werner Seiler

Moreover: easily extensible with external libraries

- Froby for monomial ideals (by Bjarke Røne)
(Run *examples/ex-froby1.C*)
- Normaliz for monomial algebras (by Winfried Bruns et al.)
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Thanks for you attention!

I hope you'll enjoy trying out
the new **CoCoA** flavours!