

# The `homalg` project and its related packages

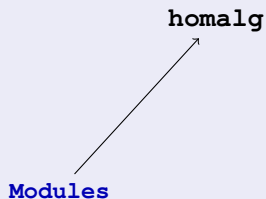
The `homalg` project authors

2007-2020

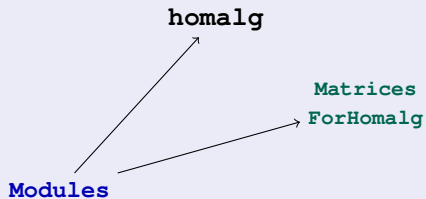
The idea: A homological algebra meta-package for computable ABELian categories

**homalg**

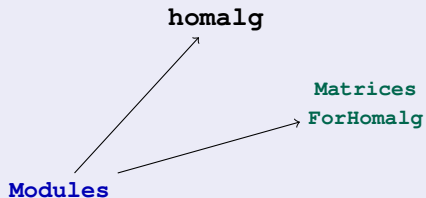
The category of finitely presented modules as the basic example of a computable ABELian category



Matrices provide the needed data structure for finitely presented modules and their morphisms



Candidates: There are several systems that could host `homalg`



Maple

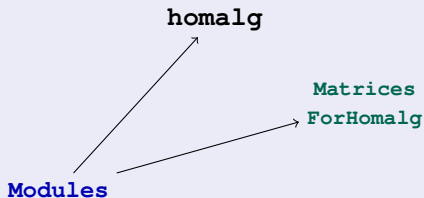
MAGMA

Macaulay2

Sage

GAP SINGULAR

Candidates: There are several systems that could host `homalg`, each supporting certain kinds of rings



Maple

$\Downarrow$   
 $\mathbb{Z}[x, \partial],$   
...

MAGMA

$\Downarrow$   
 $\mathbb{Z}[x],$   
 $\mathbb{F}[x]$

Macaulay2

$\Downarrow$   
 $\mathbb{F}[x],$   
 $\mathbb{F}[x, \partial],$   
...

Sage

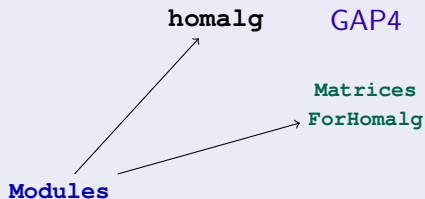
$\Downarrow$   
 $\mathbb{Z},$   
...

GAP

$\Downarrow$   
 $\mathbb{Z}$

SINGULAR

$\Downarrow$   
 $\mathbb{F}[x],$   
 $\mathbb{F}[x, \partial],$   
...



Maple  
⇓  
 $\mathbb{Z}[x, \partial],$   
...

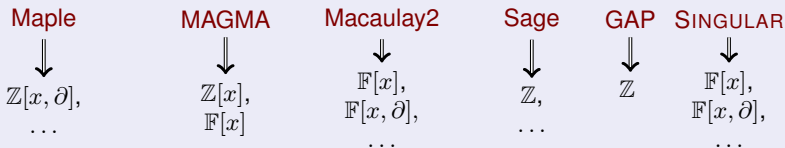
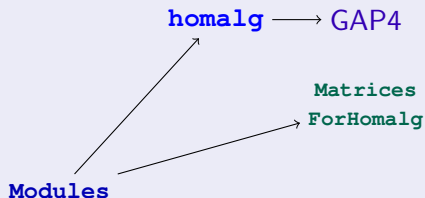
MAGMA  
⇓  
 $\mathbb{Z}[x],$   
 $\mathbb{F}[x]$

Macaulay2  
⇓  
 $\mathbb{F}[x],$   
 $\mathbb{F}[x, \partial],$   
...

Sage  
⇓  
 $\mathbb{Z},$   
...

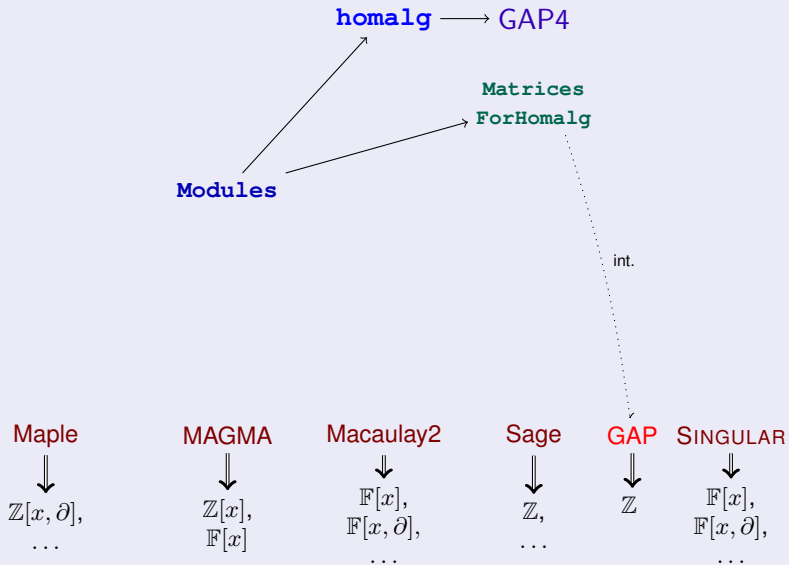
GAP  
⇓  
 $\mathbb{Z}$

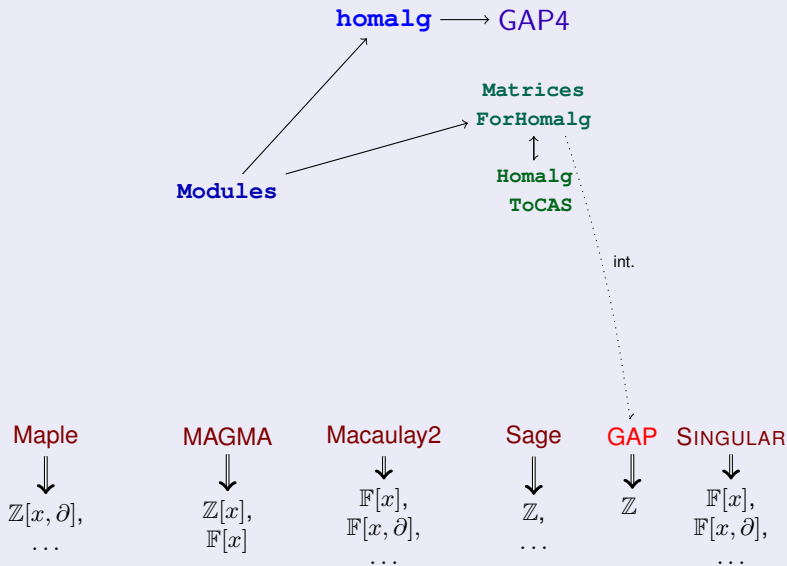
SINGULAR  
⇓  
 $\mathbb{F}[x],$   
 $\mathbb{F}[x, \partial],$   
...

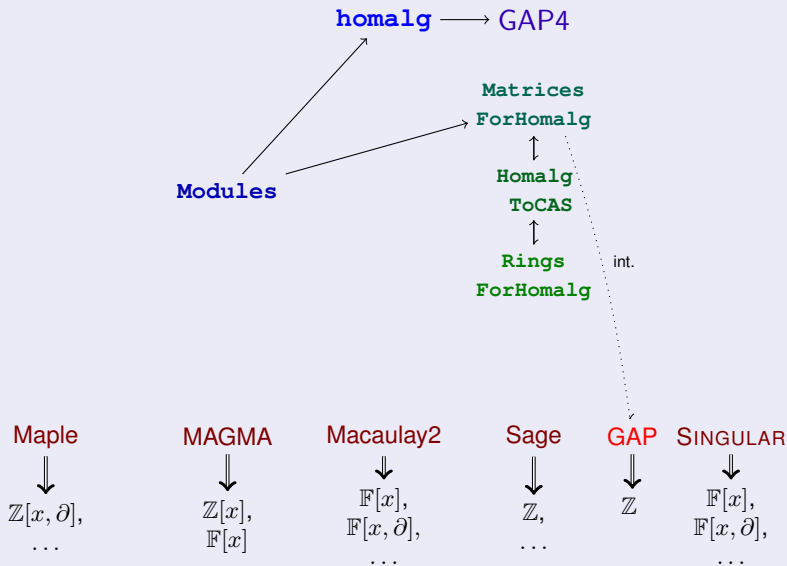


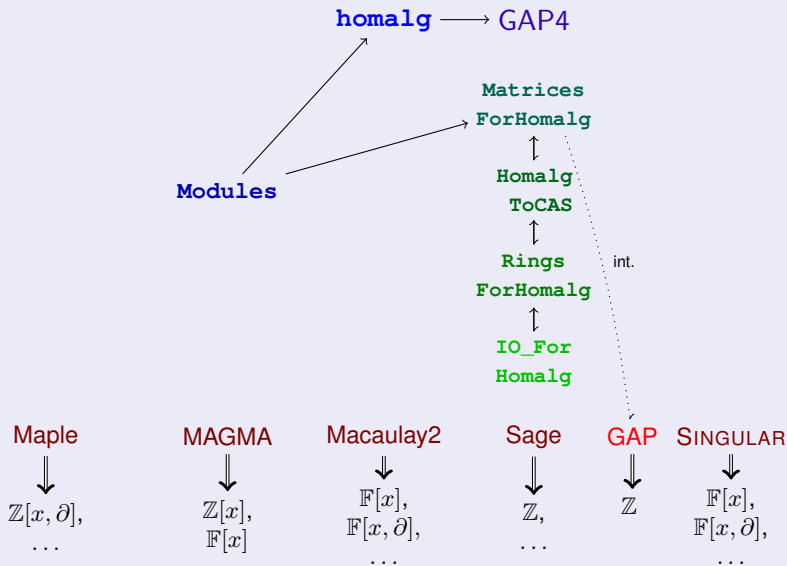


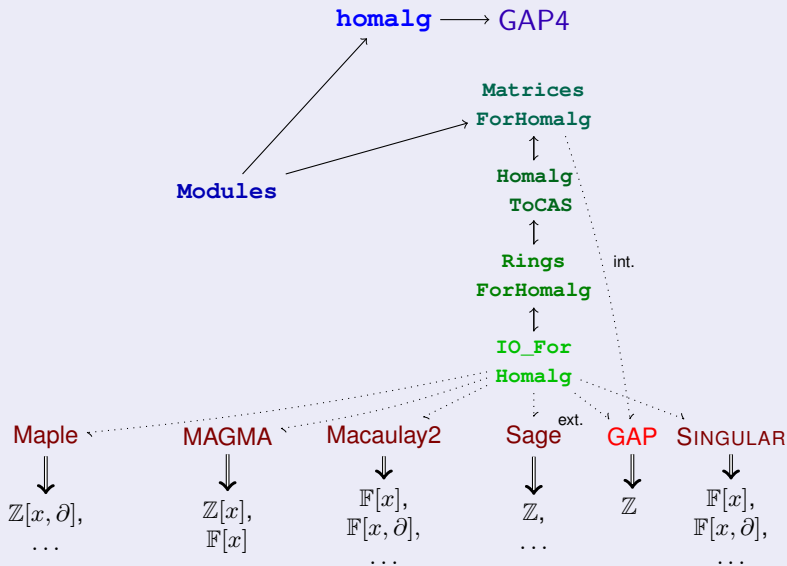
homalg: GAP “sufficiently supports” the ring of integers

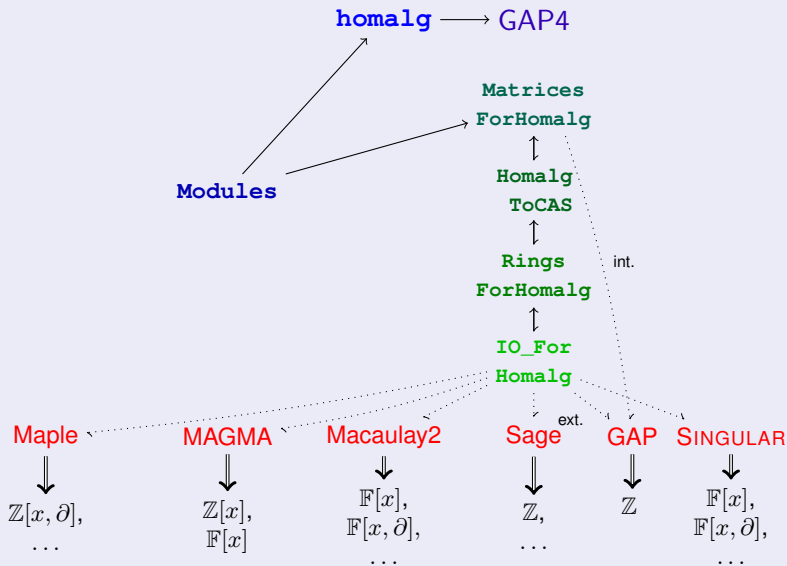


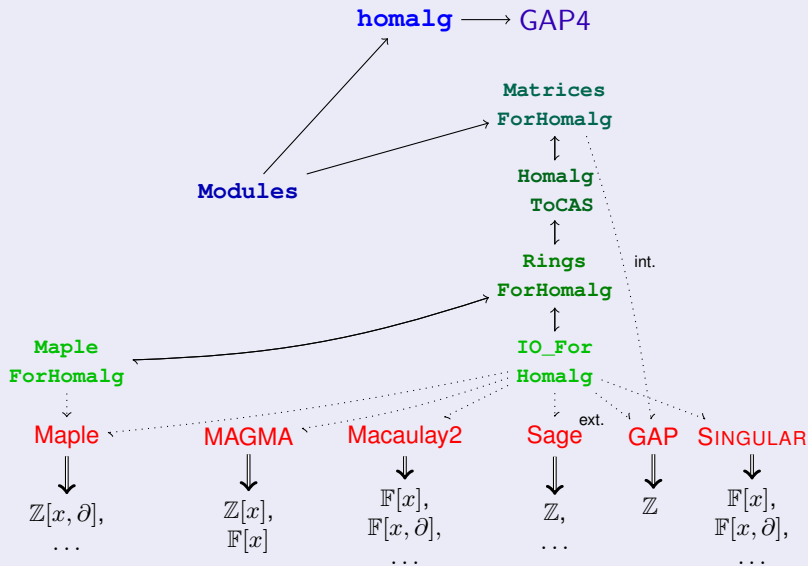




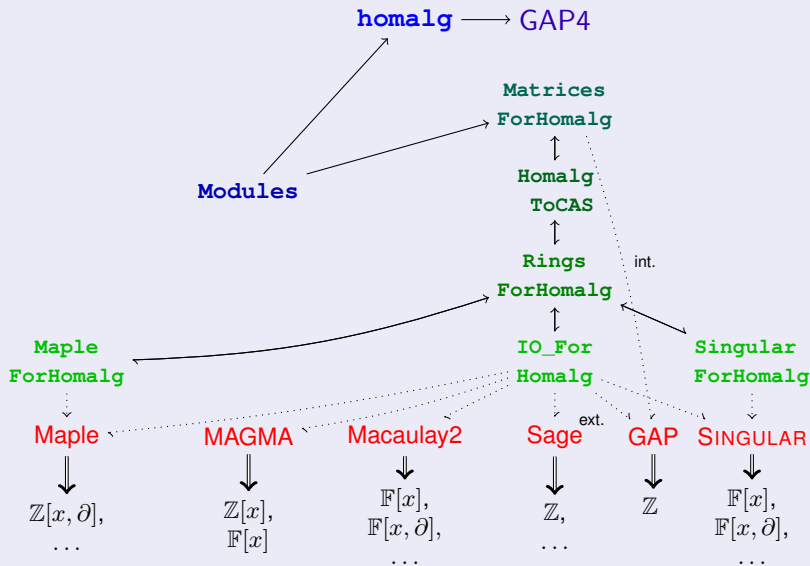






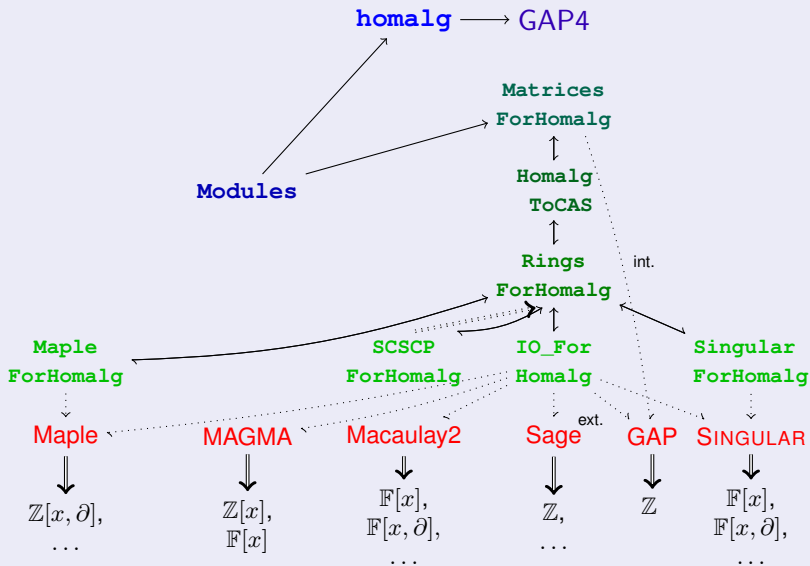


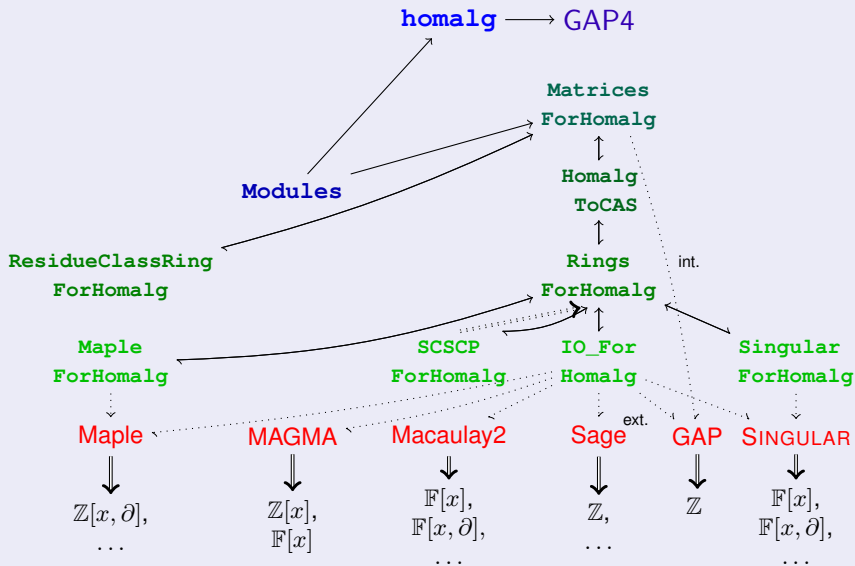
Future: Communicate with interpreters of various CASs shortcutting their command line interface.

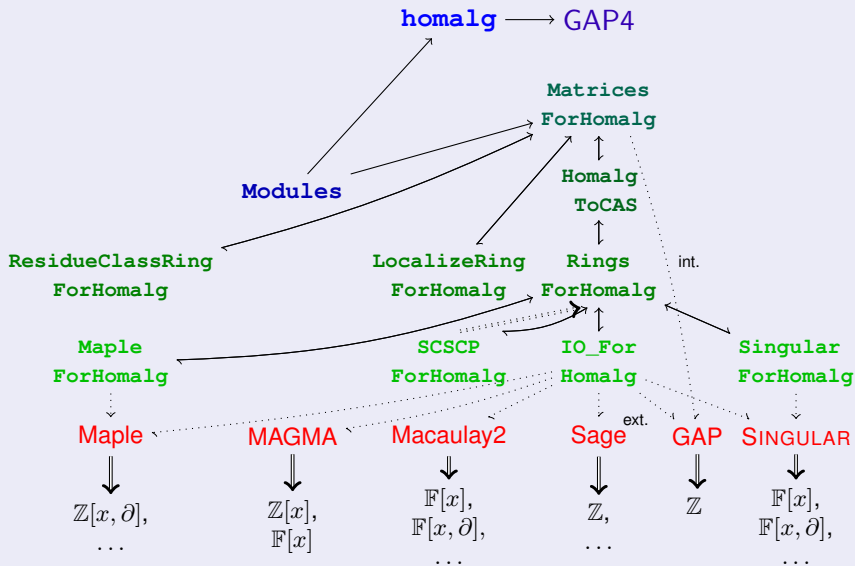




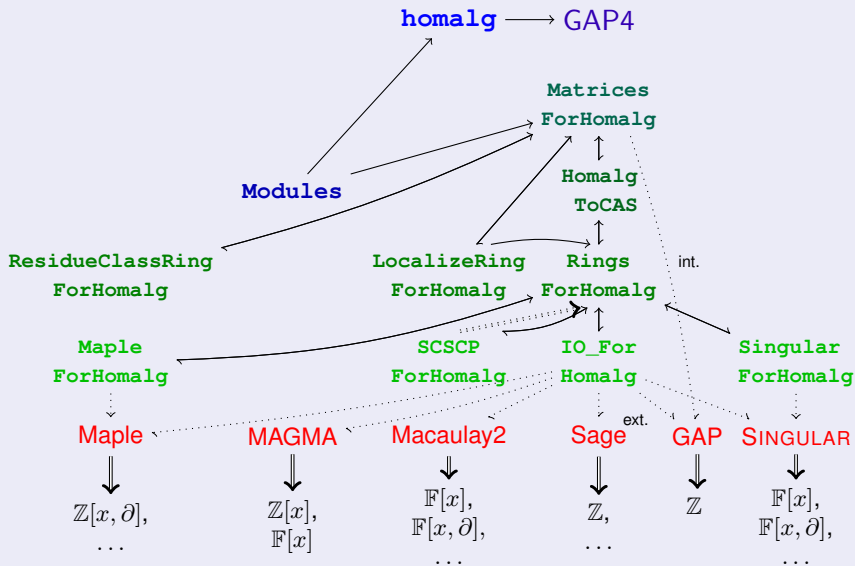
SCSCP\_ForHomalg: SCSCP can be used to reach computing engines running on local or remote machines



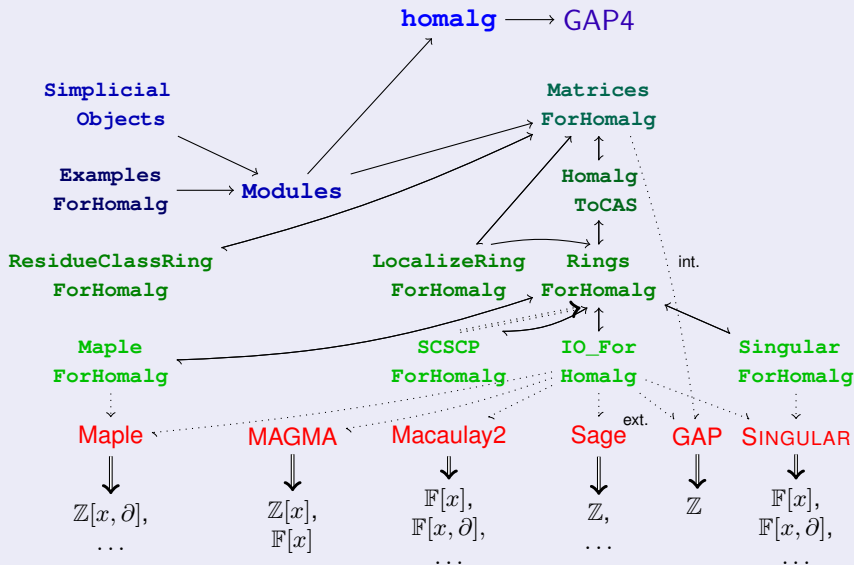


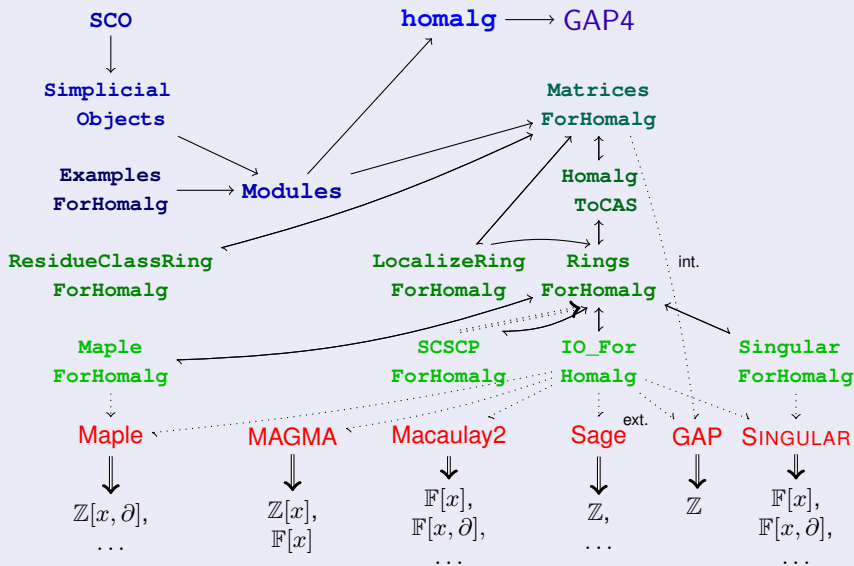


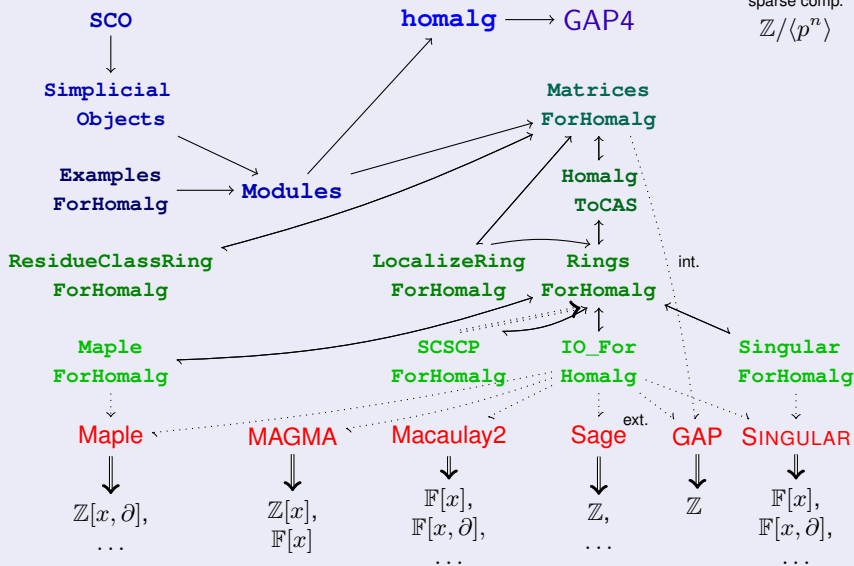
LocalizeRingForHomalg: Use MORA's algorithm in SINGULAR to localize polynomial rings at maximal ideals.





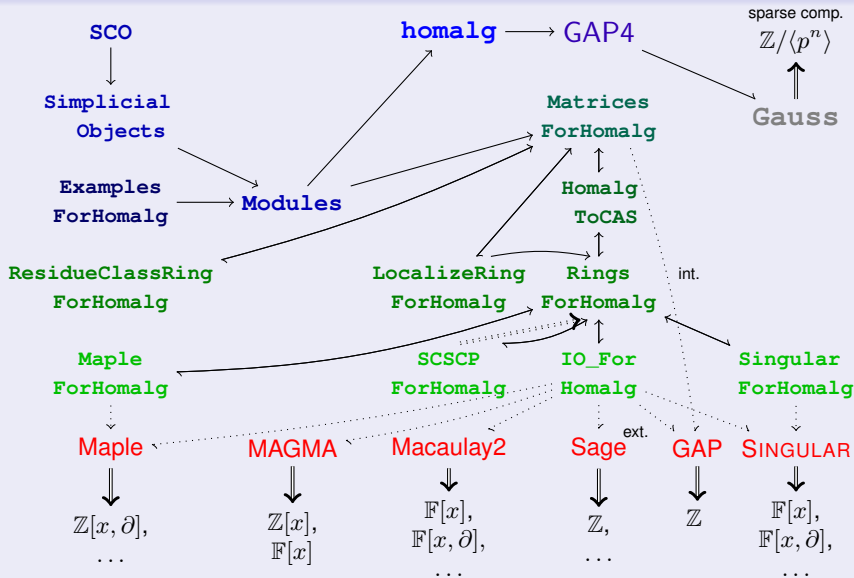


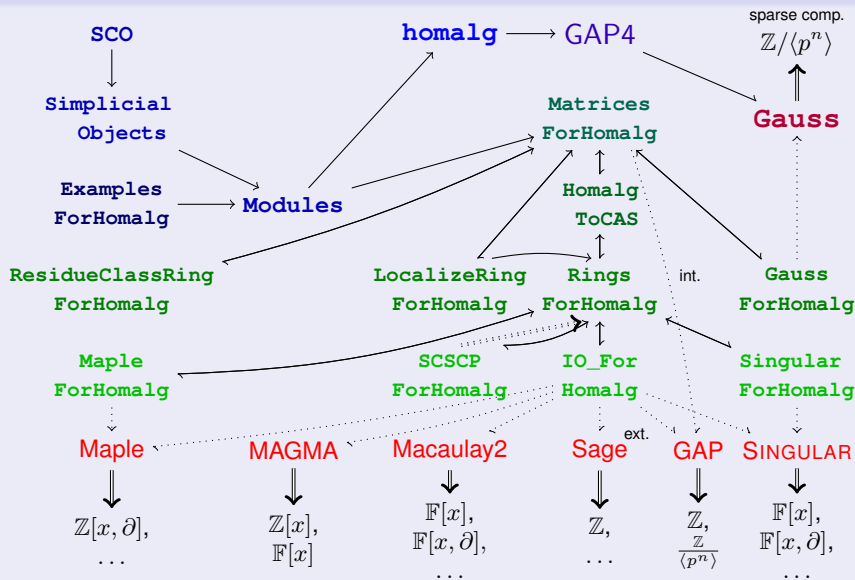






Gauss: Added missing RREF to GAP4 for **sparse** matrices over  $\mathbb{Z}/p^n\mathbb{Z}$  and  $\mathbb{Q}$





GradedRingForHomalg: Multi-graded rings serve as the data structure underlying many geometric constructions

