Package 'm2r'

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Type Package

Title Macaulay2 in R

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Description Persistent interface to Macaulay2 (<http://www.math.uiuc.edu/Macaulay2/>) and front-end tools facilitating its use in the R ecosystem.

License GPL-2

LazyData TRUE

Depends mpoly (>= 1.0.5)

Imports stringr, memoise, pryr, gmp

SystemRequirements Macaulay2 <http://www.math.uiuc.edu/Macaulay2/>

Suggests knitr, rmarkdown, testthat

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`enter_m2` *Enter a Macaulay2 session*

Description

Enter a Macaulay2 session

Usage

```
enter_m2(port = 27436L, timeout = 10)
```

Arguments

`port`	port for Macaulay2 socket
`timeout`	number of seconds before aborting

Value

`TRUE` invisibly

Examples

```
## Not run:  requires Macaulay2 be installed and an interactive session

enter_m2()

# m2 code below
1 + 1
a = 1
a
R = QQ[t,x,y,z]
I = ideal(t^4  -  x, t^3  -  y, t^2  -  z)
gens gb I
exit

# back in R, the variable persists using m2()
m2("a")
m2("I")
```

```
# we can also define variables in R that persist in m2
m2("b = 5")

enter_m2()
b
exit


## End(Not run)
```

`factor_n` *Factor an integer into primes*

Description

Factor an integer into primes

Usage

```
factor_n(n, code = FALSE, ...)

factor_n.(n, code = FALSE, ...)
```

Arguments

`n`	an integer or a polynomial
`code`	return only the M2 code? (default: `FALSE`)
`...`	...

Value

a data frame with integer columns `prime` and `power` or `m2_pointer` referencing the factorization in M2.

Examples

```
## Not run:  requires Macaulay2

##### basic usage
########################################

2^2 * 3^7 * 5^2 # = 218700
factor_n(218700)
factor_n.(218700)
```

```
(df <- factor_n(218700))
df$prime
df$power
str(df)


factor_n(218700, code = TRUE)


##### other options
########################################

(integer_pointer <- m2.("218700"))
m2_name(integer_pointer)
factor_n(integer_pointer, code = TRUE)
factor_n(integer_pointer)



factor_n(3234432540)
factor_n(323443254223453)
factor_n(rpois(1, 1e4))


##### known issues
########################################

# R doesn't handle big ints well. note in the following
# the m2 code number is different than the supplied number
factor_n(32344325422364353453, code = TRUE)

# this can be circumvented by passing a string instead
factor_n("32344325422364353453", code = TRUE)

# but if the factors are large, R can't handle the parsing well
factor_n("32344325422364353453")

# here's a workaround:
factor_pointer <- factor_n."32344325422364353453")
m2_meta(factor_pointer, "ext_str")
extract_factors <- function(pointer) {
  require(stringr)
  str <- m2_meta(pointer, "ext_str")
  str <- str_sub(str, 19, -2)
  str <- str_extract_all(str, "\\{[0-9]+,[0-9]+\\}")[[1]]
  str <- str_sub(str, 2, -2)
  str <- str_split(str, ",")
  df <- as.data.frame(t(simplify2array(str)))
  names(df) <- c("prime", "power")
  df
}
(df <- extract_factors(factor_pointer))
```

```
# using gmp (currently broken)
# factor_n("32344325422364353453", gmp = TRUE)
m2("11 * 479 * 6138607975396537")
11 * 479 * 6138607975396537


## End(Not run)
```

---

factor_poly *Factor a polynomial*

Description

Factor a polynomial

Usage

```
factor_poly(mpoly, code = FALSE)

factor_poly.(mpoly, code = FALSE, ...)
```

Arguments

mpoly	a character parseable by mp, an mpoly object, or a pointer to a polynomial in M2
code	return only the M2 code? (default: FALSE)
...	...

Value

a named list with elements factor (an mpolyList object) and power, an integer vector

Examples

```
## Not run:  requires Macaulay2 be installed and an interactive session

##### basic usage
########################################

ring("x", "y", coefring = "QQ")
factor_poly("x^4 - y^4")

# reference function
factor_poly.("x^4 - y^4")


##### different inputs
```

```
#######################################

# factor_poly accepts mpoly objects:
(p <- mp("x^4 - y^4"))
factor_poly.(p)
factor_poly(p)
mp("(x-y) (x+y) (x^2+y^2)")



##### other examples
#######################################

ring("x","y", "z", coefring = "QQ")
(p <- mp("(x^2 - y) (x^2 + y) (x + y)^2 (x - z)^2"))
factor_poly.(p)
factor_poly(p)

(p <- mp("(x-1)^3 (y-1)^3"))
factor_poly.(p)
factor_poly(p)


## End(Not run)
```

---

gb *Compute a Grobner basis with Macaulay2*

Description

Compute a Grobner basis with Macaulay2

Usage

```
gb(..., control = list(), raw_chars = FALSE, code = FALSE)

gb.(..., control = list(), raw_chars = FALSE, code = FALSE)

gb_(x, control = list(), raw_chars = FALSE, code = FALSE, ...)

gb_.(x, control = list(), raw_chars = FALSE, code = FALSE, ...)
```

Arguments

`...`	...
`control`	a list of options, see examples
`raw_chars`	if `TRUE`, the character vector will not be parsed by `mp`, saving time (default: `FALSE`). the down-side is that the strings must be formated for M2 use directly, as opposed to for `mp`. (e.g. `"x*y+3"` instead of `"x y + 3"`)

code	return only the M2 code? (default: FALSE)
x	a character vector of polynomials to be parsed by mp, a mpolyList object, an ideal or pointer to an ideal

Details

gb uses nonstandard evaluation; gb_ is the standard evaluation equivalent.

Value

an mpolyList object of class m2_grobner_basis or a m2_grobner_basis_pointer pointing to the same

See Also

mp, use_ring

Examples

```
## Not run:  requires Macaulay2


##### basic usage
########################################

# the last ring evaluated is the one used in the computation
ring("t","x","y","z", coefring = "QQ")
gb("t^4 - x", "t^3 - y", "t^2 - z")

# here's the code it's running in M2
gb("t^4 - x", "t^3 - y", "t^2 - z", code = TRUE)



##### different versions of gb
########################################

# standard evaluation version
poly_chars <- c("t^4 - x", "t^3 - y", "t^2 - z")
gb_(poly_chars)

# reference nonstandard evaluation version
gb.("t^4 - x", "t^3 - y", "t^2 - z")

# reference standard evaluation version
gb_.(poly_chars)



##### different inputs to gb
########################################
```

```
# ideals can be passed to gb
I <- ideal("t^4 - x", "t^3 - y", "t^2 - z")
gb_(I)

# note that gb() works here, too, since there is only one input
gb(I)

# ideal pointers can be passed to gb
I. <- ideal."t^4 - x", "t^3 - y", "t^2 - z")
gb_(I.)

# setting raw_chars is a bit faster, because it doesn't use ideal()
gb("t^4 - x", "t^3 - y", "t^2 - z", raw_chars = TRUE, code = TRUE)
gb("t^4 - x", "t^3 - y", "t^2 - z", raw_chars = TRUE)



##### more advanced usage
########################################

# the control argument accepts a named list with additional
# options
gb_(
  c("t^4 - x", "t^3 - y", "t^2 - z"),
  control = list(StopWithMinimalGenerators = TRUE),
  code = TRUE
)

gb_(
  c("t^4 - x", "t^3 - y", "t^2 - z"),
  control = list(StopWithMinimalGenerators = TRUE)
)



##### potential issues
########################################

# when specifying raw_chars, be sure to add asterisks
# between variables to create monomials; that's the M2 way
ring("x", "y", "z", coefring = "QQ")
gb("x y", "x z", "x", raw_chars = TRUE, code = TRUE) # errors without code = TRUE
gb("x*y", "x*z", "x", raw_chars = TRUE, code = TRUE) # correct way
gb("x*y", "x*z", "x", raw_chars = TRUE)
```

```
## End(Not run)
```

`ideal` *Create a new ideal in Macaulay2*

Description

Create a new ideal in Macaulay2

Usage

```
ideal(..., raw_chars = FALSE, code = FALSE)

ideal.(..., raw_chars = FALSE, code = FALSE)

ideal_(x, raw_chars = FALSE, code = FALSE, ...)

ideal_.(x, raw_chars = FALSE, code = FALSE, ...)

## S3 method for class 'm2_ideal'
print(x, ...)

## S3 method for class 'm2_ideal_list'
print(x, ...)

radical(ideal, ring, code = FALSE, ...)

radical.(ideal, ring, code = FALSE, ...)

saturate(I, J, code = FALSE, ...)

saturate.(I, J, code = FALSE, ...)

quotient(I, J, code = FALSE, ...)

quotient.(I, J, code = FALSE, ...)

primary_decomposition(ideal, code = FALSE, ...)

primary_decomposition.(ideal, code = FALSE, ...)

dimension(ideal, code = FALSE, ...)

## S3 method for class 'm2_ideal'
e1 + e2
```

```
## S3 method for class 'm2_ideal'
e1 * e2

## S3 method for class 'm2_ideal'
e1 == e2

## S3 method for class 'm2_ideal'
e1 ^ e2
```

Arguments

...	...
raw_chars	if TRUE, the character vector will not be parsed by mp, saving time (default: FALSE). the down-side is that the strings must be formated for M2 use directly, as opposed to for mp. (e.g. "x*y+3" instead of "x y + 3")
code	return only the M2 code? (default: FALSE)
x	a listing of polynomials. several formats are accepted, see examples.
ideal	an ideal object of class m2_ideal or m2_ideal_pointer
ring	the referent ring in Macaulay2
I, J	ideals or objects parsable into ideals
e1, e2	ideals for arithmetic

Value

a reference to a Macaulay2 ideal

Examples

```
## Not run:  requires Macaulay2


##### basic usage
########################################

ring("x", "y", coefring = "QQ")
ideal("x + y", "x^2 + y^2")



##### different versions of gb
########################################

# standard evaluation version
poly_chars <- c("x + y", "x^2 + y^2")
ideal_(poly_chars)

# reference nonstandard evaluation version
```

```
ideal.("x + y", "x^2 + y^2")

# reference standard evaluation version
ideal_.(poly_chars)



##### different inputs to gb
########################################

ideal_(   c("x + y", "x^2 + y^2") )
ideal_(mp(c("x + y", "x^2 + y^2")))
ideal_(list("x + y", "x^2 + y^2") )



##### predicate functions
########################################

I  <- ideal ("x + y", "x^2 + y^2")
I. <- ideal.("x + y", "x^2 + y^2")
is.m2_ideal(I)
is.m2_ideal(I.)
is.m2_ideal_pointer(I)
is.m2_ideal_pointer(I.)



##### ideal radical
########################################

I <- ideal("(x^2 + 1)^2 y", "y + 1")
radical(I)
radical.(I)



##### ideal dimension
########################################

I <- ideal_(c("(x^2 + 1)^2 y", "y + 1"))
dimension(I)

# dimension of a line
ring("x", "y", coefring = "QQ")
I <- ideal("y - (x+1)")
dimension(I)

# dimension of a plane
ring("x", "y", "z", coefring = "QQ")
I <- ideal("z - (x+y+1)")
dimension(I)
```

```
##### ideal quotients and saturation
########################################

ring("x", "y", "z", coefring = "QQ")
(I <- ideal("x^2", "y^4", "z + 1"))
(J <- ideal("x^6"))

quotient(I, J)
quotient.(I, J)

saturate(I)
saturate.(I)
saturate(I, J)
saturate(I, mp("x"))
saturate(I, "x")


ring("x", "y", coefring = "QQ")
saturate(ideal("x y"), "x^2")

# saturation removes parts of varieties
# solution over R is x = -1, 0, 1
ring("x", coefring = "QQ")
I <- ideal("(x-1) x (x+1)")
saturate(I, "x") # remove x = 0 from solution
ideal("(x-1) (x+1)")



##### primary decomposition
########################################

ring("x", "y", "z", coefring = "QQ")
I <- ideal("(x^2 + 1) (x^2 + 2)", "y + 1")
primary_decomposition(I)
primary_decomposition.(I)

I <- ideal("x (x + 1)", "y")
primary_decomposition(I)

# variety = z axis union x-y plane
(I <- ideal("x z", "y z"))
dimension(I) # =  max dimension of irreducible components
(Is <- primary_decomposition(I))
dimension(Is)



##### ideal arithmetic
########################################
```

```
ring("x", "y", "z", coefring = "RR")

# sums (cox et al., 184)
(I <- ideal("x^2 + y"))
(J <- ideal("z"))
I + J

# products (cox et al., 185)
(I <- ideal("x", "y"))
(J <- ideal("z"))
I * J

# equality
(I <- ideal("x", "y"))
(J <- ideal("z"))
I == J
I == I

# powers
(I <- ideal("x", "y"))
I^3


## End(Not run)
```

`is` *Macaulay2 object tests*

Description

Predicate functions for Macaulay2 objects.

Usage

```
is.m2(x)

is.m2_pointer(x)

is.ring(x)

is.m2_polynomialring(x)

is.m2_polynomialring_pointer(x)

is.m2_grobner_basis(x)

is.m2_ideal(x)

is.m2_ideal_pointer(x)
```

```
is.m2_ideal_list(x)

is.m2_ideal_list_pointer(x)

is.m2_module(x)

is.m2_option(x)

is.m2_matrix(x)

is.m2_matrix_pointer(x)

is.m2_list(x)

is.m2_array(x)

is.m2_sequence(x)
```

Arguments

x	an object

Value

logical(1)

Examples

```
## Not run:  requires Macaulay2

R <- ring(c("x1", "x2", "x3"))
is.m2(R)
is.ring(R)
is.ring(10)
is.ring(mp("x+1"))


## End(Not run)
```

---

m2r *Macaulay2 in R*

Description

Back-end connections to Macaulay2 (http://www.math.uiuc.edu/Macaulay2/)

`m2_call` *Call and reset a Macaulay2 process*

Description

Call and reset a Macaulay2 process

Usage

```
m2r_version_number()

start_m2(port = 27436L, timeout = 10, attempts = 10, cloud = FALSE,
  hostname = m2r_cloud_url())

stop_m2()

reset_m2(port = 27436L, timeout = 10, attempts = 10,
  hostname = "ec2-52-10-66-241.us-west-2.compute.amazonaws.com")

m2(code, timeout = -1)

m2.(code, timeout = -1)

## S3 method for class 'm2_pointer'
print(x, ...)
```

Arguments

`port`	port for Macaulay2 socket
`timeout`	number of seconds before aborting
`attempts`	numer of times to try to make connection
`cloud`	use a cloud?
`hostname`	the remote host to connect to; defaults to the Amazon EC2 instance
`code`	Macaulay2 code
`x`	formal argument for print method
`...`	...

Value

m2 return value

Examples

```
## Not run:  requires Macaulay2

m2("1 + 1")
m2.("1 + 1")

m2("factor 32004")

# run a chunk of m2 code, only pulling the end value back into R
m2("
  R = QQ[a..d]
  I = ideal(a^3-b^2*c, b*c^2-c*d^2, c^3)
  G = gens gb I
")

# illustrate the persistent connection
m2("a = 1 + 1")
m2("a")
reset_m2()
m2("a")



m2.("peek(QQ[x,y,z])")
m2("peek(QQ[x,y,z])")

# m2 returns in its ext_str position the result of running
# toExternalString on the return value of the chunk of code
# you run. in principle, toExternalString provides the code
# needed to recreate the m2 object of interest. however,
# does not work for all objects represtable in the m2 language.
# in particular, mutable objects are not supported.
# this is what happens when you look at those:
m2.("new MutableList from {1,2,3}")
m2("new MutableList from {1,2,3}")


## End(Not run)
```

`m2_matrix` *Create a new matrix in Macaulay2*

Description

Create a new matrix in Macaulay2

Usage

```
m2_matrix(mat, ring, name, code = FALSE)

m2_matrix.(mat, ring, name, code = FALSE)

m2_numrows(x, code = FALSE, ...)

m2_numcols(x, code = FALSE, ...)

m2_length(x, code = FALSE, ...)

## S3 method for class 'm2_matrix'
print(x, ...)

## S3 method for class 'm2_image'
print(x, ...)

m2_kernel(mat, name, code = FALSE)

m2_kernel.(mat, name, code = FALSE)
```

Arguments

mat	a matrix
ring	a ring containing the matrix entries
name	the m2_name of the object, which is it's name on the M2 side
code	return only the M2 code? (default: FALSE)
x	formal argument for print method
...	...

Value

a reference to a Macaulay2 ring

Examples

```
## Not run:  requires Macaulay2

##### basic usage
########################################

(mat <- m2_matrix(matrix(c(1,2,3,4,5,6), nrow = 3, ncol = 2))
m2_matrix(matrix(c(1,2,3,4,5,6), nrow = 3, ncol = 2))

m2_name(mat)
m2(m2_name(mat))
m2(sprintf("class(%s)", m2_name(mat)))
```

```
(mat <- m2_matrix.(matrix(c(1,2,3,4,5,6), nrow = 3, ncol = 2)))

##### known issues
########################################

ring("x", "y", "z", coefring = "QQ")
mat <- matrix(mp(c("x","y","x+y","y-2","x-3","y-z")), nrow = 2, ncol = 3)
m2_matrix(mat, code = TRUE)
m2_matrix(mat)
# the above is an mpoly problem, not a m2r problem
# mpoly does not have a data structure for matrices (as of 12/2016)

mat_chars <- sapply(m2_matrix(mat), print, silent = TRUE)
dim(mat_chars) <- c(2, 3)
mat_chars


m2_numrows(mat)
m2_numcols(mat)
m2_parse(mat)

(mat <- m2_matrix(matrix(c(1,2),nrow=1)))
m2_kernel(mat)


## End(Not run)
```

`m2_parser` *Convert a M2 object into an R object*

Description

Convert a M2 object into an R object

Usage

```
m2_parse(s)

## S3 method for class 'm2_integer'
print(x, ...)

## S3 method for class 'm2_float'
print(x, ...)

## S3 method for class 'm2_complex'
print(x, ...)

## S3 method for class 'm2_string'
print(x, ...)
```

```
## S3 method for class 'm2_boolean'
print(x, ...)

## S3 method for class 'm2_list'
print(x, ...)

## S3 method for class 'm2_array'
print(x, ...)

## S3 method for class 'm2_sequence'
print(x, ...)

## S3 method for class 'm2_symbol'
print(x, ...)

## S3 method for class 'm2_option'
print(x, ...)

## S3 method for class 'm2_hashtable'
print(x, ...)

## S3 method for class 'm2_module'
print(x, ...)

m2_toggle_gmp()

get_m2_gmp()
```

Arguments

s	a character(1), typically the result of running toExternalString on an M2 object
x	an object to be printed
...	...

Value

an R object

Examples

```
## Not run:  requires Macaulay2

m2("1+1")
m2.("1+1")
m2_parse(m2.("1+1"))

m2("QQ[x,y]")
```

```
m2.("QQ[x,y]")
m2_parse(m2.("QQ[x,y]"))

get_m2_gmp()
m2("3/2") %>% m2_parse()
m2_toggle_gmp() # gmp on
m2("3/2") %>% m2_parse()
m2("6/4") %>% m2_parse()
m2("33452345243524354324/22345432523543252435243324 5") %>% m2_parse()
m2_toggle_gmp() # gmp off



m2("50!") %>% m2_parse()
m2_toggle_gmp() # gmp on
m2("50!") %>% m2_parse()
m2_toggle_gmp() # gmp off


## End(Not run)
```

`m2_path` *Set path to Macaulay2 (M2)*

Description

This function sets the path to external programs either by (1) passing it a character string or (2) using `file.choose`.

Usage

```
set_m2_path(path = NULL)

get_m2_path()

get_m2_con()

get_m2_procid()

get_m2_port()
```

Arguments

`path`	A character string, the path to M2

Details

When m2r is loaded it attempts to find M2. How it looks depends on your operating system.

If you're using a Mac or Linux machine, it looks based on your system's path. Unfortunately, R changes the system path in such a way that the path that R sees is not the same as the path that you'd see if you were working in the terminal. (You can open the Terminal app on a Mac by going to /Applications/Utilities/Terminal.) Consequently, m2r tries to guess the file in which your path is set. To do so, it first checks if your home directory (type echo ~/ in the terminal to figure out which directory this is if you don't know) for the file named .bash_profile. If this file is present, it runs it and then checks your system's path variable (echo $PATH). If it's not present, it does the same for .bashrc and then .profile. In any case, once it has its best guess at your path, it looks for "M2".

On Windows, m2r just defaults to the cloud implementation. Local M2 instances are not currently supported on Windows.

Value

An invisible character string, the path found. More importantly, the function has the side effect of setting the global m2r option "m2_path"

Author(s)

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Examples

```
## Not run:  requires Macaulay2


getOption("m2r")
get_m2_path()
set_m2_path()


## each of these functions can be used statically as well
(m2_path <- get_m2_path())
set_m2_path("/path/to/m2/directory")
get_m2_path()
set_m2_path(m2_path) # undoes example


# if you'd like to use the cloud, after you library(m2r)
# and before you use m2() type
set_m2_path(NULL)

# alternatively, if you have already been using m2, do:
stop_m2()
set_m2_path(NULL)
m2("1+1")
```

```
## End(Not run)
```

`m2_utility` *Utility tools for M2*

Description

Utility tools for M2

Usage

```
m2_name(x)

m2_name(x) <- value

m2_meta(x, m2_attr)

m2_meta(x, m2_attr) <- value

m2_structure(x = NA, m2_name, m2_class, m2_meta, base_class)

m2_exists(name)

m2_ls(all.names = FALSE)

m2_rm(name)

m2_getwd()
```

Arguments

`x`	an object of class `m2`
`value`	the value to assign
`m2_attr`	the name of an M2 attribute
`m2_name`	`m2_name` M2 attribute
`m2_class`	`m2_class` M2 attribute
`m2_meta`	`m2_meta` M2 attribute
`base_class`	a base class; an R class to use for dispatching if there is no relevant method for the other classes (e.g. `m2`)
`name`	a string; the name of a M2 object
`all.names`	if `TRUE`, all registered Macaulay2 variables, including ones internally used by m2r, will be returned

Examples

```
## Not run:  requires Macaulay2

m2("a = 5")
m2_ls()
m2_exists("a")
m2("b = 1")
m2_exists(c("a","b","c"))

m2_getwd()

x <- 1
class(x) <- "m2"
attr(x, "m2_meta") <- list(a = 1, b = 2)
m2_meta(x)
m2_meta(x, "b")
m2_meta(x, "b") <- 5
m2_meta(x, "b")

# R <- ring(c("x1", "x2", "x3"))
# m2_name(R)
# m2(sprintf("class %s", m2_name(R)))
# m2_ls()
# m2_rm(m2_name(R))
# m2_ls()
# m2(paste("class", m2_name(R)))

m2_ls()
m2_ls(all.names = TRUE)



## End(Not run)
```

---

phc *PHCpack*

Description

Call PHCpack to solve a zero-dimensional system

Usage

```
solve_system(mpolyList)

solve_system.(mpolyList)

mixed_volume(mpolyList)
```

Arguments

mpolyList	An mpolyList object

Details

Note that solve_system() doesn't take in an input ring because the solver only works over the complex numbers.

Value

(currently) the output of an m2() call (string?)

Examples

```
## Not run:  requires Macaulay2

# for this to work, you need to have modified your
# init-PHCpack.m2 file instead of changing your .bashrc
# file to establish the path of phc
# (**clarify**, maybe checkout algstat::polySolve)

(mpolyList <- mp(c("t^4 - x", "t^3 - y", "t^2 - z", "x+y+z")))
solve_system(mpolyList)
mixed_volume(mpolyList)


## End(Not run)
```

---

ring *Create a new ring in Macaulay2*

Description

Create a new ring in Macaulay2

Usage

```
ring(..., coefring = m2_coefrings(), order = m2_termorders(),
  code = FALSE)

ring.(..., coefring = m2_coefrings(), order = m2_termorders(),
  code = FALSE)

ring_(vars, coefring = m2_coefrings(), order = m2_termorders(),
  code = FALSE, ...)

ring_.(vars, coefring = m2_coefrings(), order = m2_termorders(),
```

```
  code = FALSE, ...)

m2_coefrings()

m2_termorders()

## S3 method for class 'm2_polynomialring'
print(x, ...)
```

Arguments

...	...
coefring	coefficient ring (default: "CC")
order	a term order (default: "grevlex")
code	return only the M2 code? (default: FALSE)
vars	vector of variable names
x	formal argument for print method

Value

a reference to a Macaulay2 ring

Examples

```
## Not run:  requires Macaulay2

##### basic usage
########################################

ring("x", "y")
ring("x", "y", coefring = "QQ")


##### standard evaluation
########################################

ring_(c("x", "y"))
ring_(c("x", "y"), code = TRUE)

(myring <- ring_(c("x1","x2","x3","y"), coefring = "QQ", order = "lex"))

m2_name(myring)
m2_meta(myring, "vars")
m2_meta(myring, "coefring")
m2_meta(myring, "order")

##### other options
########################################
```

```
ring_.(c("x", "y"))
ring_.(c("x", "y"), code = TRUE)


## End(Not run)
```

---

snf *Smith normal form*

Description

For an integer matrix M, this computes the matrices D, P, and Q such that $D = PMQ$, which can be seen as an analogue of the singular value decomposition. All are integer matrices, and P and Q are unimodular (have determinants +- 1).

Usage

```
snf(mat, code = FALSE)

snf.(mat, code = FALSE)
```

Arguments

mat	a matrix (integer entries)
code	return only the M2 code? (default: FALSE)

Value

a list of integer matrices D, P, and Q

Examples

```
## Not run:  requires Macaulay2

##### basic usage
########################################

M <- matrix(c(
   2,  4,   4,
  -6,  6,  12,
  10, -4, -16
), nrow = 3, byrow = TRUE)

snf(M)

(mats <- snf(M))
P <- mats$P; D <- mats$D; Q <- mats$Q
```

```
P %*% M %*% Q                # = D
solve(P) %*% D %*% solve(Q)  # = M

det(P)
det(Q)


M <- matrix(c(
     1,    2,    3,
     1,   34,   45,
  2213, 1123, 6543,
     0,    0,    0
), nrow = 4, byrow = TRUE)
(mats <- snf(M))
P <- mats$P; D <- mats$D; Q <- mats$Q
P %*% M %*% Q                # = D


##### other options
########################################

snf.(M)
snf(M, code = TRUE)




## End(Not run)
```

`str_m2` *Give the structure of a Macaulay2 ring*

Description

Give the structure of a Macaulay2 ring

Usage

```
str_m2(object, ...)
```

Arguments

`object`	An `m2` object
`...`	...

Value

Invisible the object passed in.

Examples

```
## Not run:  requires Macaulay2

a <- m2("1")

R <- ring(c("x1", "x2", "x3"))
str_m2(R)
str_m2.default(R)


## End(Not run)
```

---

use_ring *Set Macaulay2 ring*

Description

use_ring() sets the default referent ring on the Macaulay2 side using the use function.

Usage

```
use_ring(ring)
```

Arguments

ring	a m2_ring (ring), m2_ring_pointer (ring.), or a character string containing the name of a ring in Macaulay2

Examples

```
## Not run:  requires Macaulay2


##### basic usage
########################################

ring("x", coefring = "QQ")
factor_poly("x^4 + 1")

QQtxyz <- ring("t","x","y","z", coefring = "QQ")
gb("t^4 - x", "t^3 - y", "t^2 - z")

ring("x", "y", "z", "t", coefring = "QQ")
gb("t^4 - x", "t^3 - y", "t^2 - z")

use_ring(QQtxyz)
```

```
gb("t^4 - x", "t^3 - y", "t^2 - z")

## End(Not run)
```

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