

Package ‘Ryacas’

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Title R Interface to the 'Yacas' Computer Algebra System

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Description Interface to the 'yacas' computer algebra system (<<http://www.yacas.org/>>).

Depends R (>= 3.3.0)

Imports Rcpp (>= 0.12.0), stats, methods, magrittr

LinkingTo Rcpp

Suggests devtools, exams, knitr, Matrix, pkgload, rmarkdown, igraph, testthat (>= 2.1.0), unix, Rmpfr

License GPL

SystemRequirements C++11

URL <https://github.com/r-cas/ryacas>, <http://www.yacas.org>

BugReports <https://github.com/r-cas/ryacas/issues>

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R topics documented:

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Ryacas-package

R interface to yacas computer algebra package

Description

Ryacas allows one to use the yacas computer algebra package entirely from within R.

Details

Please read the "Getting started" vignette.

as.character.yac_symbol

Convert yac symbol to character

Description

Convert yac symbol to character

Usage

```
## S3 method for class 'yac_symbol'
as.character(x, ...)
```

Arguments

| | |
|-----|--------------|
| x | A yac_symbol |
| ... | not used |

as_r

Convert yacas object to R

Description

If x is a yacas command as string, convert to a character vector/matrix in R. If x is a yac_symbol (e.g. from `ysym()`), then convert it to a numeric object if there are no variables or a character type if there are variables.

Usage

```
as_r(x)
```

Arguments

x yacas list or list of lists to convert

Details

In yacas a vector is a list, and a matrix is a list of lists.

as_y *Convert R vector/matrix to yacas vector (list) or matrix (list of lists)*

Description

Convert R vector/matrix to yacas vector (list) or matrix (list of lists)

Usage

```
as_y(x)
```

Arguments

x R vector to convert

cbind.yac_symbol *Combine R Objects by Columns*

Description

Combine R Objects by Columns

Usage

```
## S3 method for class 'yac_symbol'  
cbind(..., deparse.level = 1)
```

Arguments

... Objects to bind
deparse.level Not used

| | |
|------------------|--|
| deriv.yac_symbol | <i>Find the derivative of yac symbol</i> |
|------------------|--|

Description

Find the derivative of yac symbol

Usage

```
## S3 method for class 'yac_symbol'  
deriv(expr, ...)
```

Arguments

| | |
|------|--|
| expr | A yac_symbol |
| ... | variables as character vector to take derivate with respect to |

| | |
|------|-------------------------|
| diag | <i>Matrix diagonals</i> |
|------|-------------------------|

Description

From [base::diag\(\)](#).

Usage

```
diag(x, ...)
```

Arguments

| | |
|-----|---|
| x | If yac_symbol treat as such, else call base::diag() . |
| ... | further arguments passed to base::diag() |

| | |
|--------|-------------------------|
| diag<- | <i>Matrix diagonals</i> |
|--------|-------------------------|

Description

From `base::diag()`.

Usage

```
diag(x) <- value
```

Arguments

| | |
|-------|--|
| x | If <code>yac_symbol</code> treat as such, else call <code>base::diag<-()</code> . |
| value | New value for <code>diag(x)</code> |

| | |
|---------|--|
| Hessian | <i>Find the Hessian matrix of yac symbol</i> |
|---------|--|

Description

Find the Hessian matrix of `yac` symbol

Usage

```
Hessian(expr, ...)
```

Arguments

| | |
|------|---|
| expr | A <code>yac_symbol</code> |
| ... | variables as character vector to take Hessian with respect to |

integrate

Integration of Functions

Description

If `f` is a `yac_symbol`, `yacas`'s `Integrate()` is used. Else, `stats::integrate()` is used.

Usage

```
integrate(f, ...)
```

Arguments

| | |
|------------------|-------------------------------------|
| <code>f</code> | Function to integrate. See details. |
| <code>...</code> | See details. |

Details

Additional arguments:

- `yac_symbol`: `var`, `lower`, `upper`
- Else (`stats::integrate()`): `lower`, `upper`

Jacobian

Find the Jacobian matrix of yac symbol

Description

Find the Jacobian matrix of `yac` symbol

Usage

```
Jacobian(expr, ...)
```

Arguments

| | |
|-------------------|--|
| <code>expr</code> | A <code>yac_symbol</code> |
| <code>...</code> | variables as character vector to take Jacobian with respect to |

| | |
|-----|---------------|
| lim | <i>Limits</i> |
|-----|---------------|

Description

If first argument is a `yac_symbol`, `yacas's Limit()` is used.

Usage

```
lim(...)
```

Arguments

... See details.

Details

Arguments:

- `yac_symbol`: `f`, `var`, `val`, `from_left`, `from_right`

| | |
|-----------|--|
| lower.tri | <i>Lower and upper triangular part of a matrix</i> |
|-----------|--|

Description

Lower and upper triangular part of a matrix

Usage

```
lower.tri(x, diag = FALSE)
```

Arguments

`x` If `yac_symbol` treat as such, else call `base::lower.tri()/base::upper.tri()`.
`diag` Whether diagonal is included.

Math.yac_symbol *Math functions*

Description

Math functions

Usage

```
## S3 method for class 'yac_symbol'  
Math(x, ...)
```

Arguments

x yac_symbol.
... further arguments passed to methods

Ops.yac_symbol *Math operators*

Description

Math operators

Usage

```
## S3 method for class 'yac_symbol'  
Ops(e1, e2)
```

Arguments

e1 A yac_symbol.
e2 A yac_symbol.

prod.yac_symbol *Product of Vector Elements*

Description

Product of Vector Elements

Usage

```
## S3 method for class 'yac_symbol'  
prod(expr, ..., na.rm = FALSE)
```

Arguments

| | |
|-------|-----------------------------|
| expr | Expression to be multiplied |
| ... | Not used |
| na.rm | Not used |

rbind.yac_symbol *Combine R Objects by Rows*

Description

Combine R Objects by Rows

Usage

```
## S3 method for class 'yac_symbol'  
rbind(..., deparse.level = 1)
```

Arguments

| | |
|---------------|-----------------|
| ... | Objects to bind |
| deparse.level | Not used |

| | |
|----------|----------------------------|
| simplify | <i>Simplify expression</i> |
|----------|----------------------------|

Description

Simplify expression

Usage

```
simplify(x, timeout = 2)
```

Arguments

| | |
|---------|--|
| x | A yac_symbol |
| timeout | timeout in seconds before simplification is aborted; only works when package unix is available |

| | |
|------------------|------------------------------------|
| solve.yac_symbol | <i>Solve a system of equations</i> |
|------------------|------------------------------------|

Description

This generic function solves the equation $a x = b$ for x .

Usage

```
## S3 method for class 'yac_symbol'
solve(a, b, ...)
```

Arguments

| | |
|-----|--|
| a | A yac_symbol |
| b | A yac_symbol or a value, see details and examples. |
| ... | See details and examples. |

Details

When a is a matrix and b not provided, this finds the inverse of a. When a is a matrix and a vector b is provided, the linear system of equations is solved.

Note that solving non-linear equations:

- solve(a, b): find roots of a for variable b, i.e. yacas Solve(a == 0, b)
- solve(a, b, v): find solutions to a == b for variable v, i.e. yacas Solve(a == b, v)

This also works for a system of equations (when a is a vector)

Examples

```

A <- outer(0:3, 1:4, "-") + diag(2:5)
a <- 1:4
B <- ysym(A)
b <- ysym(a)
solve(A)
solve(B)
solve(A, a)
solve(B, b)

poly <- ysym("x^2 - x - 6")
solve(poly, "x") # Solve(poly == 0, x)
solve(poly, 3, "x") # Solve(poly == 3, x)

```

sum.yac_symbol

Summation

Description

If only expr given: sum elements.

Usage

```

## S3 method for class 'yac_symbol'
sum(expr, var, lower, upper, ..., na.rm = FALSE)

```

Arguments

| | |
|-------|-------------------------|
| expr | Expression to be summed |
| var | Variable to sum |
| lower | Lower limit |
| upper | Upper limit |
| ... | Not used |
| na.rm | Not used |

Details

Else: sums expr by letting var taking values from lower to upper (potentially Inf)

| | |
|---|----------|
| t | <i>t</i> |
|---|----------|

Description

t

Usage

```
## S3 method for class 'yac_symbol'
t(x)
```

Arguments

x If `yac_symbol` treat as such, else call `base::t()`.

| | |
|-----|-----------------------------|
| tex | <i>Export object to TeX</i> |
|-----|-----------------------------|

Description

Export object to TeX

Usage

tex(x)

Arguments

x A `yac_symbol`

| | |
|-----------|--|
| upper.tri | <i>Lower and upper triangular part of a matrix</i> |
|-----------|--|

Description

Lower and upper triangular part of a matrix

Usage

upper.tri(x, diag = FALSE)

Arguments

x If `yac_symbol` treat as such, else call `base::lower.tri()/base::upper.tri()`.
diag Whether diagonal is included.

| | |
|------------|--------------------------------|
| with_value | <i>Give a variable a value</i> |
|------------|--------------------------------|

Description

Give a variable a value

Usage

```
with_value(x, var, val)
```

Arguments

| | |
|-----|------------|
| x | yac_symbol |
| var | Variable |
| val | Value |

| | |
|-----|--------------------------|
| yac | <i>Run yacas command</i> |
|-----|--------------------------|

Description

Run yacas command

Usage

```
yac(x, rettype = c("str", "expr", "silent"))
```

Arguments

| | |
|---------|--|
| x | yacas command |
| rettype | str for string/character, expr for expression, silent for silent |

Examples

```
yac("D(x) x^2 + 4*x")
yac("D(x) x^2 + 4*x", rettype = "str")
yac("D(x) x^2 + 4*x", rettype = "expr")
yac("D(x) x^2 + 4*x", rettype = "silent")
```

| | |
|------------|------------------------------|
| yac_assign | <i>Assign yacas variable</i> |
|------------|------------------------------|

Description

Assign yacas variable

Usage

```
yac_assign(value, x)
```

Arguments

| | |
|-------|---------------|
| value | Expression |
| x | Variable name |

| | |
|---------|-------------------------------------|
| yac_cli | <i>yacas command line interface</i> |
|---------|-------------------------------------|

Description

Interactive interface to the yacas

Usage

```
yac_cli(enable_history = TRUE)
```

Arguments

enable_history Use R history such that previous yacas commands can be used. Default is TRUE.

Details

The user types valid yacas input and presses return. Type 'quit' to return to R prompt.

Value

Output of yacas is returned.

Note

Note that command will use R `history()` and modify it by default. Yacas is given a limited amount of time to complete, otherwise `\[1\]` `CommandLine(1)` : User interrupted calculation is returned. E.g. `Taylor(x,0,5) 1/(1+x)` will work, but `Taylor(x,0,12) 1/(1+x)` is likely to take too long.

References

<http://yacas.sourceforge.net>

Examples

```
## Not run:  
yac_cli()  
(x+y)^3-(x-y)^3  
Simplify(%)  
q  
  
## End(Not run)
```

yac_expr

Run yacas command returning R expression

Description

Run yacas command returning R expression

Usage

```
yac_expr(x)
```

Arguments

x yacas command

Examples

```
yac_expr("D(x) x^2 + 4*x")  
yac_expr("Limit(x, 1) (x^2 - 1)/(x - 1)")  
yac_expr("Sum(n, 1, Infinity, (1/2)^n)")  
yac_expr("Fibonacci(10)")  
yac_expr("Sum(n, 1, 10, Fibonacci(n))")
```

| | |
|------------|-----------------------------------|
| yac_silent | <i>Run yacas command silently</i> |
|------------|-----------------------------------|

Description

Run yacas command silently

Usage

yac_silent(x)

Arguments

x yacas command

| | |
|---------|---|
| yac_str | <i>Run yacas command returning string/character</i> |
|---------|---|

Description

Run yacas command returning string/character

Usage

yac_str(x)

Arguments

x yacas command

Examples

```
yac_str("D(x) x^2 + 4*x")
yac_str("Limit(x, 1) (x^2 - 1)/(x - 1)")
yac_str("Sum(n, 1, Infinity, (1/2)^n)")
yac_str("Fibonacci(10)")
yac_str("Sum(n, 1, 10, Fibonacci(n))")
yac_str("TeXForm(x^2 - 1)")
```

`yac_symbol`*Make a yacas symbol*

Description

This is an alias for [ysym\(\)](#). See description there.

Usage`yac_symbol(x)`**Arguments**

`x` A vector or a matrix

Value

A `yac_symbol`

`ysym`*Make a yacas symbol*

Description

Note that this results in multiple calls to `yacas` and the performance may be slower than manually using e.g. [yac_str\(\)](#).

Usage`ysym(x)`**Arguments**

`x` A vector or a matrix

Value

A `yac_symbol`

| | |
|---------|---------------------------------|
| ysym_ls | <i>List defined yac_symbols</i> |
|---------|---------------------------------|

Description

List defined yac_symbols

Usage

```
ysym_ls(print_details = FALSE)
```

Arguments

print_details print content of symbols

| | |
|------|----------------------------------|
| y_fn | <i>Prepare simple yacas call</i> |
|------|----------------------------------|

Description

Prepare simple yacas call

Usage

```
y_fn(x, fn, ...)
```

Arguments

x parameter to function fn
fn function with parameter x
... additional arguments to fn

Examples

```
y_fn("x^2 - 1", "TeXForm")
yac_str(y_fn("x^2 - 1", "TeXForm"))

y_fn("x^2 - 1", "Factor")
yac_str(y_fn("x^2 - 1", "Factor"))

cmd <- "x^2 - 1 == 0" %>% y_fn("Solve", "x")
cmd
sol <- yac_str(cmd)
sol
yac_str(y_rmvars(sol))
```

y_print

Pretty print yacas strings

Description

Pretty print yacas strings

Usage

```
y_print(x)
```

Arguments

x yacas string, e.g. a matrix

Examples

```
A <- diag(4)
Ayac <- as_y(A)
y_print(Ayac)
```

```
B <- A
B[2, 2] <- "-t"
Byac <- as_y(B)
Byac
y_print(Byac)
```

y_rmvars*Remove/strip variable names*

Description

This only builds a yacas command. You need to also call [yac_str\(\)](#), [yac_expr\(\)](#) or similar. This is the reason that it does not call yacas: it depends on how you want it returned (string, expression).

Usage

```
y_rmvars(x)
```

Arguments

x yacas command

Examples

```
cmd <- "{x == 2, y == 4}"
yac_str(cmd)
yac_str(y_rmvvars(cmd))
```

[.yac_symbol *Extract or replace parts of an object*

Description

Extract or replace parts of an object

Usage

```
## S3 method for class 'yac_symbol'
x[i, j]
```

Arguments

| | |
|---|--|
| x | A yac_symbol. |
| i | row indices specifying elements to extract or replace |
| j | column indices specifying elements to extract or replace |

[<-.yac_symbol *Extract or replace parts of an object*

Description

Extract or replace parts of an object

Usage

```
## S3 replacement method for class 'yac_symbol'
x[i, j] <- value
```

Arguments

| | |
|-------|--|
| x | A yac_symbol. |
| i | row indices specifying elements to extract or replace |
| j | column indices specifying elements to extract or replace |
| value | the value to replace x[i, j] by |

`[[.yac_symbol` *Extract parts of an object*

Description

Extract parts of an object

Usage

```
## S3 method for class 'yac_symbol'  
x[[i]]
```

Arguments

x A yac_symbol.
i indices specifying elements to extract

`%*%` *Matrix multiplication*

Description

Matrix multiplication

Usage

```
x %*% y
```

Arguments

x A yac_symbol
y A yac_symbol

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