Package 'qspray'

December 21, 2022

Type Package

Title Multivariate Polynomials with Rational Coefficients

Version 0.1.1

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Description Symbolic calculation and evaluation of multivariate polynomials with rational coefficients. This package is strongly inspired by the 'spray' package.

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URL https://github.com/stla/qspray

BugReports https://github.com/stla/qspray/issues

Imports DescTools, gmp, methods, purrr, Rcpp (>= 1.0.9), Ryacas

LinkingTo BH, Rcpp, RcppCGAL, RcppEigen

Encoding UTF-8

RoxygenNote 7.2.3

SystemRequirements C++ 17, gmp, mpfr

Collate 'RcppExports.R' 'internal.R' 'qspray.R' 'yacas.R'

NeedsCompilation yes

Author Stéphane Laurent [aut, cre], Robin Hankin [ctb, cph] (author of the 'spray' package, which strongly inspired this package)

Repository CRAN

Date/Publication 2022-12-21 00:20:02 UTC

R topics documented:

`qspray-package` *A short title line describing what the package does*

Description

A more detailed description of what the package does. A length of about one to five lines is recommended.

Details

This section should provide a more detailed overview of how to use the package, including the most important functions.

Author(s)

Your Name, email optional.

Maintainer: Your Name <your@email.com>

References

This optional section can contain literature or other references for background information.

See Also

Optional links to other man pages

Examples

```
## Not run:
   ## Optional simple examples of the most important functions
   ## These can be in \dontrun{} and \donttest{} blocks.

## End(Not run)
```

as.function.qspray *Multivariate polynomial as function*

Description

Coerces a qspray polynomial into a function.

Usage

```
## S3 method for class 'qspray'
as.function(x, ...)
```

Arguments

x	object of class qspray
...	ignored

Value

A function having the same variables as the polynomial. It returns a string.

Examples

```
library(qspray)
P <- (qlone(1) + "1/2"*qlone(2))^2 + 5
f <- as.function(P)
f(2, "3/7")
f("x", "y")
# the evaluation is performed by (R)yacas and complex numbers are
# allowed; the imaginary unit is denoted by `I`
f("2 + 2*I", "1/4")
```

as.qspray *Coercion to a 'qspray' object*

Description

Coercion to a 'qspray' object

Usage

```
## S4 method for signature 'character'
as.qspray(x)

## S4 method for signature 'qspray'
as.qspray(x)

## S4 method for signature 'numeric'
as.qspray(x)

## S4 method for signature 'bigz'
as.qspray(x)

## S4 method for signature 'bigq'
as.qspray(x)
```

Arguments

x	a qspray object or an object yielding a quoted integer or a quoted fraction after an application of as.character

Value

A qspray object.

Examples

```
as.qspray(2)
as.qspray("1/3")
```

---

detQ *Determinant of a rational matrix*

Description

Determinant of a square matrix with rational entries.

Usage

```
detQ(M)
```

Arguments

M	a square matrix such that each entry of as.character(M) is a quoted integer or a quoted fraction

Value

A quoted rational number representing the determinant.

Examples

```
library(qspray)
M <- cbind(c("1/2", "3"), c("5/3", "-2/7"))
detQ(M)
```

ESFpoly *Elementary symmetric function*

Description

Returns an elementary symmetric function as a polynomial.

Usage

```
ESFpoly(m, lambda)
```

Arguments

m	integer, the number of variables
lambda	an integer partition, given as a vector of decreasing positive integers

Value

A qspray object.

Examples

```
library(qspray)
ESFpoly(3, c(3, 1))
```

---

evalQspray *Evaluate a 'qspray' object*

Description

Evaluation of the multivariate polynomial represented by a qspray object.

Usage

```
evalQspray(qspray, values_re, values_im = NULL)
```

Arguments

qspray	a qspray object
values_re	vector of the real parts of the values; each element of as.character(values_re) must be quoted integer or a quoted fraction
values_im	vector of the imaginary parts of the values; each element of as.character(values_im) must be quoted integer or a quoted fraction

Value

A bigq number if values_im=NULL, a pair of bigq numbers otherwise: the real part and the imaginary part of the result.

Examples

```
x <- qlone(1); y <- qlone(2)
P <- 2*x + "1/2"*y
evalQspray(P, c("2", "5/2", "99999")) # "99999" will be ignored
```

---

integratePolynomialOnSimplex

Integral of a multivariate polynomial over a simplex

Description

Returns the exact value of the integral of a multivariate polynomial with rational coefficients over a simplex whose vertices have rational coordinates.

Usage

```
integratePolynomialOnSimplex(P, S)
```

Arguments

P	a qspray object
S	the simplex, a (n+1)xn matrix such that each entry of the matrix as.character(S) is a quoted integer or a quoted fraction

Value

A bigq number, the exact value of the integral.

Examples

```
library(qspray)
x <- qlone(1); y <- qlone(2)
P <- x/2 + x*y
S <- rbind(c("0", "0"), c("1", "0"), c("1", "1")) # a triangle
integratePolynomialOnSimplex(P, S)
```

MSFpoly *Monomial symmetric function*

Description

Returns a monomial symmetric function as a polynomial.

Usage

```
MSFpoly(m, lambda)
```

Arguments

m	integer, the number of variables
lambda	an integer partition, given as a vector of decreasing positive integers

Value

A qspray object.

Examples

```
library(qspray)
MSFpoly(3, c(3, 1))
```

prettyQspray *Pretty polynomial*

Description

Pretty form of a qspray polynomial.

Usage

```
prettyQspray(qspray, vars = NULL)
```

Arguments

qspray	a qspray object
vars	variable names; NULL for "x1", "x2", ...

Value

A character string.

Examples

```
library(qspray)
P <- (qlone(1) + "1/2"*qlone(2))^2 + 5
prettyP <- prettyQspray(P, vars = c("x", "y"))
prettyP
Ryacas::yac_str(sprintf("PrettyForm(%s)", prettyP))
Ryacas::yac_str(sprintf("TeForm(%s)", prettyP))
```

---

qlone *Polynomial variable*

Description

Create a polynomial variable.

Usage

```
qlone(n)
```

Arguments

n	nonnegative integer, the index of the variable

Value

A qspray object.

Examples

```
qlone(2)
```

---

qspray-unary *Unary operators for qspray objects*

Description

Unary operators for qspray objects.

Usage

```
## S4 method for signature 'qspray,missing'
e1 + e2

## S4 method for signature 'qspray,missing'
e1 - e2
```

Arguments

e1	object of class qspray
e2	nothing

Value

A qspray object.

---

qsprayMaker *Make a 'qspray' object*

Description

Make a qspray object from a list of exponents and a vector of coefficients.

Usage

```
qsprayMaker(powers, coeffs, string = NULL)
```

Arguments

powers	list of positive integer vectors
coeffs	a vector such that each element of as.character(coeffs) is a quoted integer or a quoted fraction; it must have the same length as the powers list
string	if not NULL, this argument takes precedence over powers and vertices; it must be a string representing a multivariate polynomial; see the example

Value

A qspray object.

Examples

```
powers <- list(c(1, 1), c(0, 2))
coeffs <- c("1/2", "4")
qsprayMaker(powers, coeffs)
qsprayMaker(string = "1/2 x^(1, 1) + 4 x^(0, 2)")
```

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