Package ‘rationalfun’

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Title Manipulation of Rational Functions
Description This package provides several functions to manipulate rational functions, including basic arithmetic operators, derivatives and integrals with EXPLICIT forms.
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as.character.rationalfun

Convert object to character

Description
This function converts an object of class "rationalfun" to a character string.

Usage
## S3 method for class 'rationalfun'
as.character(x, ...)

Arguments
x an object of class "rationalfun"
...
not used in this function

Value
A character string representing the rational function.

See Also
as.character.polynomial

Examples
r <- rationalfun(c(1, 1), c(3, 2, 1))
as.character(r)

as.function.rationalfun

Convert object to function

Description
This function converts an object of class "rationalfun" to a function.

Usage
## S3 method for class 'rationalfun'
as.function(x, ...)


**Arguments**

- `x`  
  an object of class "rationalfun"
- `...`  
  not used in this function

**Value**

A function with one argument which could be a real or complex vector.

**See Also**

`as.function.polynomial`

**Examples**

```r
r <- rationalfun(c(1, 1), c(3, 2, 1))
r
f <- as.function(r)
f
f(1:10)
f(1:10 + (0 + (0+2i)))
```

---

**Description**

Calculate the derivative of a rational function. The returned value result is still an object of class "rationalfun".

**Usage**

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

**Arguments**

- `expr`  
  an object of class "rationalfun"
- `...`  
  not used in this function

**Value**

An object of class "rationalfun" representing the derivative of the original rational function.

**See Also**

`deriv.polynomial, deriv`
Examples

```r
# (x + 1) / (x^2 + x + 1)
r <- rationalfun(c(1, 1), c(1, 1, 1))
deriv(r)
```

Description

Convert a function call to a function in R. In this package, the function is typically used to convert the result of `integral.rationalfun()` to a function with one argument.

Usage

```r
int2fun(expr)
```

Arguments

- `expr` a function call, typically returned by `integral.rationalfun()`.

Value

A function with one argument which could be a real or complex vector.

See Also

- `integral.polynomial`

Examples

```r
x <- rationalfun(c(-6, -1, -8, 15, -1, 8, -9, 2),
                 c(8, 12, 16, 4, 4))
int <- integral(x)
fun <- int2fun(int)
fun(c(0, 1))
```
integral.rationalfun

Integrate a rational function

Description

Calculate the integral of a rational function. See "Details".

Usage

```r
# S3 method for class 'rationalfun'
integral(expr, ...)
```

Arguments

- `expr`: an object of class "rationalfun"
- `...`: not used in this function

Details

The returned value is a function call with argument named "x". That is, the integral is an expression in R with an explicit form, which could be evaluated directly by calling `eval()`, or indirectly using the `int2fun()` function.

The algorithm is based on the Hermite-Ostrogradski formula which is discussed in the reference. See the article for more details.

Value

A function call representing the explicit form of the integral.

References


See Also

integral.polynomial

Examples

```r
# (x + 1) / (x^2 + x + 1)
r <- rationalfun(c(1, 1), c(1, 1, 1))
expr <- integral(r)
# Evaluate the call directly
eval(expr, list(x = 2))
# Use int2fun()
f <- int2fun(expr)
f(2)
```
**Ops.rationalfun**  
*Operators for rational functions*

**Description**

Basic arithmetic operators for rational functions.

**Usage**

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

**Arguments**

- `e1`: an object of class "rationalfun"
- `e2`: for "^", a positive integer; in other cases, an object of class "rationalfun"

**Value**

A new object of "rationalfun" class.

**Examples**

```r
r1 <- rationalfun(c(1, 2), c(1, 2, 1))
r2 <- rationalfun(c(1, 1), c(1, -2, 1))
r1 + r2
r1 * r2
r1^2
```

---

**predict.rationalfun**  
*Evaluate a rational function*

**Description**

Evaluate a rational function at a real or complex vector.

**Usage**

```r
# S3 method for class 'rationalfun'
predict(object, newdata, ...)
```

**Arguments**

- `object`: an object of class "rationalfun"
- `newdata`: a vector at which evaluation is requested.
- `...`: not used in this function Both real and complex vectors are accepted.
Value

A vector of evaluated results.

See Also

predict.polynomial

Examples

```r
r <- rationalfun(c(1, 1), c(3, 2, 1))
predict(r, 1:10)
```

---

Description

Print a rational function in a fraction form.

Usage

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

Arguments

- `x`: an object of class "rationalfun"
- `...`: not used in this function

Value

Invisible, the object itself.

See Also

print.polynomial

Examples

```r
r <- rationalfun(c(1, 1), c(3, 2, 1))
print(r)
```
rationalfun

Description

Construction of rational functions.

Usage

rationalfun(numer = c(0, 1), denom = c(1, 1, 1))
rfun(numer = c(0, 1), denom = c(1, 1, 1))
rationalfun.poly(numer = polynomial(c(0, 1)), denom = polynomial(c(1, 1, 1)))
rfun.poly(numer = polynomial(c(0, 1)), denom = polynomial(c(1, 1, 1)))

Arguments

numer in rationalfun(), the coefficient vector of the numerator; in rationalfun.poly(), an object of class "polynom" in polynom package representing the numerator

denom similar to numer, but for the denominator

Details

A rational function object could be constructed either by calling rationalfun() or by calling rationalfun.poly().
rationalfun() constructs a rational function from the coefficient vectors of the numerator and the denominator. For example, consider a rational function \( R(x) = \frac{P(x)}{Q(x)} \) where

\[
P(x) = p_1 + p_2 x + p_3 x^2 + \ldots + p_k x^{k-1}
\]

and

\[
Q(x) = q_1 + q_2 x + q_3 x^2 + \ldots + q_m x^{m-1}
\]

, you may call rationalfun(p[1:k], q[1:m]) to build the object.

For rationalfun.poly(), it receives two objects of class "polynomial" from the polynom package, representing the polynomials of the numerator and the denominator respectively. Use this function if you already have objects of "polynomial" class, typically by calling polynomial(), poly.calc() or poly.orth().

rfun() and rfun.poly() are aliases of rationalfun() and rationalfun.poly() in order to type fewer letters.

The value returned by rationalfun() and rationalfun.poly() is an object of class "rationalfun". You can coerce the object to a function, by calling as.function.rationalfun(), or to a character string, by calling as.character.rationalfun().
Objects of "rationalfun" class support basic operators including "+", ",", ",*," and ",^". To evaluate a rational function at a given vector, use `predict.rationalfun()`. To compute the derivative and integral in explicit form, call `deriv.rationalfun()` and `integral.rationalfun()` respectively.

### Value

An object of class "rationalfun".

### See Also

`polynomial, poly.calc, poly.orth`

### Examples

```r
# (x + 1) / (x^2 + 2 * x + 3)
r1 <- rationalfun(c(1, 1), c(3, 2, 1))
print(r1)

# Construct from objects of 'polynomial' class
if (require(polynom)) {
  pl <- poly.calc(c(1, 2))
  p2 <- polynomial(rep(1, 5))
  r2 <- rationalfun(pl, p2)
  print(r2)
}
```

---

### simplify

**Simplify a rational function**

#### Description

Simplify a rational function by dropping terms whose coefficients are close to zero, and then reducing it to an irreducible form.

#### Usage

```
simplify(x, ...)
```

#### Arguments

- `x` an object of class "rationalfun"
- `...` currently not used in this function

#### Value

A new object of class "rationalfun" representing the simplified rational function.
Examples

# (x + 1) / (x^2 + 2 * x + 1) => 1 / (x + 1)

r <- rationalfun(c(1, 1), c(1, 2, 1))
simplify(r)
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