**Package ‘rsgeo’**

September 8, 2023

**Title**  An Interface to Rust's 'geo' Library

**Version**  0.1.6

**Description**  An R interface to the GeoRust crates 'geo' and 'geo-types' providing access to geometry primitives and algorithms.

**URL**  https://github.com/JosiahParry/rsgeo,
https://josiahparry.r-universe.dev/rsgeo,
https://rsgeo.josiahparry.com/

**License**  MIT + file LICENSE

**Encoding**  UTF-8

**Language**  en

**RoxygenNote**  7.2.3

**Imports**  rlang, vctrs

**Suggests**  sf, testthat (>= 3.0.0), wk

**Config/rextendr/version**  0.3.1.9000

**SystemRequirements**  Cargo (Rust's package manager), rustc

**Config/testthat/edition**  3

**Config/Needs/website**  rmarkdown

**NeedsCompilation**  yes

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**Repository**  CRAN

**Date/Publication**  2023-09-08 21:50:06 UTC

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### as_rsgeo

Convert to an rsgeo vector

**Description**

Given an vector of geometries, cast it as an rsgeo class object.

**Usage**

```r
as_rsgeo(x)
```

**Arguments**

- `x` a geometry vector

**Value**

an object of class rsgeo

**Examples**

```r
x <- sf::st_sfc(sf::st_point(c(0,0)))
as_rsgeo(x)
```
**bearing_geodesic**  

*Calculate Bearing*

**Description**  
Calculates the bearing between two point geometries.

**Usage**  
```r  
bearing_geodesic(x, y)  
bearing_haversine(x, y)  
```  

**Arguments**  
- `x` an object of class `rs_POINT`  
- `y` an object of class `rs_POINT`  

**Value**  
A vector of doubles of the calculated bearing for between x and y

**Examples**  
```r  
x <- geom_point(runif(10, 0, 90), rnorm(10, 1, 90))  
y <- geom_point(runif(10, 0, 90), rnorm(10, 1, 90))  
bearing_geodesic(x, y)  
bearing_haversine(x, y)  
```  

**bounding_boxes**  

*Compute Geometric Boundaries*

**Description**  
From a vector of geometries identify different types of boundaries.

**Usage**  
```r  
bounding_boxes(x)  
bounding_rect(x)  
minimum_rotated_rect(x)  
convex_hull(x)  
```
concave_hull(x, concavity)

extreme_coords(x)

bounding_box(x)

Arguments

  x  an object of class rsgeo
  concavity  a value between 0 and 1 specifying the concavity of the convex hull

Details

  Note that if you want a convex or concave hull over an entire vector of geometries you must first union or combine them using either combine_geoms() or union_geoms()

Value

  •  bounding_box() returns a named vector of xmin, ymin, xmax, and ymax
  •  bounding_boxes() returns a list of bounding box numeric vectors for each geometry
  •  bounding_rect() returns an rs_POLYGON of the bounding rectangle of each geometry
  •  convex_hull() returns an rs_POLYGON of the convex hull for each geometry
  •  concave_hull() returns an rs_POLYGON of the specified concavity for each geometry
  •  extreme_coords() returns the extreme coordinates of each geometry as a list where each element is a named vector of xmin, ymin, xmax, and ymax where each element is a Point geometry of the extreme value
  •  minimum_rotated_rect() returns the minimum rotated rectangle covering a geometry as an rs_POLYGON

Examples

  lns <- geom_linestring(
    1:20,
    runif(20, -5, 5),
    rep.int(1:5, 4)
  )
  bounding_box(lns)
  bounding_boxes(lns)
  minimum_rotated_rect(lns)
  convex_hull(lns)
  concave_hull(lns, 0.5)
  extreme_coords(lns)
**cast_geoms**

**Cast geometries to another type**

**Description**

Cast geometries to another type

**Usage**

```r
cast_geoms(x, to)
```

**Arguments**

- **x**: an object of class `rsgeo`
- **to**: a character scalar of the target geometry type. Must be one of "point", "multipoint", "polygon", "multipolygon", "linestring", or "multilinestring".

**Details**

The below conversions are made available. The left hand column indicates the originating vector class and the right hand column indicates the class that it will can be cast to.

Note that correctness of conversions will not be checked or verified. If you cast an `rs_MULTIPOINT` to an `rs_POLYGON`, the validity of the polygon cannot be guaranteed.

Conversions from an `rs_POLYGON` into an `rs_LINESTRING` will result in only the exterior ring of the polygon ignoring any interior rings if there are any.

**From** | **To**
--- | ---
rs_POINT | rs_MULTIPOINT
rs_MULTIPOINT | rs_POLYGON, rs_MULTIPOINT, rs_MULTIPOLYGON, rs_LINESTRING, rs_MULTILINESTRING
rs_POLYGON | rs_MULTIPOINT, rs_MULTIPOINT, rs_MULTIPOLYGON, rs_LINESTRING, rs_MULTILINESTRING
rs_MULTIPOINT | rs_MULTIPOINT, rs_MULTILINESTRING
rs_LINESTRING | rs_MULTIPOINT, rs_MULTILINESTRING, rs_POLYGON
rs_MULTILINESTRING | rs_MULTIPOINT, rs_MULTIPOINT, rs_MULTIPOLYGON

**Value**

An object of class `rsgeo`

**Examples**

```r
ply <- geom_polygon(c(0, 1, 1, 0, 0), c(0, 0, 1, 1, 0))
cast_geoms(ply, "linestring")
cast_geoms(ply, "multipoint")
```
centroids

*Extract Centroids*

### Description

Given a vector of geometries, extract their centroids.

### Usage

```r
centroids(x)
```

### Arguments

- `x` an object of class `rsgeo`

### Value

an object of class `rs_POINT`

### Examples

```r
lns <- geom_linestring(1:100, runif(100, -10, 10), rep.int(1:5, 20))
centroids(lns)
```

closest_point

*Find Closest Point*

### Description

For a given geometry, find the closest point on that geometry to a point. The closest point may be an intersection, a single point, or unable to be determined.

### Usage

```r
closest_point(x, y)
closest_point_haversine(x, y)
```

### Arguments

- `x` an object of class `rsgeo`
- `y` an object of class `rs_POINT`

### Value

An `rs_POINT` vector
**Examples**

```r
x <- geom_linestring(1:100, runif(100, 0, 90), rep.int(1:10, 10))
y <- geom_point(runif(10, 0, 90), rnorm(10, 1, 90))
closest_point(x, y)
closest_point_haversine(x, y)
```

**Description**

Given a vector of geometries combine them into a single geometry.

**Usage**

```r
combine_geoms(x)
union_geoms(x)
```

**Arguments**

- `x` an object of class rsgeo

**Details**

`combine_geoms()`: `combine_geoms()` combines a vector of geometries into a vector of length one their MULTI counterpart.

- `rs_POINT` and `rs_MULTIPOINT` -> `rs_MULTIPOINT`
- `rs_LINESTRING` and `rs_MULTILINESTRING` -> `rs_MULTILINESTRING`
- `rs_POLYGON` and `rs_MULTIPOlygon` -> `rs_MULTIPOlygon`
- `rs_GEOMETRYCOLLECTION` is not supported

`union_geoms()`: `union_geoms()` creates a union of all geometries removing repeated points or dissolving shared boundaries.

- `rs_POINT` - combines and removes repeated points
- `rs_MULTIPOINT` - combines removes repeated points
- `rs_LINESTRING` - combines and removes duplicated points
- `rs_MULTILINESTRING` - combines and removes duplicated points
- `rs_POLYGON` - unions geometries into a single geometry
- `rs_MULTIPOlygon` - unions geometries into a single geometry

**Value**

An object of class rsgeo of length one.
### Examples

```r
pnts <- geom_point(runif(10), runif(10))
combine_geoms(pnts)

lns <- geom_linestring(1:100, runif(100, -10, 10), rep.int(1:5, 20))
union_geoms(lns)

x <- c(0, 1, 1, 0, 0)
y <- c(0, 0, 1, 1, 0)

p1 <- geom_polygon(x, y)
p2 <- geom_polygon(x - 1, y + 0.5)

z <- c(p1, p2)
res <- union_geoms(z)
res

if (rlang::is_installed(c("sf", "wk"))) {
  plot(z)
  plot(res, lty = 3, border = "blue", add = TRUE, lwd = 4)
}
```

---

### coords

**Extract Coordinates**

Given an rsgeo class object, extract the object's coordinates as a data frame. Empty or missing geometries are ignored.

#### Usage

```r
coords(x)
```

#### Arguments

- `x` an object of class rsgeo

#### Value

A data.frame with columns x, y. Additional columns are returned based on the geometry type. Additional columns are:

- `id`
- `line_id`: refers to the LineString ID for rs_LINESTRING, or the component LineString in a MultiLineString, or as the ring ID for a Polygon.
- `multilinestring_id`
- `polygon_id`
- `multipolygon_id`
**Examples**

```r
pnt <- geom_point(3, 0.14)
mpnt <- geom_multipoint(1:10, 10:1)
ln <- geom_linestring(1:10, 10:1)
ply <- geom_polygon(c(0, 1, 1, 0, 0), c(0, 0, 1, 1, 0))

coords(pnt)
coords(mpnt)
coords(ln)
coords(union_geoms(rep(ln, 2)))
coords(ply)
coords(union_geoms(rep(ply, 2)))
```

**distance_euclidean_pairwise**

*Calculate Distances*

**Description**

Calculates distances between two vectors of geometries. There are a number of different distance methods that can be utilized.

**Usage**

```r
distance_euclidean_pairwise(x, y)
distance_hausdorff_pairwise(x, y)
distance_vicenty_pairwise(x, y)
distance_geodesic_pairwise(x, y)
distance_haversine_pairwise(x, y)
distance_euclidean_matrix(x, y)
distance_hausdorff_matrix(x, y)
distance_vicenty_matrix(x, y)
distance_geodesic_matrix(x, y)
distance_haversine_matrix(x, y)
```

**Arguments**

- `x` and object of class `rsgeo`
- `y` and object of class `rsgeo`
Details

There are _pairwise() and _matrix() suffixed functions to generate distances pairwise or as a dense matrix respectively. The pairwise functions calculate distances between the ith element of each vector. Whereas the matrix functions calculate the distance between each and every geometry. Euclidean distance should be used for planar geometries. Haversine, Geodesic, and Vicenty are all methods of calculating distance based on spherical geometries. There is no concept of spherical geometries in rsgeo, so choose your distance measure appropriately.

Notes:
- Hausdorff distance is calculated using Euclidean distance.
- Haversine, Geodesic, and Vicenty distances only work with rs_POINT geometries.

Value

For _matrix functions, returns a dense matrix of distances whereas _pairwise functions return a numeric vector.

Examples

```r
set.seed(1)
x <- geom_point(runif(5, -1, 1), runif(5, -1, 1))
y <- rev(x)
distance_euclidean_matrix(x, y)
distance_hausdorff_matrix(x, y)
distance_vicenty_matrix(x, y)
distance_geodesic_matrix(x, y)
distance_haversine_matrix(x, y)
distance_euclidean_pairwise(x, y)
distance_hausdorff_pairwise(x, y)
distance_vicenty_pairwise(x, y)
distance_geodesic_pairwise(x, y)
distance_haversine_pairwise(x, y)
```

**expand_geoms**

*Expand Geometries*

Description

Expands geometries into a list of vectors of their components.

Usage

`expand_geoms(x)`

Arguments

- `x`: an object of class `rsgeo`
Details

• rs_MULTIPOINT expands into a vector of points
• rs_LINESTRING expands into a vector points
• rs_MULTILINESTRING expands into a vector of linestrings
• rs_POLYGON expands into a vector of linestrings
• rs_MULTIPOLYGON expands into a vector of polygons

If you wish to have a single vector returned, pass the results into `flatten_geoms()`.

Value

A list of rsgeo vectors containing each original geometry’s components as a new vector.

Examples

```r
mpnts <- geom_multipoint(runif(10), runif(10), rep.int(1:5, 2))
expand_geoms(mpnts)
```

```r
flatten_geoms
Flatten a list of rsgeo vectors
```

Description

Flatten a list of rsgeo vectors

Usage

`flatten_geoms(x)`

Arguments

x: list object where each element is an object of class rsgeo

Value

Returns an object of class rsgeo

Examples

```r
pnts <- replicate(10,
  geom_point(runif(1), runif(1)),
  simplify = FALSE
)

flatten_geoms(pnts)
```
frechet_distance  

Calculate Frechet Distance

Description
Given two LineStrings compare their similarity by calculating the Fréchet distance.

Usage
frechet_distance(x, y)

Arguments
x an object of class rs_LINESTRING
y an object of class rs_LINESTRING

Value
A numeric vector

Examples
x <- geom_linestring(1:10, runif(10, -1, 1))
y <- geom_linestring(1:10, runif(10, -3, 3))
frechet_distance(x, y)

geom_point  

Construct Geometries

Description
Constructs geometries from numeric vectors.

Usage
geom_point(x, y)
geom_multipoint(x, y, id = 1)
geom_linestring(x, y, id = 1)
geom_polygon(x, y, id = 1, ring = 1)
Arguments

- **x**: a vector of x coordinates
- **y**: a vector of y coordinates
- **id**: the feature identifier
- **ring**: the id of the polygon ring

Value

an object of class `rsgeo`

Examples

```r
geom_point(3, 0.14)
geom_multipoint(1:10, 10:1)
geom_linestring(1:10, 10:1)
geom_polygon(c(0, 1, 1, 0, 0), c(0, 0, 1, 1, 0))
```

---

**haversine_destination**  *Identify a destination point*

Description

Given a vector of point geometries, bearings, and distances, identify a destination location.

Usage

```r
haversine_destination(x, bearing, distance)
```

Arguments

- **x**: an object of class `rs_POINT`
- **bearing**: a numeric vector specifying the degree of the direction where 0 is north
- **distance**: a numeric vector specifying the distance to travel in the direction specified by bearing in meters

Value

an object of class `rs_POINT`
Examples

```r
# create 10 points at the origin
pnts <- geom_point(rep(0, 10), rep(0, 10))

# set seed for reproducibility
set.seed(1)

# generate random bearings
bearings <- runif(10, 0, 360)

# generate random distances
distances <- runif(10, 10000, 100000)

# find the destinations
dests <- haversine_destination(pnts, bearings, distances)

# plot points
if (rlang::is_installed(c("sf", "wk"))) {
  plot(pnts, pch = 3)
  plot(dests, add = TRUE, pch = 17)
}
```

---

**haversine_intermediate**

*Identifies a point between two points*

---

Description

Identifies the location between two points on a great circle along a specified fraction of the distance.

Usage

```r
haversine_intermediate(x, y, distance)
```

Arguments

- `x`: an `rs_POINT` vector
- `y`: an `rs_POINT` vector
- `distance`: a numeric vector of either length 1 or the same length as `x` and `y`

Value

an object of class `rs_POINT`
**intersects_sparse**

### Examples

```r
x <- geom_point(1:10, rep(5, 10))
y <- geom_point(1:10, rep(0, 10))
res <- haversine_intermediate(x, y, 0.5)
if (rlang::is_installed(c("wk", "sf"))) {
  plot(
    c(x, y, res),
    col = sort(rep.int(c("red", "blue", "purple"), 10)),
    pch = 16
  )
}
```

---

**intersects_sparse**  Binary Predicates

### Description

Functions to ascertain the binary relationship between two geometry vectors. Binary predicates are provided both pairwise as a sparse matrix.

### Usage

- `intersects_sparse(x, y)`
- `intersects_pairwise(x, y)`
- `contains_sparse(x, y)`
- `contains_pairwise(x, y)`
- `within_sparse(x, y)`
- `within_pairwise(x, y)`

### Arguments

- `x`: an object of class `rsgeo`
- `y`: an object of class `rsgeo`

### Value

- For `_sparse` a list of integer vectors containing the position of the geometry in `y`
- For `_pairwise` a logical vector
Examples

```r
if (rlang::is_installed("sf")) {
  nc <- sf::st_read(
    system.file("shape/nc.shp", package = "sf"),
    quiet = TRUE
  )

  x <- as_rsgeo(nc$geometry[1:5])
  y <- rev(x)

  # intersects
  intersects_sparse(x, y)
  intersects_pairwise(x, y)

  # contains
  contains_sparse(x, y)
  contains_pairwise(x, y)

  # within
  within_sparse(x, y)
  within_pairwise(x, y)
}
```

---

**is_convex**

*Determine the Convexity of a LineString*

**Description**

For a given rs_LINESTRING vector, test its convexity. Convexity can be tested strictly or strongly, as well as based on winding.

**Usage**

```r
is_convex(x)

is_ccw_convex(x)

is_cw_convex(x)

is_strictly_convex(x)

is_strictly_ccw_convex(x)

is_strictly_cw_convex(x)
```

**Arguments**

- `x` an object of class rs_LINESTRING

See geo docs for further details
**length_euclidean**

**Value**

a logical vector

**Examples**

```r
lns <- geom_linestring(
  1:20,
  runif(20, -5, 5),
  rep.int(1:5, 4)
)

is_convex(lns)
is_cw_convex(lns)
is_ccw_convex(lns)
is_strictly_convex(lns)
is_strictly_cw_convex(lns)
is_strictly_ccw_convex(lns)
```

---

**length_euclidean  Calculate LineString Length**

**Description**

For a given LineString or MultiLineString geometry, calculate its length. Other geometries will return a value of NA.

**Usage**

```r
length_euclidean(x)
length_geodesic(x)
length_vincenty(x)
length_haversine(x)
```

**Arguments**

- `x` an object of class `rsgeo`

**Details**

**Notes:**

- Vicenty, Geodesic, and Haversine methods will return in units of meters.
- Geodesic length will always converge and is more accurate than the Vicenty methods.
- Haversine uses a mean earth radius of 6371.088 km.

See geo docs for more details.
line_interpolate_point

Interpolate a Point on a LineString

Description

Finds the point that lies a given fraction along a line.

Usage

line_interpolate_point(x, fraction)

Arguments

x

an object of class rs_LINESTRING

fraction

a numeric vector of length 1 or the same length as x. Must be a value between 0 and 1 inclusive.

Value

An object of class rs_POINT

Examples

x <- geom_linestring(c(-1, 0, 0), c(0, 0, 1))
line_interpolate_point(x, 0.5)
**line_segmentize**

Segments a LineString into \( n \) equal length LineStrings

**Description**

Given a LineString, segment it into \( n \) equal length LineStrings. The \( n \) LineStrings are provided as a MultiLineString which can be expanded using expand_geoms() and consequently flattened using flatten_geoms() if desired.

**Usage**

```r
describe_point_on_line(x, y)
```

**Arguments**

- **x** and object of class `rs_LINESTRING`
- **n** an integer vector determining the number of equal length LineStrings to create

**Value**

A vector of class `rs_MULTILINESTRING`

**Examples**

```r
x <- geom_linestring(1:10, runif(10, -1, 1))
segs <- line_segmentize(x, 3)
flatten_geoms(
  expand_geoms(segs)
)
```

**locate_point_on_line**

Locate a Point on a LineString

**Description**

Calculates the fraction of a LineString's length to a point that is closest to a corresponding point in \( y \).

**Usage**

```r
locate_point_on_line(x, y)
```
Arguments

  x  an object of class rs_LINESTRING
  y  an object of class rs_POINT

Value

A numeric vector containing the fraction of the LineString that would need to be traveled to reach the closest point.

Examples

  x <- geom_linestring(c(-1, 0, 0), c(0, 0, 1))
  y <- geom_point(-0.5, 0)
  locate_point_on_line(x, y)

plot.rsgeo  

Plot Geometries

Description

Plot Geometries

Usage

## S3 method for class 'rsgeo'
plot(x, ...)

Arguments

  x  an object of class rsgeo
  ... arguments passed to wk::wk_plot()

Details

Plotting geometries utilizes wk::wk_plot(). The rust geometries are handled by first converting to an sfc object in the wk::wk_handle() method thus requiring both packages for plotting.

Value

Nothing.

Examples

  if (rlang::is_installed(c("sf", "wk"))) {
    plot(geom_linestring(1:10, runif(10)))
  }
signed_area

Calculate the area of a polygon

Description

Functions to calculate different types of area for polygons.

Usage

signed_area(x)
unsigned_area(x)
signed_area_cd(x)
unsigned_area_cd(x)
signed_area_geodesic(x)
unsigned_area_geodesic(x)

Arguments

x an object of class rsgeo

Details

• functions assume counter clock-wise winding in accordance with the simple feature access standard
• functions ending in _cd use the Chamberlain-Duquette algorithm for spherical area
• Chamberlain-Duquette and Geodesic areas are returned in meters squared and assume non-planar geometries

See geo docs for more:

• GeodesicArea
• Area
• ChamberlainDuquetteArea

Value

a numeric vector of the area contained by the geometry
simplify_geoms

Examples

```
x <- c(0, 1, 1, 0, 0)
y <- c(0, 0, 1, 1, 0)
p <- geom_polygon(x, y)
signed_area(p)
signed_area_cd(p)
signed_area_geodesic(p)
```

```
simplify_geoms
```

Simplify Geometry

Description

Simplifies LineStrings, Polygons, and their Multi- counterparts.

Usage

```
simplify_geoms(x, epsilon)
simplify_vw_geoms(x, epsilon)
simplify_vw_preserve_geoms(x, epsilon)
```

Arguments

- `x`: an object of class of `rsgeo`
- `epsilon`: a tolerance parameter. Cannot be equal to or less than 0.

Details

Simplify functions use the Ramer–Douglas–Peucker algorithm. Functions with `vw` use the Visvalingam-Whyatt algorithm.

For more see `geo docs`.

Value

an object of class `rsgeo`

Examples

```
x <- geom_linestring(1:100, runif(100, 5, 10))
simplify_geoms(x, 3)
simplify_vw_geoms(x, 2)
simplify_vw_preserve_geoms(x, 100)
```
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