Package ‘sf’

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Version 0.9-6

Title Simple Features for R

Description Support for simple features, a standardized way to encode spatial vector data. Binds to 'GDAL' for reading and writing data, to 'GEOS' for geometrical operations, and to 'PROJ' for projection conversions and datum transformations. Optionally uses the 's2' package for spherical geometry operations on geographic coordinates.

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BugReports https://github.com/r-spatial/sf/issues/

Depends methods, R (>= 3.3.0)

Imports classInt (>= 0.4-1), DBI (>= 0.8), graphics, grDevices, grid, magrittr, Rcpp (>= 0.12.18), stats, tools, units (>= 0.6-0), utils

Suggests blob, covr, dplyr (>= 0.8-3), ggplot2, knitr, lwgeom (>= 0.2-1), maps, mapview, microbenchmark, odbc, pillar, pool, raster, rgdal, rgeos, rlang, rmarkdown, RPostgres (>= 1.1.0), RPostgreSQL, RSQLite, s2 (>= 1.0.1), sp (>= 1.2-4), spatstat, spatstat.utils, stars (>= 0.2-0), testthat, tidbyr (>= 1.4.1), tidyverse (>= 1.0.0), tidyselect (>= 1.0.0), tmap (>= 2.0), vctrs

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Collate 'RcppExports.R' 'init.R' 'crs.R' 'bbox.R' 'read.R' 'db.R'
'sfc.R' 'sfg.R' 'sf.R' 'bind.R' 'wkb.R' 'wkt.R' 'plot.R'
'geom-measures.R' 'geom-predicates.R' 'geom-transformers.R'
'transform.R' 'sp.R' 'grid.R' 'arith.R' 'tidyverse.R'
'tidyverse-vctrs.R' 'cast_sfg.R' 'cast_sfc.R' 'graticule.R'

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datasets.R  'aggregate.R'  'agr.R'  'maps.R'  'join.R'  'sample.R'
'valid.R'  'collection_extract.R'  'jitter.R'  'sgbp.R'
'spatstat.R'  'stars.R'  'crop.R'  'gdal_utils.R'  'nearest.R'
'normalize.R'  'defunct.R'  'z_range.R'  'm_range.R'
'shift_longitude.R'  'make_grid.R'  's2.R'

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aggregate.an.sf.object

Description

aggregate an sf object, possibly union-ing geometries

Usage

```r
## S3 method for class 'sf'
aggregate(
  x,
  by,
  FUN,
  ...,  # arguments passed on to FUN
do_union = TRUE,
simplify = TRUE,
join = st_intersects
)
```

Arguments

- `x` object of class `sf`
- `by` either a list of grouping vectors with length equal to `nrow(x)` (see `aggregate`), or an object of class `sf` or `sfc` with geometries that are used to generate groupings, using the binary predicate specified by the argument `join`
- `FUN` function passed on to `aggregate`, in case `ids` was specified and attributes need to be grouped
- `...` arguments passed on to `FUN`
- `do_union` logical; should grouped geometries be unioned using `st_union`? See details.
- `simplify` logical; see `aggregate`
- `join` logical spatial predicate function to use if `by` is a simple features object or geometry; see `st_join`
Details

In case do_union is FALSE, aggregate will simply combine geometries using `c.sfg`. When polygons sharing a boundary are combined, this leads to geometries that are invalid; see https://github.com/r-spatial/sf/issues/681.

Value

an sf object with aggregated attributes and geometries; additional grouping variables having the names of names(ids) or are named Group.i for ids[[i]]; see aggregate.

Note

Does not work using the formula notation involving ~ defined in aggregate.

Examples

```r
m1 = cbind(c(0, 0, 1, 0), c(0, 1, 1, 0))
m2 = cbind(c(0, 1, 1, 0), c(0, 0, 1, 0))
pol = st_sfc(st_polygon(list(m1)), st_polygon(list(m2)))
set.seed(1985)
d = data.frame(matrix(runif(15), ncol = 3))
p = st_as_sf(x = d, coords = 1:2)
plot(pol)
plot(p, add = TRUE)
(p_ag1 = aggregate(p, pol, mean))
plot(p_ag1) # geometry same as pol

# works when x overlaps multiple objects in 'by':
p_buff = st_buffer(p, 0.2)
plot(p_buff, add = TRUE)
(p_ag2 = aggregate(p_buff, pol, mean)) # increased mean of second
  # with non-matching features
m3 = cbind(c(0, 0, -0.1, 0), c(0, 0.1, 0.1, 0))
pol = st_sfc(st_polygon(list(m3)), st_polygon(list(m1)), st_polygon(list(m2)))
(p_ag3 = aggregate(p, pol, mean))
plot(p_ag3)

# In case we need to pass an argument to the join function:
(p_ag4 = aggregate(p, pol, mean,
  join = function(x, y) st_is_within_distance(x, y, dist = 0.3)))
```

---

**as**

Methods to coerce simple features to Spatial* and Spatial*DataFrame objects

Description

`as_Spatial()` allows to convert sf and sfc to Spatial*DataFrame and Spatial* for sp compatibility. You can also use `as(x, "Spatial")` To transform sp objects to sf and sfc with `as(x,"sf")`. 
Usage

```r
as_Spatial(from, cast = TRUE, IDs = paste0("ID", seq_along(from)))
```

Arguments

- `from`: object of class `sf`, `sfc_POINT`, `sfc_MULTIPOINT`, `sfc_LINestring`, `sfc_MULTILINESTRING`, `sfc_POLYGON`, or `sfc_MULTIPOLYGON`.
- `cast`: logical; if `TRUE`, `st_cast()` from before converting, so that e.g. `GEOMETRY` objects with a mix of `POLYGON` and `MULTIPOLYGON` are cast to `MULTIPOLYGON`.
- `IDs`: character vector with IDs for the `Spatial*` geometries

Details

Package `sp` supports three dimensions for `POINT` and `MULTIPOINT` (`SpatialPoint*`). Other geometries must be two-dimensional (XY). Dimensions can be dropped using `st_zm()` with `what = "M"` or `what = "ZM"`.

For converting simple features (i.e., `sf` objects) to their `Spatial` counterpart, use `as(obj,"Spatial")`

Value

geometry-only object deriving from `Spatial`, of the appropriate class

Examples

```r
nc <- st_read(system.file("shape/nc.shp", package="sf"))
# convert to `SpatialPolygonsDataFrame`
spdf <- as_Spatial(nc)
# identical to
spdf <- as(nc, "Spatial")
# convert to `SpatialPolygons`
as(st_geometry(nc), "Spatial")
# back to `sf`
as(spdf, "sf")
```

Description

Bind rows (features) of `sf` objects
bind

Usage

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

## S3 method for class 'sf'
cbind(..., deparse.level = 1, sf_column_name = NULL)

st_bind_cols(...)
```

Arguments

- `...`: objects to bind; note that for the rbind and cbind methods, all objects have to be of class `sf`; see `dotsMethods`
- `deparse.level`: integer; see `rbind`
- `sf_column_name`: character; specifies active geometry; passed on to `st_sf`

Details

Both `rbind` and `cbind` have non-standard method dispatch (see `cbind`): the `rbind` or `cbind` method for `sf` objects is only called when all arguments to be binded are of class `sf`.

If you need to `cbind` e.g. a `data.frame` to an `sf`, use `data.frame` directly and use `st_sf` on its result, or use `bind_cols`; see examples.

`st_bind_cols` is deprecated; use `cbind` instead.

Value

`cbind` called with multiple `sf` objects warns about multiple geometry columns present when the geometry column to use is not specified by using argument `sf_column_name`; see also `st_sf`.

Examples

```r
crs = st_crs(3857)
a = st_sf(a=1, geom = st_sfc(st_point(0:1)), crs = crs)
b = st_sf(a=1, geom = st_sfc(st_linestring(matrix(1:4,2))), crs = crs)
c = st_sf(a=4, geom = st_sfc(st_multilinestring(list(matrix(1:4,2)))))

rbind(a,b,c)
rbind(a,b)
rbind(a,b)
rbind(b,c)

if (require(dplyr))
  dplyr::bind_cols(a,b)

cbind(a,b,c) # warns
c = st_sf(a=4, geomc = st_sfc(st_multilinestring(list(matrix(1:4,2)))))

cbind(a,b,c, sf_column_name = "geomc")
df = data.frame(x=3)
st_sf(data.frame(c, df))

dplyr::bind_cols(c, df)
```
**db_drivers**

Drivers for which update should be TRUE by default

**Description**

Drivers for which update should be TRUE by default

**Usage**

```r
db_drivers
```

**Format**

An object of class character of length 12.

---

**dbDataType, PostgreSQLConnection, sf-method**

Determine database type for R vector

**Description**

Determine database type for R vector

**Usage**

```r
## S4 method for signature 'PostgreSQLConnection, sf'
dbDataType(dbObj, obj)
```

```r
## S4 method for signature 'DBIObject, sf'
dbDataType(dbObj, obj)
```

**Arguments**

- `dbObj` DBIObject driver or connection.
- `obj` Object to convert

---

**db_drivers**

Drivers for which update should be TRUE by default
extension_map

Map extension to driver

Description
Map extension to driver

Usage
extension_map

Format
An object of class list of length 25.

gdal

functions to interact with gdal not meant to be called directly by users
(but e.g. by stars::read_stars)

Description
functions to interact with gdal not meant to be called directly by users (but e.g. by stars::read_stars)

Usage
gdal_read(
  x,
  ..., options = character(0),
  driver = character(0),
  read_data = TRUE,
  NA_value = NA_real_,
  RasterIO_parameters = list()
)

gdal_write(
  x,
  ...,
  file,
  driver = "GTiff",
  options = character(0),
  type = "Float32",
  NA_value = NA_real_,
  geotransform,
  update = FALSE
gdal_inv_geotransform(gt)

gdal_crs(file, options = character(0))

gdal_metadata(
  file,
  domain_item = character(0),
  options = character(0),
  parse = TRUE
)

gdal_subdatasets(file, options = character(0), name = TRUE)

gdal_polygonize(
  x,
  mask = NULL,
  file = tempfile(),
  driver = "GTiff",
  use_integer = TRUE,
  geotransform,
  breaks = classInt::classIntervals(na.omit(as.vector(x[[1]])))$brks,
  use_contours = FALSE,
  contour_lines = FALSE,
  connect8 = FALSE,
  ...
)

gdal_rasterize(sf, x, gt, file, driver = "GTiff", options = character())

Arguments

x character vector, possibly of length larger than 1 when more than one raster is read
...
ignored
options character; raster layer read options
driver character; when empty vector, driver is auto-detected.
read_data logical; if FALSE, only the imagery metadata is returned
NA_value (double) non-NA value to use for missing values; if NA, when writing missing values are not specially flagged in output dataset, when reading the default (dataset) missing values are used (if present / set).
RasterIO_parameters list with named parameters to GDAL’s RasterIO; see the stars::read_stars documentation.
file character; file name
type gdal write type
geotransform  length 6 numeric vector with GDAL geotransform parameters.
update       logical; TRUE if in an existing raster file pixel values shall be updated.
gt           double vector of length 6
domain_item  character vector of length 0, 1 (with domain), or 2 (with domain and item); use "" for the default domain, use NA_character_ to query the domain names.
parse        logical; should metadata be parsed into a named list (TRUE) or returned as character data?
name         logical; retrieve name of subdataset? If FALSE, retrieve description
mask         stars object with NA mask (0 where NA), or NULL
use_integer  boolean; if TRUE, raster values are read as (and rounded to) unsigned 32-bit integers values; if FALSE they are read as 32-bit floating points numbers. The former is supposedly faster.
breaks       numeric vector with break values for contour polygons (or lines)
use_contours logical;
contour_lines logical;
connect8     logical; if TRUE use 8 connection algorithm, rather than 4
sf           object of class sf

Details

These functions are exported for the single purpose of being used by package stars, they are not meant to be used directly and may change or disappear without prior notice or deprecation warnings.
gdal_inv_geotransform returns the inverse geotransform
gdal_crs reads coordinate reference system from GDAL data set
get_metadata gets metadata of a raster layer
gdal_subdatasets returns the subdatasets of a gdal dataset

Value

object of class crs, see st_crs.
named list with metadata items
gdal_subdatasets returns a zero-length list if file does not have subdatasets, and else a named list with subdatasets.

Examples

## Not run:
f = system.file("tif/L7_ETMs.tif", package="stars")
f = system.file("nc/avhrr-only-v2.19810901.nc", package = "stars")
gdal_metadata(f)
gdal_metadata(f, NA_character_)
try(gdal_metadata(f, "wrongDomain"))
gdal_metadata(f, c("", "AREA_OR_POINT"))

## End(Not run)
Native interface to gdal utils

Usage

gdal_utils(
  util = "info",
  source,
  destination,
  options = character(0),
  quiet = !(util %in% c("info", "mdiminfo")),
  processing = character(0),
  colorfilename = character(0)
)

Arguments

util character; one of info, warp, rasterize, translate, vectortranslate (for ogr2ogr), buildvrt, demprocessing, nearblack, grid, mdiminfo and mdimtranslate (the last two requiring GDAL 3.1)

source character; name of input layer(s); for warp, buildvrt or mdimtranslate this can be more than one

destination character; name of output layer

options character; options for the utility

quiet logical; if TRUE, suppress printing the output for info and mdiminfo, and suppress printing progress

processing character; processing options for demprocessing

colorfilename character; name of color file for demprocessing (mandatory if processing="color-relief")

Value

info returns a character vector with the raster metadata; all other utils return (invisibly) a logical indicating success (i.e., TRUE); in case of failure, an error is raised.

Examples

if (sf_extSoftVersion()["GDAL"] > "2.1.0") {
  # info utils can be used to list information about about a raster
  # dataset. More info: https://gdal.org/programs/gdalinfo.html
  in_file <- system.file("tif/geomatrix.tif", package = "sf")
  gdal_utils("info", in_file, options = c("-mm", "-proj4"))
}
# vectortranslate utils can be used to convert simple features data between
in_file <- system.file("shape/storms_xyz.shp", package="sf")
out_file <- paste0(tempfile(), ".gpkg")
gdal_utils(
  util = "vectortranslate",
  source = in_file,
  destination = out_file, # output format must be specified for GDAL < 2.3
  options = c("-f", "GPKG")
)
# The parameters can be specified as c("name") or c("name", "value"). The
# vectortranslate utils can perform also various operations during the
# conversion process. For example we can reproject the features during the
# translation.

gdal_utils(
  util = "vectortranslate",
  source = in_file,
  destination = out_file,
  options = c(
    "-f", "GPKG", # output file format for GDAL < 2.3
    "-s_srs", "EPSG:4326", # input file SRS
    "-t_srs", "EPSG:2264", # output file SRS
    "-overwrite"
  )
)
st_read(out_file)
# The parameter s_srs had to be specified because, in this case, the in_file
# has no associated SRS.
st_read(in_file)

---

### geos_binary_ops

*Geometric operations on pairs of simple feature geometry sets*

#### Description

Perform geometric set operations with simple feature geometry collections

#### Usage

```r
st_intersection(x, y, ...)
```

## S3 method for class 'sfc'
```r
st_intersection(x, y, ...)
```

## S3 method for class 'sf'
```r
st_intersection(x, y, ...)
```
st_difference(x, y, ...)

### S3 method for class 'sfc'
st_difference(x, y, ...)

st_sym_difference(x, y, ...)

st_snap(x, y, tolerance)

**Arguments**

- **x**
  - object of class sf, sfc or sfg
- **y**
  - object of class sf, sfc or sfg
- **...**
  - arguments passed on to s2_options
- **tolerance**
  - tolerance values used for st_snap; numeric value or object of class units; may have tolerance values for each feature in x

**Details**


When called with missing y, the sfc method for st_intersection returns all non-empty intersections of the geometries of x; an attribute idx contains a list-column with the indexes of contributing geometries.

When called with a missing y, the sf method for st_intersection returns an sf object with attributes taken from the contributing feature with lowest index; two fields are added: n.overlaps with the number of overlapping features in x, and a list-column origins with indexes of all overlapping features.

When st_difference is called with a single argument, overlapping areas are erased from geometries that are indexed at greater numbers in the argument to x; geometries that are empty or contained fully inside geometries with higher priority are removed entirely. The st_difference.sfc method with a single argument returns an object with an "idx" attribute with the orginal index for returned geometries.

st_snap snaps the vertices and segments of a geometry to another geometry’s vertices. If y contains more than one geometry, its geometries are merged into a collection before snapping to that collection.

(from the GEOS docs:) "A snap distance tolerance is used to control where snapping is performed. Snapping one geometry to another can improve robustness for overlay operations by eliminating nearly-coincident edges (which cause problems during noding and intersection calculation). Too much snapping can result in invalid topology being created, so the number and location of snapped vertices is decided using heuristics to determine when it is safe to snap. This can result in some potential snaps being omitted, however."
Value

The intersection, difference or symmetric difference between two sets of geometries. The returned object has the same class as that of the first argument (x) with the non-empty geometries resulting from applying the operation to all geometry pairs in x and y. In case x is of class sf, the matching attributes of the original object(s) are added. The sfc geometry list-column returned carries an attribute idx, which is an n-by-2 matrix with every row the index of the corresponding entries of x and y, respectively.

Note

To find whether pairs of simple feature geometries intersect, use the function st_intersects instead of st_intersection.

See Also

st_union for the union of simple features collections; intersect and setdiff for the base R set operations.

Examples

```r
set.seed(131)
library(sf)
m = rbind(c(0,0), c(1,0), c(1,1), c(0,1), c(0,0))
p = st_polygon(list(m))
n = 100
l = vector("list", n)
for (i in 1:n)
  l[[i]] = p + 10 * runif(2)
s = st_sfc(l)
plot(s, col = sf.colors(categorical = TRUE, alpha = .5))
title("overlapping squares")
d = st_difference(s) # sequential differences: s1, s2-s1, s3-s2-s1, ...
plot(d, col = sf.colors(categorical = TRUE, alpha = .5))
title("non-overlapping differences")
i = st_intersection(s) # all intersections
plot(i, col = sf.colors(categorical = TRUE, alpha = .5))
title("non-overlapping intersections")
summary(lengths(st_overlaps(s, s))) # includes self-counts!
summary(lengths(st_overlaps(d, d)))
summary(lengths(st_overlaps(i, i)))
sf = st_sf(s)
i = st_intersection(sf) # all intersections
plot(i["n.overlaps"],
summary(i$s$n.overlaps - lengths(i$s$origins))
# A helper function that erases all of y from x:
st_erase = function(x, y) st_difference(x, st_union(st_combine(y)))
poly = st_polygon(list(cbind(c(0, 0, 1, 1, 0), c(0, 1, 1, 0, 0))))
lines = st_multilinestring(list(
  cbind(c(0, 1, 1.05)),
  cbind(c(0, 1, c(0, -.05)),
  cbind(c(1, .95, 1), c(1.05, .5, -.05))))
```
snapped = st_snap(poly, lines, tolerance=.1)
plot(snapped, col='red')
plot(poly, border='green', add=TRUE)
plot(lines, lwd=2, col='blue', add=TRUE)

geos_binary_pred  Geometric binary predicates on pairs of simple feature geometry sets

Description
Geometric binary predicates on pairs of simple feature geometry sets

Usage

st_intersects(x, y, sparse = TRUE, ...)
st_disjoint(x, y = x, sparse = TRUE, prepared = TRUE)
st_touches(x, y, sparse = TRUE, prepared = TRUE, ...)
st_crosses(x, y, sparse = TRUE, prepared = TRUE, ...)
st_within(x, y, sparse = TRUE, prepared = TRUE, ...)
st_contains(x, y, sparse = TRUE, prepared = TRUE, ..., s2_model = "open")
st_contains_properly(x, y, sparse = TRUE, prepared = TRUE, ...)
st_overlaps(x, y, sparse = TRUE, prepared = TRUE, ...)
st_equals(x, y, sparse = TRUE, prepared = FALSE, ...)
st_covers(x, y, sparse = TRUE, prepared = TRUE, ..., s2_model = "closed")

st_covered_by(
  x,
  y = x,
  sparse = TRUE,
  prepared = TRUE,
  ...

  s2_model = "closed"
)
st_equals_exact(x, y, par, sparse = TRUE, prepared = FALSE, ...)
st_is_within_distance(x, y = x, dist, sparse = TRUE, ...)

))

```r
geos_binary_pred
```
Arguments

- **x**: object of class `sf`, `sfc` or `sfg`.
- **y**: object of class `sf`, `sfc` or `sfg`; if missing, `x` is used.
- **sparse**: logical; should a sparse index list be returned (TRUE) or a dense logical matrix? See below.

... passed on to `s2_options`

- **prepared**: logical; prepare geometry for `x`, before looping over `y`? See Details.
- **s2_model**: character; polygon/polylin model; one of "OPEN", "SEMI_OPEN", and "CLOSED"; see Details.
- **par**: numeric; parameter used for "equals_exact" (margin);
- **dist**: distance threshold; geometry indexes with distances smaller or equal to this value are returned; numeric value or units value having distance units.

Details

If **prepared** is TRUE, and `x` contains POINT geometries and `y` contains polygons, then the polygon geometries are prepared, rather than the points.

For most predicates, a spatial index is built on argument `x`; see [https://www.r-spatial.org/r/2017/06/22/spatial-index.html](https://www.r-spatial.org/r/2017/06/22/spatial-index.html). Specifically, `st_intersects`, `st_disjoint`, `st.touches`
`st.covers`, `st.contains`, `st.contains_properly`, `st.overlaps`, `st.equals`, `st.covers`
and `st.covered_by` all build spatial indexes for more efficient geometry calculations. `st.relate`,
`st.equals_exact`, and do not; `st.is.within.distance` uses a spatial index for geographic coor-
dinates when `sf.use.s2()` is true.

If `y` is missing, 'st.predicate(x, x)' is effectively called, and a square matrix is returned with diago-
nal elements 'st.predicate(x[i], x[i])'.

Sparse geometry binary predicate (`sgbp`) lists have the following attributes: `region.id` with the
`row.names` of `x` (if any, else 1:n), `ncol` with the number of features in `y`, and `predicate` with the
name of the predicate used.

for `s2_model`, see [https://github.com/r-spatial/s2/issues/32](https://github.com/r-spatial/s2/issues/32)

'`st.contains_properly(A,B)`' is true if A intersects B’s interior, but not its edges or exterior; A
contains A, but A does not properly contain A.

See also `st.relate` and [https://en.wikipedia.org/wiki/DE-9IM](https://en.wikipedia.org/wiki/DE-9IM) for a more detailed description
of the underlying algorithms.

`st.equals_exact` returns true for two geometries of the same type and their vertices corresponding
by index are equal up to a specified tolerance.

Value

If `sparse=FALSE`, `st.predicate` (with predicate e.g. “intersects”) returns a dense logical ma-
trix with element `i,j` TRUE when `predicate(x[i],y[j])` (e.g., when geometry of feature `i` and `j`
intersect); if `sparse=TRUE`, an object of class `sgbp` with a sparse list representation of the same
matrix, with list element `i` an integer vector with all indices `j` for which `predicate(x[i],y[j])` is
TRUE (and hence a zero-length integer vector if none of them is TRUE). From the dense matrix, one
can find out if one or more elements intersect by `apply(mat,1,any)`, and from the sparse list by
`lengths(lst) > 0`, see examples below.
Note
For intersection on pairs of simple feature geometries, use the function `st_intersection` instead of `st_intersects`.

Examples
```r
g <- st_sfc(st_point(c(.5,.5)), st_point(c(1.5, 1.5)), st_point(c(2.5, 2.5)))
pol = st_polygon(list(rbind(c(0,0), c(2,0), c(2,2), c(0,2), c(0,0))))
(mat = st_intersects(g, pol))
# which points fall inside a polygon?
apply(mat, 1, any)
lengths(mat) > 0
# which points fall inside the first polygon?
st_intersects(pol, g)[[1]]
```

Description
Combine several feature geometries into one, without unioning or resolving internal boundaries

Usage
```r
st_combine(x)
st_union(x, y, ..., by_feature = FALSE, is_coverage = FALSE)
```

Arguments
- `x` object of class `sf`, `sfc` or `sfg`
- `y` object of class `sf`, `sfc` or `sfg` (optional)
- `...` ignored
- `by_feature` logical; if TRUE, union each feature, if FALSE return a single feature that is the geometric union of the set of features
- `is_coverage` logical; if TRUE, use an optimized algorithm for features that form a polygonal coverage (have no overlaps)

Details
`st_combine` combines geometries without resolving borders, using `c.sfg` (analogous to `c` for ordinary vectors).

If `st_union` is called with a single argument, `x`, (with `y` missing) and `by_feature` is FALSE all geometries are unioned together and an `sfg` or single-geometry `sfc` object is returned. If `by_feature`...
is TRUE each feature geometry is unioned. This can for instance be used to resolve internal boundaries after polygons were combined using `st_combine`. If y is provided, all elements of x and y are unioned, pairwise (and by_feature is ignored). The former corresponds to `gUnaryUnion`, the latter to `gUnion`.

Unioning a set of overlapping polygons has the effect of merging the areas (i.e. the same effect as iteratively unioning all individual polygons together). Unioning a set of LineStrings has the effect of fully noding and dissolving the input linework. In this context "fully noded" means that there will be a node or endpoint in the output for every endpoint or line segment crossing in the input. "Dissolved" means that any duplicate (e.g. coincident) line segments or portions of line segments will be reduced to a single line segment in the output. Unioning a set of Points has the effect of merging all identical points (producing a set with no duplicates).

Value

`st_combine` returns a single, combined geometry, with no resolved boundaries; returned geometries may well be invalid.

If y is missing, `st_union(x)` returns a single geometry with resolved boundaries, else the geometries for all unioned pairs of x[i] and y[j].

See Also

`st_intersection`, `st_difference`, `st_sym_difference`

Examples

```r
nc = st_read(system.file("shape/nc.shp", package="sf"))
st_combine(nc)
plot(st_union(nc))
```

```
geos_measures  Compute geometric measurements
```

Description

Compute Euclidian or great circle distance between pairs of geometries; compute, the area or the length of a set of geometries.

Usage

```r
st_area(x, ...)
```

```r
## S3 method for class 'sfc'
st_area(x, ...)
```

```r
st_length(x, ...)
```

```r
st_distance(
```
x,
y,
...,
dist_fun,
by_element = FALSE,
which = ifelse(isTRUE(st_is_longlat(x)), "Great Circle", "Euclidean"),
par = 0,
tolerance = 0)

Arguments

x object of class sf, sfc or sfg
... ignored
y object of class sf, sfc or sfg, defaults to x
dist_fun deprecated
by_element logical; if TRUE, return a vector with distance between the first elements of x and y, the second, etc. if FALSE, return the dense matrix with all pairwise distances.
which character; for Cartesian coordinates only: one of Euclidean, Hausdorff or Frechet; for geodetic coordinates, great circle distances are computed; see details
par for which equal to Hausdorff or Frechet, optionally use a value between 0 and 1 to densify the geometry
tolerance ignored if st_is_longlat(x) is FALSE; otherwise, if set to a positive value, the first distance smaller than tolerance will be returned, and true distance may be smaller; this may speed up computation. In meters, or a units object convertible to meters.

Details


Value

If the coordinate reference system of x was set, these functions return values with unit of measurement; see set_units.

st_area returns the area of a geometry, in the coordinate reference system used; in case x is in degrees longitude/latitude, st_geod_area is used for area calculation.

st_length returns the length of a LINESTRING or MULTILINESTRING geometry, using the coordinate reference system. POINT, MULTPOINT, POLYGON or MULTIPOLYGON geometries return zero.

If by_element is FALSE st_distance returns a dense numeric matrix of dimension length(x) by length(y); otherwise it returns a numeric vector of length x or y, the shorter one being recycled. Distances involving empty geometries are NA.
See Also

`st_dimension, st_cast` to convert geometry types

Examples

```r
b0 = st_polygon(list(rbind(c(-1,-1), c(1,-1), c(1,1), c(-1,1), c(-1,-1))))
b1 = b0 + 2
b2 = b0 + c(-0.2, 2)
x = st_sfc(b0, b1, b2)
st_area(x)
line = st_sfc(st_linestring(rbind(c(30,30), c(40,40))), crs = 4326)
st_length(line)
outer = matrix(c(0,0,10,0,10,0,10,0,0),ncol=2, byrow=TRUE)
hole1 = matrix(c(1,1,2,2,2,2,1,1,1),ncol=2, byrow=TRUE)
hole2 = matrix(c(5,5,6,6,6,6,5,5,5),ncol=2, byrow=TRUE)
poly = st_polygon(list(outer, hole1, hole2))
mpoly = st_multipolygon(list(
                        list(outer, hole1, hole2),
                        list(outer + 12, hole1 + 12)
))
st_length(st_sfc(poly, mpoly))
p = st_sfc(st_point(c(0,0)), st_point(c(0,1)), st_point(c(0,2)))
st_distance(p, p)
st_distance(p, p, by_element = TRUE)
```

---

**geos_query**

*Dimension, simplicity, validity or is_empty queries on simple feature geometries*

**Description**

Dimension, simplicity, validity or is_empty queries on simple feature geometries

**Usage**

```r
st_dimension(x, NA_if_empty = TRUE)
st_is_simple(x)
st_is_empty(x)
```

**Arguments**

- `x` object of class sf, sfc or sfg
- `NA_if_empty` logical; if TRUE, return NA for empty geometries
Value

st_dimension returns a numeric vector with 0 for points, 1 for lines, 2 for surfaces, and, if NA_if_empty is TRUE, NA for empty geometries.

st_is_simple returns a logical vector, indicating for each geometry whether it is simple (e.g., not self-intersecting)

st_is_empty returns for each geometry whether it is empty

Examples

```r
x = st_sfc(
  st_point(0:1),
  st_linestring(rbind(c(0,0),c(1,1))),
  st_polygon(list(rbind(c(0,0),c(1,0),c(0,1),c(0,0)))),
  st_multipoint(),
  st_linestring(),
  st_geometrycollection())
```

```r
st_dimension(x)
st_dimension(x, FALSE)
```

```r
ls = st_linestring(rbind(c(0,0), c(1,1), c(1,0), c(0,1)))
st_is_simple(st_sfc(ls, st_point(c(0,0))))
```

```r
ls = st_linestring(rbind(c(0,0), c(1,1), c(1,0), c(0,1)))
st_is_empty(st_sfc(ls, st_point(), st_linestring()))
```

---

**geos_unary**

**Geometric unary operations on simple feature geometry sets**

**Description**

Geometric unary operations on simple feature geometries. These are all generics, with methods for sfg, sfc and sf objects, returning an object of the same class. All operations work on a per-feature basis, ignoring all other features.

**Usage**

```r
st_buffer(
  x,
  dist,
  nQuadSegs = 30,
  endCapStyle = "ROUND",
  joinStyle = "ROUND",
  mitreLimit = 1,
  singleSide = FALSE,
  ...
)
```

```r
st_boundary(x)
```
geos_unary

st_convex_hull(x)
st_simplify(x, preserveTopology = FALSE, dTolerance = 0)
st_triangulate(x, dTolerance = 0, bOnlyEdges = FALSE)
st_voronoi(x, envelope, dTolerance = 0, bOnlyEdges = FALSE)
st_polygonize(x)
st_line_merge(x)
st_centroid(x, ... , of_largest_polygon = FALSE)
st_point_on_surface(x)
st_reverse(x)
st_node(x)
st_segmentize(x, dfMaxLength, ...)

Arguments

x object of class sfg, sfc or sf
dist numeric; buffer distance for all, or for each of the elements in x; in case dist is a units object, it should be convertible to arc_degree if x has geographic coordinates, and to st_crs(x)$units otherwise
nQuadSegs integer; number of segments per quadrant (fourth of a circle), for all or per-feature
endCapStyle character; style of line ends, one of 'ROUND', 'FLAT', 'SQUARE'
joinStyle character; style of line joins, one of 'ROUND', 'MITRE', 'BEVEL'
mitreLimit numeric; limit of extension for a join if joinStyle 'MITRE' is used (default 1.0, minimum 0.0)
singleSide logical; if TRUE, single-sided buffers are returned for linear geometries, in which case negative dist values give buffers on the right-hand side, positive on the left.
... ignored
preserveTopology logical; carry out topology preserving simplification? May be specified for each, or for all feature geometries. Note that topology is preserved only for single feature geometries, not for sets of them.
dTolerance numeric; tolerance parameter, specified for all or for each feature geometry.
bOnlyEdges logical; if TRUE, return lines, else return polygons
envelope object of class sfc or sfg containing a POLYGON with the envelope for a voronoi diagram; this only takes effect when it is larger than the default envelope, chosen when envelope is an empty polygon
of_largest_polygon
  logical; for st_centroid: if TRUE, return centroid of the largest (sub)polygon
  of a MULTIPOLYGON rather than of the whole MULTIPOLYGON

dfMaxLength
  maximum length of a line segment. If x has geographical coordinates (long/lat),
  dfMaxLength is either a numeric expressed in meter, or an object of class units
  with length units rad or degree; segmentation in the long/lat case takes place
  along the great circle, using st_geod_segmentize.

Details

st_buffer computes a buffer around this geometry/each geometry. If any of endCapStyle, joinStyle,
  or mitreLimit are set to non-default values (‘ROUND’, ‘ROUND’, 1.0 respectively) then the under-
  lying ‘buffer with style’ GEOS function is used. See postgis.net/docs/ST_Buffer.html for details.

st_boundary returns the boundary of a geometry

st_convex_hull creates the convex hull of a set of points

st_simplify simplifies lines by removing vertices

st_triangulate triangulates set of points (not constrained). st_triangulate requires GEOS
  version 3.4 or above

st_voronoi creates voronoi tesselation. st_voronoi requires GEOS version 3.5 or above

st_polygonize creates polygon from lines that form a closed ring. In case of st_polygonize,
  x must be an object of class LINESTRING or MULTILINESTRING, or an sfc geometry list-column
  object containing these

st_line_merge merges lines. In case of st_line_merge, x must be an object of class MULTILINESTRING,
  or an sfc geometry list-column object containing these

st_centroid gives the centroid of a geometry

st_point_on_surface returns a point guaranteed to be on the (multi)surface.

st_reverse reverses the nodes in a line

st_node adds nodes to linear geometries at intersections without a node, and only works on indi-
  vidual linear geometries

st_segmentize adds points to straight lines

Value

an object of the same class of x, with manipulated geometry.

Examples

## st_buffer, style options (taken from rgeos gBuffer)
l1 = st_as_sfc("LINESTRING(0 0,1 5,4 5,5 2,8 2,9 4,4 6.5)")
op = par(mfrow=c(2,3))
plot(st_buffer(l1, dist = 1, endCapStyle="ROUND"), reset = FALSE, main = "endCapStyle: ROUND")
plot(l1,col='blue',add=TRUE)
plot(st_buffer(l1, dist = 1, endCapStyle="FLAT"), reset = FALSE, main = "endCapStyle: FLAT")
plot(l1,col='blue',add=TRUE)
plot(st_buffer(l1, dist = 1, endCapStyle="SQUARE"), reset = FALSE, main = "endCapStyle: SQUARE")
plot(l1,col='blue',add=TRUE)
plot(st_buffer(l1, dist = 1, nQuadSegs=1), reset = FALSE, main = "nQuadSegs: 1")
plot(l1,col='blue',add=TRUE)
plot(st_buffer(l1, dist = 1, nQuadSegs=2), reset = FALSE, main = "nQuadSegs: 2")
plot(l1,col='blue',add=TRUE)
plot(st_buffer(l1, dist = 1, nQuadSegs= 5), reset = FALSE, main = "nQuadSegs: 5")
plot(l1,col='blue',add=TRUE)
par(op)

l2 = st_as_sfc("LINESTRING(0 0,1 5,3 2)"
op = par(mfrow = c(2, 3))
plot(st_buffer(l2, dist = 1, joinStyle="ROUND"), reset = FALSE, main = "joinStyle: ROUND")
plot(l2, col = 'blue', add = TRUE)
plot(st_buffer(l2, dist = 1, joinStyle="MITRE"), reset = FALSE, main = "joinStyle: MITRE")
plot(l2, col='blue', add = TRUE)
plot(st_buffer(l2, dist = 1, joinStyle="BEVEL"), reset = FALSE, main = "joinStyle: BEVEL")
plot(l2, col = 'blue', add = TRUE)
plot(st_buffer(l2, dist = 1, joinStyle="MITRE", mitreLimit=0.5), reset = FALSE,
main = "mitreLimit: 0.5")
plot(l2, col='blue', add = TRUE)
plot(st_buffer(l2, dist = 1, joinStyle="MITRE",mitreLimit=1), reset = FALSE,
main = "mitreLimit: 1")
plot(l2, col = 'blue', add = TRUE)
plot(st_buffer(l2, dist = 1, joinStyle="MITRE",mitreLimit=3), reset = FALSE,
main = "mitreLimit: 3")
plot(l2, col = 'blue', add = TRUE)
par(op)
nc = st_read(system.file("shape/nc.shp", package="sf"))
plot(st_convex_hull(nc))
plot(nc, border = grey(.5))
set.seed(1)
x = st_multipoint(matrix(runif(10),,2))
box = st_polygon(list(rbind(c(0,0),c(1,0),c(1,1),c(0,1),c(0,0))))
if (sf_extSoftVersion()["GEOS"] >= "3.5.0") {
  v = st_sfc(st_voronoi(x, st_sfc(box)))
  plot(v, col = 0, border = 1, axes = TRUE)
  plot(box, add = TRUE, col = 0, border = 1) # a larger box is returned, as documented
  plot(x, add = TRUE, col = 'red', cex=2, pch=16)
  plot(st_intersection(st_cast(v), box)) # clip to smaller box
  plot(x, add = TRUE, col = 'red', cex=2, pch=16)
  # matching Voronoi polygons to data points:
  # https://github.com/r-spatial/sf/issues/1030
  # generate 50 random unif points:
  n = 100
  pts = st_as_sf(data.frame(matrix(runif(n), , 2), id = 1:(n/2)), coords = c("X1", "X2"))
  # compute Voronoi polygons:
  pols = st_collection_extract(st_voronoi(do.call(c, st_geometry(pts)))))
  # match them to points:
  pts$pols = pols[unlist(st_intersects(pts, pols))]
  plot(pts["id"], pch = 16) # ID is color
  plot(st_set_geometry(pts, "pols")["id"], xlab = c(0,1), ylab = c(0,1), reset = FALSE)
  plot(st_geometry(pts), add = TRUE)
is_driver_available

Internal functions

Description
Internal functions

Usage
.stop_geos(msg)

Arguments

msg error message

is_driver_available Check if driver is available

Description
Search through the driver table if driver is listed
is_driver_can

Usage

is_driver_available(drv, drivers = st_drivers())

Arguments

drv character. Name of driver
drivers data.frame. Table containing driver names and support. Default is from st_drivers

is_driver_can Check if a driver can perform an action

Description

Search through the driver table to match a driver name with an action (e.g. "write") and check if the action is supported.

Usage

is_driver_can(drv, drivers = st_drivers(), operation = "write")

Arguments

drv character. Name of driver
drivers data.frame. Table containing driver names and support. Default is from st_drivers
operation character. What action to check

is_geometry_column Check if the columns could be of a coercable type for sf

Description

Check if the columns could be of a coercable type for sf

Usage

is_geometry_column(con, x, classes = "")

Arguments

con database connection
x inherits data.frame
classes classes inherited
merge.sf

merge method for sf and data.frame object

Description
merge method for sf and data.frame object

Usage
## S3 method for class 'sf'
merge(x, y, ...)

Arguments
x
object of class sf
y
object of class data.frame
...
arguments passed on to merge.data.frame

Examples
a = data.frame(a = 1:3, b = 5:7)
st_geometry(a) = st_sfc(st_point(c(0,0)), st_point(c(1,1)), st_point(c(2,2)))
b = data.frame(x = c("a", "b", "c"), b = c(2,5,6))
merge(a, b)
merge(a, b, all = TRUE)

nc
North Carolina SIDS data

Description
Sudden Infant Death Syndrome (SIDS) sample data for North Carolina counties, two time periods (1974-78 and 1979-84). The details of the columns can be found on the seealso URL, spdep package’s vignette. Please note that, though this is basically the same as nc.sids dataset in spData package, nc only contains a subset of variables. The differences are also discussed on the vignette.

See Also
https://r-spatial.github.io/spdep/articles/sids.html
Ops

S3 Ops Group Generic Functions for simple feature geometries

Description

S3 Ops Group Generic Functions for simple feature geometries

Usage

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

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

Arguments

e1 object of class sfg or sfc
e2 numeric, or object of class sfg; in case e1 is of class sfc also an object of class sfc is allowed

Details

in case e2 is numeric, +, -, *, /,

If e1 is of class sfc, and e2 is a length 2 numeric, then it is considered a two-dimensional point (and if needed repeated as such) only for operations + and -, in other cases the individual numbers are repeated; see commented examples.

Value

object of class sfg

Examples

st_point(c(1,2,3)) + 4
st_point(c(1,2,3)) * 3 + 4
m = matrix(0, 2, 2)
diag(m) = c(1, 3)
# affine:
st_point(c(1,2)) * m + c(2,5)
# world in 0-360 range:
library(maps)
w = st_as_sf(map('world', plot = FALSE, fill = TRUE))
w2 = (st_geometry(w) + c(360,0)) %% c(360) - c(0,90)
w3 = st_wrap_dateline(st_set_crs(w2 - c(180,0), 4326)) + c(180,0)
plot(st_set_crs(w3, 4326), axes = TRUE)
(mp <- st_point(c(1,2)) + st_point(c(3,4))) # MULTIPOINT (1 2, 3 4)
mp - st_point(c(3,4)) # POINT (1 2)
opar = par(mfrow = c(2,2), mar = c(0, 0, 1, 0))
a = st_buffer(st_point(c(0,0)), 2)
b = a + c(2, 0)
p = function(m) { plot(c(a,b)); plot(eval(parse(text=m)), col=grey(.9), add = TRUE); title(m) }
lapply(c('a | b', 'a / b', 'a & b', 'a %/% b'), p)
par(opar)
sfc = st_sfc(st_point(0:1), st_point(2:3))
sfc + c(2,3) # added to EACH geometry
sfc * c(2,3) # first geometry multiplied by 2, second by 3
nc = st_transform(st_read(system.file("gpkg/nc.gpkg", package="sf")), 32119) # nc state plane, m
b = st_buffer(st_centroid(st_union(nc)), units::set_units(50, km)) # shoot a hole in nc:
plot(st_geometry(nc) / b, col = grey(.9))

### S3 method for class 'sf'
plot(
  x,
  y,
  ..., main,
  pal = NULL,
  nbreaks = 10,
  breaks = "pretty",
  max.plot = if (is.null(n <- options("sf_max.plot"))[1])) 9 else n,
  key.pos = get_key_pos(x, ...),
  key.length = 0.618,
  key.width = lcm(1.8),
  reset = TRUE,
  logz = FALSE,
  extent = x,
  xlim = st_bbox(extent)[c(1, 3)],
  ylim = st_bbox(extent)[c(2, 4)]
)

get_key_pos(x, ...)

### S3 method for class 'sfc_POINT'
plot(
  x,
  y,
...,
pch = 1,
cex = 1,
col = 1,
bg = 0,
lwd = 1,
lty = 1,
type = "p",
add = FALSE
)

## S3 method for class 'sfc_MULTIPOINT'
plot(
  x,
y,
...
,
pch = 1,
cex = 1,
col = 1,
bg = 0,
lwd = 1,
lty = 1,
type = "p",
add = FALSE
)

## S3 method for class 'sfc_LINESTRING'
plot(x, y, ..., lty = 1, lwd = 1, col = 1, pch = 1, type = "l", add = FALSE)

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

## S3 method for class 'sfc_MULTILINESTRING'
plot(x, y, ..., lty = 1, lwd = 1, col = 1, pch = 1, type = "l", add = FALSE)

## S3 method for class 'sfc_POLYGON'
plot(
  x,
y,
...
,
lty = 1,
lwd = 1,
col = NA,
cex = 1,
pch = NA,
border = 1,
add = FALSE,
rule = "evenodd"
## S3 method for class 'sfc_MULTIPOLYGON'
plot(
  x,
  y,
  ..., 
  lty = 1,
  lwd = 1,
  col = NA,
  border = 1,
  add = FALSE,
  rule = "evenodd"
)

## S3 method for class 'sfc_GEOMETRYCOLLECTION'
plot(
  x,
  y,
  ..., 
  pch = 1,
  cex = 1,
  bg = 0,
  lty = 1,
  lwd = 1,
  col = 1,
  border = 1,
  add = FALSE
)

## S3 method for class 'sfc_GEOMETRY'
plot(
  x,
  y,
  ..., 
  pch = 1,
  cex = 1,
  bg = 0,
  lty = 1,
  lwd = 1,
  col = ifelse(st_dimension(x) == 2, NA, 1),
  border = 1,
  add = FALSE
)

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

plot

plot_sf(
  x,
  xlim = NULL,
  ylim = NULL,
  asp = NA,
  axes = FALSE,
  bgc = par("bg"),
  ...,
  xaxs,
  yaxs,
  lab,
  setParUsrBB = FALSE,
  bgMap = NULL,
  expandBB = c(0, 0, 0, 0),
  graticule = NA_crs_,
  col_graticule = "grey",
  border
)

sf.colors(n = 10, cutoff.tails = c(0.35, 0.2), alpha = 1, categorical = FALSE)

Arguments

x    object of class sf
y    ignored
...  further specifications, see plot_sf and plot and details.
main title for plot (NULL to remove)
pal  palette function, similar to rainbow, or palette values; if omitted, sf.colors is used
nbreaks number of colors breaks (ignored for factor or character variables)
b breaks  either a numeric vector with the actual breaks, or a name of a method accepted by the style argument of classIntervals
max.plot integer; lower boundary to maximum number of attributes to plot; the default value (9) can be overridden by setting the global option sf_max.plot, e.g. options(sf_max.plot=2)
key.pos integer; side to plot a color key: 1 bottom, 2 left, 3 top, 4 right; set to NULL to omit key, or -1 to select automatically. If multiple columns are plotted in a single function call by default no key is plotted and every submap is stretched individually; if a key is requested (and col is missing) all maps are colored according to a single key. Auto select depends on plot size, map aspect, and, if set, parameter asp.
key.length amount of space reserved for the key along its axis, length of the scale bar
key.width amount of space reserved for the key (incl. labels), thickness/width of the scale bar
reset logical; if FALSE, keep the plot in a mode that allows adding further map elements; if TRUE restore original mode after plotting sf objects with attributes; see details.
logz  logical; if TRUE, use log10-scale for the attribute variable. In that case, breaks and at need to be given as log10-values; see examples.

extent  object with an st_bbox method to define plot extent; defaults to x

xlim  see plot.window

ylim  see plot.window

pch  plotting symbol

cex  symbol size

col  color for plotting features; if length(col) does not equal 1 or nrow(x), a warning is emitted that colors will be recycled. Specifying col suppresses plotting the legend key.

bg  symbol background color

lwd  line width

lty  line type

type  plot type: 'p' for points, 'l' for lines, 'b' for both

add  logical: add to current plot? Note that when using add=TRUE, you may have to set reset=FALSE in the first plot command.

border  color of polygon border(s)

rule  see polypath; for winding, exterior ring direction should be opposite that of the holes; with evenodd, plotting is robust against misspecified ring directions

asp  see below, and see par

axes  logical; should axes be plotted? (default FALSE)

bgc  background color

xaxs  see par

yaxs  see par

lab  see par

setParUsrBB  default FALSE; set the par “usr” bounding box; see below

bgMap  object of class ggmap, or returned by function RgoogleMaps::GetMap

expandBB  numeric; fractional values to expand the bounding box with, in each direction (bottom, left, top, right)

graticule  logical, or object of class crs (e.g., st_crs(4326) for a WGS84 graticule), or object created by st_graticule; TRUE will give the WGS84 graticule or object returned by st_graticule

col_graticule  color to used for the graticule (if present)

n  integer; number of colors

cutoff.tails  numeric, in [0,0.5] start and end values

alpha  numeric, in [0,1], transparency

categorical  logical; do we want colors for a categorical variable? (see details)
Details

plot.sf maximally plots max.plot maps with colors following from attribute columns, one map per attribute. It uses sf.colors for default colors. For more control over placement of individual maps, set parameter mfrow with par prior to plotting, and plot single maps one by one; note that this only works in combination with setting parameters key.pos=NULL (no legend) and reset=FALSE.

plot.sfc plots the geometry, additional parameters can be passed on to control color, lines or symbols.

When setting reset to FALSE, the original device parameters are lost, and the device must be reset using dev.off() in order to reset it.

parameter at can be set to specify where labels are placed along the key; see examples.

plot_sf sets up the plotting area, axes, graticule, or webmap background; it is called by all plot methods before anything is drawn.

The argument setParUsrBB may be used to pass the logical value TRUE to functions within plot.Spatial. When set to TRUE, par("usr") will be overwritten with c(xlim, ylim), which defaults to the bounding box of the spatial object. This is only needed in the particular context of graphic output to a specified device with given width and height, to be matched to the spatial object, when using par("xaxs") and par("yaxs") in addition to par(mar=c(0,0,0,0)).

The default aspect for map plots is 1; if however data are not projected (coordinates are long/lat), the aspect is by default set to 1/cos(My * pi/180) with My the y coordinate of the middle of the map (the mean of ylim, which defaults to the y range of bounding box). This implies an Equirectangular projection.

non-categorical colors from sf.colors were taken from bpy.colors, with modified cutoff.tails defaults If categorical is TRUE, default colors are from https://colorbrewer2.org/ (if n < 9, Set2, else Set3).

Examples

nc = st_read(system.file("gpkg/nc.gpkg" , package="sf"), quiet = TRUE)  
# plot single attribute, auto-legend:
plot(nc["SID74"])
# plot multiple:
plot(nc[c("SID74", "SID79")]) # better use ggplot2::geom_sf to facet and get a single legend!
# adding to a plot of an sf object only works when using reset=FALSE in the first plot:
plot(nc["SID74"], reset = FALSE)
plot(st_centroid(st_geometry(nc)), add = TRUE)
# log10 z-scale:
plot(nc["SID74"], logz = TRUE, breaks = c(0,.5,1,1.5,2), at = c(0,.5,1,1.5,2))
# and we need to reset the plotting device after that, e.g. by layout(1)
# when plotting only geometries, the reset=FALSE is not needed:
plot(st_geometry(nc))
plot(st_geometry(nc)[1], col = 'red', add = TRUE)
# add a custom legend to an arbitrary plot:
layout(matrix(1:2, ncol = 2), widths = c(1, lcm(2)))
plot(1)
.image_scale(1:10, col = sf.colors(9), key.length = lcm(8), key.pos = 4, at = 1:10)
sf.colors(10)
### prefix_map

**Map prefix to driver**

**Description**

Map prefix to driver

**Usage**

prefix_map

**Format**

An object of class `list` of length 10.

---

### rawToHex

**Convert raw vector(s) into hexadecimal character string(s)**

**Description**

Convert raw vector(s) into hexadecimal character string(s)

**Usage**

rawToHex(x)

**Arguments**

- **x**: raw vector, or list with raw vectors

---

### s2

**functions for spherical geometry, using s2 package**

**Description**

functions for spherical geometry, using the s2 package based on the google s2geometry.io library
Usage

sf_use_s2(use_s2)

## S3 method for class 'wk_wkb'
st_as_sfc(x, ..., crs = st_crs(4326))

## S3 method for class 's2_geography'
st_as_sfc(
  x,
  ...

  crs = st_crs(4326),

  endian = match(.Platform$endian, c("big", "little")) - 1L
)

## S3 method for class 's2_geography'
st_as_sf(x, ..., crs = st_crs(4326))

st_as_s2(x, ...)

## S3 method for class 'sf'
st_as_s2(x, ...)

## S3 method for class 'sfc'
st_as_s2(x, ..., oriented = FALSE)

Arguments

use_s2 logical; if TRUE, use the s2 spherical geometry package for geographical coordinate operations

x object of class sf, sfc or sfg

... passed on

crs coordinate reference system; object of class crs

d endian integer; 0 or 1: defaults to the endian of the native machine

oriented logical; if FALSE, polygons that cover more than half of the globe are inverted; if TRUE, no reversal takes place and it is assumed that the inside of the polygon is to the left of the polygon’s path.

Details

st_as_s2 converts an sf POLYGON object into a form readable by s2.

Value

sf_use_s2 returns the value of this variable before (re)setting it, invisibly if use_s2 is not missing.
Examples

```r
m = rbind(c(-1,-1), c(1,-1), c(1,1), c(-1,1), c(-1,-1))
m1 = rbind(c(-1,-1), c(1,-1), c(1,1), c(-1,1), c(-1,0), c(-1,-1))
m0 = m[5:1,]
mp = st_multipolygon(list(
  list(m, 0.8 * m0, 0.01 * m1 + 0.9),
  list(0.7* m, 0.6*m0),
  list(0.5 * m0),
  list(m+2),
  list(m+4,(.9*m0)+4)
))
sf = st_sfc(mp, mp, crs = 'EPSG:4326')
s2 = st_as_s2(sf)
```

---

**sf**

Create sf object

Description

Create sf, which extends data.frame-like objects with a simple feature list column

Usage

```r
st_sf(
  ..., 
  agr = NA_agr_,
  row.names,
  stringsAsFactors = sf_stringsAsFactors(),
  crs,
  precision,
  sf_column_name = NULL,
  check_ring_dir = FALSE,
  sfc_last = TRUE
)
```

## S3 method for class 'sf'

```r
x[i, j, ..., drop = FALSE, op = st_intersects]
```

## S3 method for class 'sf'

```r
print(x, ..., n = getOption("sf_max_print", default = 10))
```

Arguments

... column elements to be binded into an sf object or a single list or data.frame with such columns; at least one of these columns shall be a geometry list-column of class sfc or be a list-column that can be converted into an sfc by st_as_sfc.

agr character vector; see details below.
row.names  row.names for the created sf object
stringsAsFactors  logical; see st_read
stringsAsFactors  logical; see st_read
crs  coordinate reference system, something suitable as input to st_crs
precision  numeric; see st_as_binary
sf_column_name  character; name of the active list-column with simple feature geometries; in case there is more than one and sf_column_name is NULL, the first one is taken.
check_ring_dir  see st_read
sfc_last  logical; if TRUE, sfc columns are always put last, otherwise column order is left unmodified.
x  object of class sf
i  record selection, see [.data.frame
j  variable selection, see [.data.frame
drop  logical, default FALSE; if TRUE drop the geometry column and return a data.frame, else make the geometry sticky and return a sf object.
op  function; geometrical binary predicate function to apply when i is a simple feature object
n  maximum number of features to print; can be set globally by options(sf_max_print=...)

Details

agr, attribute-geometry-relationship, specifies for each non-geometry attribute column how it relates to the geometry, and can have one of following values: "constant", "aggregate", "identity". "constant" is used for attributes that are constant throughout the geometry (e.g. land use), "aggregate" where the attribute is an aggregate value over the geometry (e.g. population density or population count), "identity" when the attributes uniquely identifies the geometry of particular "thing", such as a building ID or a city name. The default value, NA_agr_, implies we don’t know.

When a single value is provided to agr, it is cascaded across all input columns; otherwise, a named vector like c(feature1="constant",...) will set agr value to 'constant' for the input column named feature1. See demo(nc) for a worked example of this.

When confronted with a data.frame-like object, st_sf will try to find a geometry column of class sfc, and otherwise try to convert list-columns when available into a geometry column, using st_as_sfc.

[.sf will return a data.frame or vector if the geometry column (of class sfc) is dropped (drop=TRUE), an sfc object if only the geometry column is selected, and otherwise return an sf object; see also [.data.frame; for [.sf ... arguments are passed to op.

Examples

g = st_sfc(st_point(1:2))
st_sf(a=3,g)
st_sf(g, a=3)
st_sf(a=3, st_sfc(st_point(1:2))) # better to name it!
# create empty structure with preallocated empty geometries:
nrows <- 10
sf-defunct

### Description

These functions are provided for compatibility with older version of sf. They may eventually be completely removed.

### Usage

```r
def <= st_sf(id = 1:nrows, geometry = geometry)
g = st_sfc(st_point(1:2), st_point(3:4))
s = st_sf(a=3:4, g)
s[1,]
class(s[1,])
s[,]1
class(s[,1])
s[,2]
class(s[,2])
g = st_sf(a=2:3, g)
pol = st_sfc(st_polygon(list(cbind(c(0,3,3,0,0),c(0,0,3,3,0)))))
h = st_sf(r = 5, pol)
g[h,]
h[g,]
```

---

**sf-defunct**

### Deprecated functions in sf

---

**Description**

These functions are provided for compatibility with older version of sf. They may eventually be completely removed.

**Usage**

```r
st_read_db(
  conn = NULL,
  table = NULL,
  query = NULL,
  geom_column = NULL,
  EWKB = TRUE,
  ...
)
```

**Arguments**

- `conn` open database connection
- `table` table name
- `query` SQL query to select records; see details
- `geom_column` deprecated. Geometry column name
- `EWKB` logical; is the WKB of type EWKB? if missing, defaults to TRUE
- `...` parameter(s) passed on to `st_as_sf`

**Details**

The `geom_column` argument is deprecated. The function will automatically find the geometry type columns. For the RPostgreSQL drivers it will try to cast all the character columns, which can be long for very wide tables.
Details

\texttt{st\_read\_db} now a synonym for \texttt{st\_read}
\texttt{st\_write\_db} now a synonym for \texttt{st\_write}

\begin{itemize}
\item \texttt{sfc}
\end{itemize}

\textit{Create simple feature geometry list column}

\begin{itemize}
\item Description
Create simple feature geometry list column, set class, and add coordinate reference system and precision
\item Usage
\texttt{st\_sfc(..., crs = NA\_crs\_, precision = 0, check\_ring\_dir = FALSE, dim)}
\item Arguments
\begin{itemize}
\item \texttt{...}: zero or more simple feature geometries (objects of class \texttt{sfg}), or a single list of such objects; NULL values will get replaced by empty geometries.
\item \texttt{crs}: coordinate reference system: integer with the EPSG code, or character with \texttt{proj4string}
\item \texttt{precision}: numeric; see \texttt{st\_as\_binary}
\item \texttt{check\_ring\_dir}: see \texttt{st\_read}
\item \texttt{dim}: character; if this function is called without valid geometries, this argument may carry the right dimension to set empty geometries
\end{itemize}
\item Details
A simple feature geometry list-column is a list of class \texttt{c("stc\_TYPE","sfc")} which most often contains objects of identical type; in case of a mix of types or an empty set, \texttt{TYPE} is set to the superclass \texttt{GEOMETRY}.

\item Value
an object of class \texttt{sfc}, which is a classed list-column with simple feature geometries.
\item Examples
\begin{verbatim}
pt1 = st\_point(c(0,1))
pt2 = st\_point(c(1,1))
(sfc = st\_sfc(pt1, pt2))
d = st\_sf(data\_frame(a=1:2, geom=sfc))
\end{verbatim}
sf_extSoftVersion  
*Provide the external dependencies versions of the libraries linked to sf*

**Description**
Provide the external dependencies versions of the libraries linked to sf

**Usage**
sf_extSoftVersion()

---

sf_project  
*directly transform a set of coordinates*

**Description**
directly transform a set of coordinates

**Usage**
sf_add_proj_units()
sf_project(
  from,
  to,
  pts,
  keep = FALSE,
  warn = TRUE,
  authority_compliant = st_axis_order()
)

**Arguments**
- **from**: character description of source CRS, or object of class `crs`
- **to**: character description of target CRS, or object of class `crs`
- **pts**: two-column numeric matrix, or object that can be coerced into a matrix
- **keep**: logical value controlling the handling of unprojectable points. If `keep` is `TRUE`, then such points will yield ‘Inf’ or ‘-Inf’ in the return value; otherwise an error is reported and nothing is returned.
- **warn**: logical; if TRUE, warn when non-finite values are generated
- **authority_compliant**: logical; TRUE means handle axis order authority compliant (e.g. EPSG:4326 implying x=lat, y=lon), FALSE means use visualisation order (i.e. always x=lon, y=lat)
Details

sf_add_proj_units loads the PROJ units ‘link’, ‘us_in’, ‘ind_yd’, ‘ind_ft’, and ‘ind_ch’ into the udunits database, and returns TRUE invisibly on success.

Value

two-column numeric matrix with transformed/converted coordinates, returning invalid values as Inf

sf_proj_search_paths  Get or set the PROJ search paths

Description

Get or set the PROJ search paths

Usage

sf_proj_search_paths(paths = NULL)

Arguments

paths the search path to be set; omit if no paths need to be set

Value

the search path (possibly after setting to paths)

sgbp  Methods for dealing with sparse geometry binary predicate lists

Description

Methods for dealing with sparse geometry binary predicate lists

Usage

## S3 method for class 'sgbp'
print(x, ..., n = 10, max_nb = 10)

## S3 method for class 'sgbp'
t(x)

## S3 method for class 'sgbp'
as.matrix(x, ...)

## S3 method for class 'sgbp'
dim(x)
Arguments

x  object of class sgbp
...
  ignored
n  integer; maximum number of items to print
max_nb  integer; maximum number of neighbours to print for each item

Details

gbp are sparse matrices, stored as a list with integer vectors holding the ordered TRUE indices of each row. This means that for a dense, \( m \times n \) matrix \( Q \) and a list \( L \), if \( Q[i,j] \) is TRUE then \( j \) is an element of \( L[i] \). Reversed: when \( k \) is the value of \( L[i][j] \), then \( Q[i,k] \) is TRUE.

Description

Create simple feature from a numeric vector, matrix or list

Usage

\[
\begin{align*}
\text{st}_{-}\text{point}(x = c(\text{NA}\_\text{real}, \text{NA}\_\text{real}), \text{dim} = "\text{XYZ}"), \\
\text{st}_{-}\text{multipoint}(x = \text{matrix}(\text{numeric}(0), 0, 2), \text{dim} = "\text{XYZ}"), \\
\text{st}_{-}\text{linestring}(x = \text{matrix}(\text{numeric}(0), 0, 2), \text{dim} = "\text{XYZ}"), \\
\text{st}_{-}\text{polygon}(x = \text{list}(), \text{dim} = \text{if (length(x)) } "\text{XYZ}" \text{ else } "\text{XY}"), \\
\text{st}_{-}\text{multilinestring}(x = \text{list}(), \text{dim} = \text{if (length(x)) } "\text{XYZ}" \text{ else } "\text{XY}"), \\
\text{st}_{-}\text{multipolygon}(x = \text{list}(), \text{dim} = \text{if (length(x)) } "\text{XYZ}" \text{ else } "\text{XY}"), \\
\text{st}_{-}\text{geometrycollection}(x = \text{list}(), \text{dims} = "\text{XY}"), \\
\text{st}_{-}\text{point}(x = c(\text{NA}\_\text{real}, \text{NA}\_\text{real}), \text{dim} = "\text{XYZ}"), \\
\text{st}_{-}\text{multipoint}(x = \text{matrix}(\text{numeric}(0), 0, 2), \text{dim} = "\text{XYZ}"), \\
\text{st}_{-}\text{linestring}(x = \text{matrix}(\text{numeric}(0), 0, 2), \text{dim} = "\text{XYZ}"), \\
\text{st}_{-}\text{polygon}(x = \text{list}(), \text{dim} = \text{if (length(x)) } "\text{XYZ}" \text{ else } "\text{XY}"), \\
\text{st}_{-}\text{multilinestring}(x = \text{list}(), \text{dim} = \text{if (length(x)) } "\text{XYZ}" \text{ else } "\text{XY}"), \\
\text{st}_{-}\text{multipolygon}(x = \text{list}(), \text{dim} = \text{if (length(x)) } "\text{XYZ}" \text{ else } "\text{XY}"), \\
\text{st}_{-}\text{geometrycollection}(x = \text{list}(), \text{dims} = "\text{XY}"), \\
\end{align*}
\]

## S3 method for class 'sfg'
print(x, ..., width = 0)

## S3 method for class 'sfg'
head(x, n = 10L, ...)

## S3 method for class 'sfg'
format(x, ..., width = 30)

## S3 method for class 'sfg'
c(..., recursive = FALSE, flatten = TRUE)
## S3 method for class 'sfg'

as.matrix(x, ...)

### Arguments

- **x**
  - For `st_point`, numeric vector (or one-row-matrix) of length 2, 3 or 4; for `st_linestring` and `st_multipoint`, numeric matrix with points in rows; for `st_polygon` and `st_multilinestring`, list with numeric matrices with points in rows; for `st_multipolygon`, list of lists with numeric matrices; for `st_geometrycollection` list with (non-geometrycollection) simple feature objects

- **dim**
  - Character, indicating dimensions: "XY", "XYZ", "XYM", or "XYZM"; only really needed for three-dimensional points (which can be either XYZ or XYM) or empty geometries; see details

- **dims**
  - Character; specify dimensionality in case of an empty (NULL) geometrycollection, in which case `x` is the empty `list()`.  

- **...**
  - Objects to be pasted together into a single simple feature

- **width**
  - Integer; number of characters to be printed (max 30; 0 means print everything)

- **n**
  - Integer; number of elements to be selected

- **recursive**
  - Logical; ignored

- **flatten**
  - Logical; if TRUE, try to simplify results; if FALSE, return geometrycollection containing all objects

### Details

"XYZ" refers to coordinates where the third dimension represents altitude, "XYM" refers to three-dimensional coordinates where the third dimension refers to something else ("M" for measure); checking of the sanity of `x` may be only partial.

When `flatten=TRUE`, this method may merge points into a multipoint structure, and may not preserve order, and hence cannot be reverted. When given fish, it returns fish soup.

### Value

Object of the same nature as `x`, but with appropriate class attribute set

`as.matrix` returns the set of points that form a geometry as a single matrix, where each point is a row; use `unlist(x, recursive = FALSE)` to get sets of matrices.

### Examples

```r
(p1 = st_point(c(1,2)))
class(p1)
st_bbox(p1)
(p2 = st_point(c(1,2,3)))
class(p2)
(p3 = st_point(c(1,2,3), "XYM"))
pts = matrix(1:10, , 2)
(mp1 = st_multipoint(pts))
```
pts = matrix(1:15, , 3)
(mp2 = st_multipoint(pts))
(mp3 = st_multipoint(pts, "XYM"))
pts = matrix(1:20, , 4)
(mp4 = st_multipoint(pts))
(pts = matrix(1:10, , 2)
(ls1 = st_linestring(pts))
(pts = matrix(1:15, , 3)
(ls2 = st_linestring(pts))
(ls3 = st_linestring(pts, "XYM"))
pts = matrix(1:20, , 4)
(ls4 = st_linestring(pts))
outer = matrix(c(0,0,10,0,10,0,10,0,0), ncol=2, byrow=TRUE)
hole1 = matrix(c(1,1,1,2,2,2,1,1,1), ncol=2, byrow=TRUE)
hole2 = matrix(c(5,5,5,6,6,6,5,5,5), ncol=2, byrow=TRUE)
pts = list(outer, hole1, hole2)
(ml1 = st_multilinestring(pts))
pts3 = lapply(pts, function(x) cbind(x, 0))
(ml2 = st_multilinestring(pts3))
(ml3 = st_multilinestring(pts3, "XYM"))
pts4 = lapply(pts3, function(x) cbind(x, 0))
(ml4 = st_multilinestring(pts4))
outer = matrix(c(0,0,10,0,10,0,10,0,0), ncol=2, byrow=TRUE)
hole1 = matrix(c(1,1,1,2,2,2,1,1,1), ncol=2, byrow=TRUE)
hole2 = matrix(c(5,5,5,6,6,6,5,5,5), ncol=2, byrow=TRUE)
pts = list(outer, hole1, hole2)
(pl1 = st_polygon(pts))
pts3 = lapply(pts, function(x) cbind(x, 0))
(pl2 = st_polygon(pts3))
(pl3 = st_polygon(pts3, "XYM"))
pts4 = lapply(pts3, function(x) cbind(x, 0))
(pl4 = st_polygon(pts4))
pol1 = list(outer, hole1, hole2)
pol2 = list(outer + 12, hole1 + 12)
pol3 = list(outer + 24)
mp = list(pol1, pol2, pol3)
(mp1 = st_multipolygon(mp))
pts3 = lapply(mp, function(x) lapply(x, function(y) cbind(y, 0)))
(mp2 = st_multipolygon(pts3))
(mp3 = st_multipolygon(pts3, "XYM"))
pts4 = lapply(mp2, function(x) lapply(x, function(y) cbind(y, 0)))
(mp4 = st_multipolygon(pts4))
(gc = st_geometrycollection(list(pl, ls1, pl1, mp1)))

st_geometrycollection() # empty geometry

c(st_point(1:2), st_point(5:6))
c(st_point(1:2), st_multipoint(matrix(5:8, 2)))
c(st_multipoint(matrix(1:4, 2)), st_multipoint(matrix(5:8, 2)))
c(st_linestring(matrix(1:6, 3)), st_linestring(matrix(11:16, 3)))
c(st_multilinestring(list(matrix(1:6, 3))), st_multilinestring(list(matrix(11:16, 3))))
pl = list(rbind(c(0,0), c(1,0), c(1,1), c(0,1), c(0,0)))
c(st_polygon(pl), st_polygon(pl))
c(st_polygon(pl), st_multipolygon(list(pl)))
c(st_linestring(matrix(1:6, 3)), st_point(1:2))
Description

functions only exported to be used internally by stars

Usage

\.get_layout(bb, n, total_size, key.pos, key.length)

\.degAxis(side, at, labels, ..., lon, lat, ndiscr, reset)

\.image_scale(
  z, 
  col, 
  breaks = NULL, 
  key.pos, 
  add.axis = TRUE, 
  at = NULL, 
  ..., 
  axes = FALSE, 
  key.length, 
  logz = FALSE
)

\.image_scale_factor(
  z, 
  col, 
  key.pos, 
  add.axis = TRUE, 
  ..., 
  axes = FALSE, 
  key.width, 
  key.length
)

Arguments

bb ignore
n ignore
st_agr

get or set relation_to_geometry attribute of an sf object

Description

get or set relation_to_geometry attribute of an sf object

Usage

NA_agr

st_agr(x, ...)

st_agr(x) <- value

st_set_agr(x, value)

Arguments

x object of class sf
...
value character, or factor with appropriate levels; if named, names should correspond to the non-geometry list-column columns of x
Format

An object of class factor of length 1.

Details

NA_agr_ is the agr object with a missing value.

st_as_binary

Convert sfc object to an WKB object

Description

Convert sfc object to an WKB object

Usage

st_as_binary(x, ...)

## S3 method for class 'sfc'
st_as_binary(
  x,
  ...,
  EWKB = FALSE,
  endian = .Platform$endian,
  pureR = FALSE,
  precision = attr(x, "precision"),
  hex = FALSE
)

## S3 method for class 'sfg'
st_as_binary(
  x,
  ...,
  endian = .Platform$endian,
  EWKB = FALSE,
  pureR = FALSE,
  hex = FALSE,
  srid = 0
)

Arguments

x
  object to convert

...  ignored

EWKB
  logical; use EWKB (PostGIS), or (default) ISO-WKB?

endian
  character; either "big" or "little"; default: use that of platform
Convert sf* object to a grob

**Description**

Convert sf* object to an grid graphics object (grob)

**Usage**

```
st_as_grob(x, ...)
```

**Arguments**

- `x` object to be converted into an object class grob
- `...` passed on to the xxxGrob function, e.g. `gp = gpar(col = 'red')`
**st_as_sf**

Convert foreign object to an sf object

**Description**

Convert foreign object to an sf object

**Usage**

```r
st_as_sf(x, ...)
```

```r
## S3 method for class 'data.frame'
st_as_sf(
  x,
  ..., 
  agr = NA_agr_,
  coords,
  wkt,
  dim = "XYZ",
  remove = TRUE,
  na.fail = TRUE,
  sf_column_name = NULL
)
```

```r
## S3 method for class 'sf'
st_as_sf(x, ...)
```

```r
## S3 method for class 'sfc'
st_as_sf(x, ...)
```

```r
## S3 method for class 'Spatial'
st_as_sf(x, ...)
```

```r
## S3 method for class 'map'
st_as_sf(x, ..., fill = TRUE, group = TRUE)
```

```r
## S3 method for class 'ppp'
st_as_sf(x, ...)
```

```r
## S3 method for class 'psp'
st_as_sf(x, ...)
```

```r
## S3 method for class 'lpp'
st_as_sf(x, ...)
```

**Arguments**

- `x` object to be converted into an object class sf
passed on to `st_sf`, might included named arguments `crs` or `precision`.

- `agr` character vector; see details section of `st_sf`
- `coords` in case of point data: names or numbers of the numeric columns holding coordinates.
- `wkt` name or number of the character column that holds WKT encoded geometries
- `dim` passed on to `st_point` (only when argument `coords` is given)
- `remove` logical; when `coords` or `wkt` is given, remove these columns from `data.frame`?
- `na.fail` logical; if TRUE, raise an error if coordinates contain missing values
- `sf_column_name` character; name of the active list-column with simple feature geometries; in case there is more than one and `sf_column_name` is NULL, the first one is taken.
- `fill` logical; the value for `fill` that was used in the call to `map`.
- `group` logical; if TRUE, group id labels from `map` by their prefix before :

**Details**

Setting argument `wkt` annihilates the use of argument `coords`. If `x` contains a column called "geometry", `coords` will result in overwriting of this column by the `sfc` geometry list-column. Setting `wkt` will replace this column with the geometry list-column, unless `remove_coordinates` is FALSE.

**Examples**

```r
pt1 = st_point(c(0,1))
pt2 = st_point(c(1,1))
st_sfc(pt1, pt2)
d = data.frame(a = 1:2)
d$geom = st_sfc(pt1, pt2)
df = st_as_sf(d)
d$geom = c("POINT(0 0)", "POINT(0 1)")
df = st_as_sf(d, wkt = "geom")
d$geom2 = st_sfc(pt1, pt2)
st_as_sf(d) # should warn
data(meuse, package = "sp")
meuse_sf = st_as_sf(meuse, coords = c("x", "y"), crs = 28992, agr = "constant")
meuse_sf[1:3,]
summary(meuse_sf)
library(sp)
x = rbind(c(-1,-1), c(1,-1), c(1,1), c(-1,1), c(-1,-1))
x1 = 0.1 * x + 0.1
x2 = 0.1 * x + 0.4
x3 = 0.1 * x + 0.7
y = x + 3
y1 = x1 + 3
y3 = x3 + 3
m = matrix(c(3, 0), 5, 2, byrow = TRUE)
z = x + m
z1 = x1 + m
z2 = x2 + m
z3 = x3 + m
p1 = Polygons(list( Polygon(x[5:1,]), Polygon(x2), Polygon(x3),
```

st_as_sfc

Convert foreign geometry object to an sfc object

Description

Convert foreign geometry object to an sfc object

Usage

## S3 method for class 'pq_geometry'
st_as_sfc(
  x,
  ..., 
  EWKB = TRUE, 
  spatialite = FALSE, 
  pureR = FALSE, 
  crs = NA_crs_
## S3 method for class 'list'
st_as_sfc(x, ..., crs = NA_crs_)

## S3 method for class 'blob'
st_as_sfc(x, ...)

## S3 method for class 'bbox'
st_as_sfc(x, ...)

## S3 method for class 'WKB'
st_as_sfc(
  x,
  ...,  
  EWKB = FALSE,
  spatialite = FALSE,
  pureR = FALSE,
  crs = NA_crs_
)

## S3 method for class 'raw'
st_as_sfc(x, ...)

## S3 method for class 'character'
st_as_sfc(x, crs = NA_integer_, ..., GeoJSON = FALSE)

## S3 method for class 'factor'
st_as_sfc(x, ...)

## S3 method for class 'SpatialPoints'
st_as_sfc(x, ..., precision = 0)

## S3 method for class 'SpatialPoints'
st_as_sfc(x, ..., precision = 0)

## S3 method for class 'SpatialMultiPoints'
st_as_sfc(x, ..., precision = 0)

## S3 method for class 'SpatialLines'
st_as_sfc(x, ..., precision = 0, forceMulti = FALSE)

## S3 method for class 'SpatialPolygons'
st_as_sfc(x, ..., precision = 0, forceMulti = FALSE)

## S3 method for class 'map'
st_as_sfc

\texttt{st_as_sfc(x, ...)}

\textbf{Arguments}

\begin{itemize}
\item \texttt{x} \hspace{2cm} object to convert
\item \texttt{...} \hspace{2cm} further arguments
\item \texttt{EWKB} \hspace{2cm} logical; if \texttt{TRUE}, parse as EWKB (extended WKB; PostGIS: ST_AsEWKB), otherwise as ISO WKB (PostGIS: ST_AsBinary)
\item \texttt{spatialite} \hspace{2cm} logical; if \texttt{TRUE}, WKB is assumed to be in the spatialite dialect, see \url{https://www.gaia-gis.it/gaia-sins/BLOB-Geometry.html}; this is only supported in native endian-ness (i.e., files written on system with the same endian-ness as that on which it is being read).
\item \texttt{pureR} \hspace{2cm} logical; if \texttt{TRUE}, use only R code, if \texttt{FALSE}, use compiled (C++) code; use \texttt{TRUE} when the endian-ness of the binary differs from the host machine (.Platform$endian).
\item \texttt{crs} \hspace{2cm} integer or character; coordinate reference system for the
\item \texttt{GeoJSON} \hspace{2cm} logical; if \texttt{TRUE}, try to read geometries from GeoJSON text strings geometry, see \texttt{st_crs()}
\item \texttt{precision} \hspace{2cm} precision value; see \texttt{st_as_binary}
\item \texttt{forceMulti} \hspace{2cm} logical; if \texttt{TRUE}, force coercion into MULTIPOLYGON or MULTILINE objects, else autodetect
\end{itemize}

\textbf{Details}

When converting from WKB, the object \texttt{x} is either a character vector such as typically obtained from PostGIS (either with leading "0x" or without), or a list with raw vectors representing the features in binary (raw) form.

If \texttt{x} is a character vector, it should be a vector containing \texttt{well-known-text}, or \texttt{Postgis EWKT} or GeoJSON representations of a single geometry for each vector element.

If \texttt{x} is a factor, it is converted to character.

\textbf{Examples}

\begin{verbatim}
wkb = structure(list("01010000204071000000000080801A06410000000AC5C1441"), class = "WKB")
st_as_sfc(wkb, EWKB = TRUE)
wkb = structure(list("0x01010000204071000000000080801A06410000000AC5C1441"), class = "WKB")
st_as_sfc(wkb, EWKB = TRUE)
st_as_sfc(st_as_binary(st_sfc(st_point(0:1))[[1]], crs = 4326)
st_as_sfc("SRID=3978;LINESTRING(1663106 -105415,1664320 -104617)"")
\end{verbatim}
st_as_text

Return Well-known Text representation of simple feature geometry or coordinate reference system

Description

Return Well-known Text representation of simple feature geometry or coordinate reference system

Usage

```r
## S3 method for class 'crs'
st_as_text(x, ..., pretty = FALSE)

st_as_text(x, ...)

## S3 method for class 'sfg'
st_as_text(x, ...)

## S3 method for class 'sfc'
st_as_text(x, ..., EWKT = FALSE)
```

Arguments

- **x**: object of class `sfg`, `sfc` or `crs`
- **...**: modifiers; in particular `digits` can be passed to control the number of digits used
- **pretty**: logical; if `TRUE`, print human-readable well-known-text representation of a coordinate reference system
- **EWKT**: logical; if `TRUE`, print SRID=xxx; before the WKT string if `epsg` is available

Details

The returned WKT representation of simple feature geometry conforms to the simple features access specification and extensions, known as EWKT, supported by PostGIS and other simple features implementations for addition of SRID to a WKT string.

Examples

```r
st_as_text(st_point(1:2))
st_as_text(st_sfc(st_point(c(-90,40)), crs = 4326), EWKT = TRUE)
```
Description

Return bounding of a simple feature or simple feature set

Usage

```r
## S3 method for class 'bbox'
is.na(x)

st_bbox(obj, ...)

## S3 method for class 'POINT'
st_bbox(obj, ...)

## S3 method for class 'MULTIPOINT'
st_bbox(obj, ...)

## S3 method for class 'LINestring'
st_bbox(obj, ...)

## S3 method for class 'POLYGON'
st_bbox(obj, ...)

## S3 method for class 'MULTILINESTRING'
st_bbox(obj, ...)

## S3 method for class 'MULTIPOLYGON'
st_bbox(obj, ...)

## S3 method for class 'GEOMETRYCOLLECTION'
st_bbox(obj, ...)

## S3 method for class 'MULTISURFACE'
st_bbox(obj, ...)

## S3 method for class 'MULTICURVE'
st_bbox(obj, ...)

## S3 method for class 'CURVEPOLYGON'
st_bbox(obj, ...)

## S3 method for class 'COMPOUNDCurve'
st_bbox(obj, ...)
```
## S3 method for class 'POLYHEDRALSURFACE'
st_bbox(obj, ...)

## S3 method for class 'TIN'
st_bbox(obj, ...)

## S3 method for class 'TRIANGLE'
st_bbox(obj, ...)

## S3 method for class 'CIRCULARSTRING'
st_bbox(obj, ...)

## S3 method for class 'sfc'
st_bbox(obj, ...)

## S3 method for class 'sf'
st_bbox(obj, ...)

## S3 method for class 'Spatial'
st_bbox(obj, ...)

## S3 method for class 'Raster'
st_bbox(obj, ...)

## S3 method for class 'Extent'
st_bbox(obj, ..., crs = NA_crs_)

## S3 method for class 'numeric'
st_bbox(obj, ..., crs = NA_crs_)

NA_bbox_

## S3 method for class 'bbox'
format(x, ...)

### Arguments

- **x**  
  object of class bbox

- **obj**  
  object to compute the bounding box from

- **...**  
  for format.bbox, passed on to format to format individual numbers

- **crs**  
  object of class crs, or argument to st_crs, specifying the CRS of this bounding box.

### Format

An object of class bbox of length 4.
Details

NA_bbox_ represents the missing value for a bbox object

Value

A numeric vector of length four, with xmin, ymin, xmax and ymax values; if obj is of class sf, sfc, Spatial or Raster, the object returned has a class bbox, an attribute crs and a method to print the bbox and an st_crs method to retrieve the coordinate reference system corresponding to obj (and hence the bounding box). st_as_sfc has a methods for bbox objects to generate a polygon around the four bounding box points.

Examples

```r
a = st_sf(a = 1:2, geom = st_sfc(st_point(0:1), st_point(1:2)), crs = 4326)
st_bbox(a)
st_as_sfc(st_bbox(a))
st_bbox(c(xmin = 16.1, xmax = 16.6, ymax = 48.6, ymin = 47.9), crs = st_crs(4326))
```

---

**st_cast**  
*Cast geometry to another type: either simplify, or cast explicitly*

**Description**

Cast geometry to another type: either simplify, or cast explicitly

**Usage**

```r
## S3 method for class 'MULTIPOINT'
st_cast(x, to, ...)

## S3 method for class 'MULTILINESTRING'
st_cast(x, to, ...)

## S3 method for class 'MULTIPOINT'
st_cast(x, to, ...)

## S3 method for class 'POLYGON'
st_cast(x, to, ...)

## S3 method for class 'LINESTRING'
st_cast(x, to, ...)

## S3 method for class 'POINT'
st_cast(x, to, ...)

## S3 method for class 'GEOMETRYCOLLECTION'
st_cast(x, to, ...)
```

## S3 method for class 'CIRCULARSTRING'
st_cast(x, to, ...)

## S3 method for class 'MULTISURFACE'
st_cast(x, to, ...)

## S3 method for class 'COMPOUNDCURVE'
st_cast(x, to, ...)

## S3 method for class 'MULTICURVE'
st_cast(x, to, ...)

## S3 method for class 'CURVE'
st_cast(x, to, ...)

st_cast(x, to, ...)

## S3 method for class 'sfc'
st_cast(x, to, ..., ids = seq_along(x), group_or_split = TRUE)

## S3 method for class 'sf'
st_cast(x, to, ..., warn = TRUE, do_split = TRUE)

## S3 method for class 'sfc_CIRCULARSTRING'
st_cast(x, to, ...)

### Arguments

- **x**: object of class sfg, sfc or sf
- **to**: character; target type, if missing, simplification is tried; when x is of type sfg (i.e., a single geometry) then to needs to be specified.
- **...**: ignored
- **ids**: integer vector, denoting how geometries should be grouped (default: no grouping)
- **group_or_split**: logical; if TRUE, group or split geometries; if FALSE, carry out a 1-1 per-geometry conversion.
- **warn**: logical; if TRUE, warn if attributes are assigned to sub-geometries
- **do_split**: logical; if TRUE, allow splitting of geometries in sub-geometries

### Details

The `st_cast` method for sf objects can only split geometries, e.g. cast MULTIPoint into multiple POINT features. In case of splitting, attributes are repeated and a warning is issued when non-constant attributes are assigned to sub-geometries. To merge feature geometries and attribute values, use `aggregate` or `summarise`.

Value

object of class to if successful, or unmodified object if unsuccessful. If information gets lost while type casting, a warning is raised.

In case to is missing, st_cast.sfc will coerce combinations of "POINT" and "MULTIPOINT", "LINESTRING" and "MULTILINESTRING", "POLYGON" and "MULTIPOLYGON" into their "MULTI..." form, or in case all geometries are "GEOMETRYCOLLECTION" will return a list of all the contents of the "GEOMETRYCOLLECTION" objects, or else do nothing. In case to is specified, if to is "GEOMETRY", geometries are not converted, else, st_cast will try to coerce all elements into to; ids may be specified to group e.g. "POINT" objects into a "MULTIPOINT", if not specified no grouping takes place. If e.g. a "sfc_MULTIPOINT" is cast to a "sfc_POINT", the objects are split, so no information gets lost, unless group_or_split is FALSE.

Examples

# example(st_read)
c1 = st_read(system.file("shape/nc.shp", package="sf"))
mpl <- c1$geometry[[4]]
#st_cast(x) ## error 'argument "to" is missing, with no default'
cast_all <- function(xg) {
  lapply(c("MULTIPOLYGON", "MULTILINESTRING", "MULTIPOINT", "POLYGON", "LINESTRING", "POINT"),
        function(x) st_cast(xg, x))
}
st_sfc(cast_all(mpl))
## no closing coordinates should remain for multipoint
any(duplicated(unclass(st_cast(mpl, "MULTIPOINT")))) ## should be FALSE
## number of duplicated coordinates in the linestrings should equal the number of polygon rings
## (... in this case, won't always be true)
sum(duplicated(do.call(rbind, unclass(st_cast(mpl, "MULTILINESTRING")))))

p1 <- structure(c(0, 1, 3, 2, 1, 0, 0, 2, 4, 4, 0), .Dim = c(6L, 2L))
p2 <- structure(c(1, 1, 2, 1, 1, 2, 2, 1), .Dim = c(4L, 2L))
st_polygon(list(p1, p2))
mls <- st_cast(c1$geometry[[4]], "MULTILINESTRING")
st_sfc(cast_all(mls))
mpt <- st_cast(c1$geometry[[4]], "MULTIPOINT")
st_sfc(cast_all(mpt))
pl <- st_cast(c1$geometry[[4]], "POLYGON")
st_sfc(cast_all(pl))
lis <- st_cast(c1$geometry[[4]], "LINESTRING")
st_sfc(cast_all(lis))
pt <- st_cast(c1$geometry[[4]], "POINT")

## st_sfc(cast_all(pt)) ## Error: cannot create MULTIPOLYGON from POINT
st_sfc(lapply(c("POINT", "MULTIPOINT"), function(x) st_cast(pt, x)))
s = st_multipoint(rbind(c(1,0)))
st_cast(s, "POINT")
Coerce geometry to \texttt{MULTI*} geometry

**Description**

Mixes of \texttt{POINTS} and \texttt{MULTIPOINTS}, \texttt{LINESTRING} and \texttt{MULTILINESTRING}, \texttt{POLYGON} and \texttt{MULTIPOLYGON} are returned as \texttt{MULTIPOINTS}, \texttt{MULTILINESTRING} and \texttt{MULTIPOLYGON} respectively.

**Usage**

\begin{verbatim}
st_cast_sfc_default(x)
\end{verbatim}

**Arguments**

- \texttt{x} list of geometries or simple features

**Details**

Geometries that are already \texttt{MULTI*} are left unchanged. Features that can’t be cast to a single \texttt{MULTI*} geometry are return as a \texttt{GEOMETRYCOLLECTION}.

**st_collection_extract**

\texttt{st_collection_extract} given an object with geometries of type \texttt{GEOMETRY} or \texttt{GEOMETRYCOLLECTION}, return an object consisting only of elements of the specified type.

**Description**

Similar to \texttt{ST_CollectionExtract} in PostGIS. If there are no sub-geometries of the specified type, an empty geometry is returned.

**Usage**

\begin{verbatim}
st_collection_extract(
    x,
    type = c("POLYGON", "POINT", "LINESTRING"),
    warn = FALSE
)
\end{verbatim}

\texttt{## S3 method for class 'sfg'}

\begin{verbatim}
# S3 method for class 'sfg'
st_collection_extract(
    x,
    type = c("POLYGON", "POINT", "LINESTRING"),
    warn = FALSE
)
\end{verbatim}
## S3 method for class 'sfc'
st_collection_extract(
  x,
  type = c("POLYGON", "POINT", "LINestring"),
  warn = FALSE
)

## S3 method for class 'sf'
st_collection_extract(
  x,
  type = c("POLYGON", "POINT", "LINestring"),
  warn = FALSE
)

### Arguments

- **x**: an object of class sf, sfc or sfg that has mixed geometry (GEOMETRY or GEOMETRYCOLLECTION).
- **type**: character; one of "POLYGON", "POINT", "LINestring"
- **warn**: logical; if TRUE, warn if attributes are assigned to sub-geometries when casting (see st_cast)

### Value

An object having the same class as x, with geometries consisting only of elements of the specified type. For sfg objects, an sfg object is returned if there is only one geometry of the specified type, otherwise the geometries are combined into an sfc object of the relevant type. If any subgeometries in the input are MULTI, then all of the subgeometries in the output will be MULTI.

### Examples

```r
pt <- st_point(c(1, 0))
ls <- st_linestring(matrix(c(4, 3, 0, 0), ncol = 2))
poly1 <- st_polygon(list(matrix(c(5.5, 7, 7, 6, 5.5, 0, 0, -0.5, -0.5, 0), ncol = 2)))
poly2 <- st_polygon(list(matrix(c(6.6, 8, 8, 7, 6.6, 1, 1, 1.5, 1.5, 1), ncol = 2)))
multipoly <- st_multipolygon(list(poly1, poly2))
i <- st_geometrycollection(list(pt, ls, poly1, poly2))
j <- st_geometrycollection(list(pt, ls, poly1, poly2, multipoly))

st_collection_extract(i, "POLYGON")
st_collection_extract(i, "POINT")
st_collection_extract(i, "LINestring")

## A GEOMETRYCOLLECTION
aa <- rbind(st_sf(a=1, geom = st_sfc(i)),
  st_sf(a=2, geom = st_sfc(j)))

## With sf objects
st_collection_extract(aa, "POLYGON")
```
st_collection_extract(aa, "LINESTRING")
st_collection_extract(aa, "POINT")

## With sfc objects
st_collection_extract(st_geometry(aa), "POLYGON")
st_collection_extract(st_geometry(aa), "LINESTRING")
st_collection_extract(st_geometry(aa), "POINT")

## A GEOMETRY of single types
bb <- rbind(
st_sf(a = 1, geom = st_sfc(pt)),
st_sf(a = 2, geom = st_sfc(ls)),
st_sf(a = 3, geom = st_sfc(poly1)),
st_sf(a = 4, geom = st_sfc(multipoly))
)
st_collection_extract(bb, "POLYGON")

## A GEOMETRY of mixed single types and GEOMETRYCOLLECTIONS
cc <- rbind(aa, bb)
st_collection_extract(cc, "POLYGON")

---

st_coordinates  
retrieves coordinates in matrix form

Description

retrieves coordinates in matrix form

Usage

st_coordinates(x, ...)

Arguments

x 
object of class sf, sfc or sfg

... 
ignored

Value

tmatrix with coordinates (X, Y, possibly Z and/or M) in rows, possibly followed by integer indicators L1,...,L3 that point out to which structure the coordinate belongs; for POINT this is absent (each coordinate is a feature), for LINESTRING L1 refers to the feature, for MULTIPOLYGON L1 refers to the main ring or holes, L2 to the ring id in the MULTIPOLYGON, and L3 to the simple feature.
st_crop

crop an sf object to a specific rectangle

Description

crop an sf object to a specific rectangle

Usage

st_crop(x, y, ...)

## S3 method for class 'sfc'
st_crop(x, y, ..., xmin, ymin, xmax, ymax)

## S3 method for class 'sf'
st_crop(x, y, ...)

Arguments

x  
object of class sf or sfc

y  
numeric vector with named elements xmin, ymin, xmax and ymax, or object of class bbox, or object for which there is an st_bbox method to convert it to a bbox object

...  
ignored

xmin  
minimum x extent of cropping area

ymin  
minimum y extent of cropping area

xmax  
maximum x extent of cropping area

ymax  
maximum y extent of cropping area

Details

setting arguments xmin, ymin, xmax and ymax implies that argument y gets ignored.

Examples

box = c(xmin = 0, ymin = 0, xmax = 1, ymax = 1)
pol = st_sfc(st_buffer(st_point(c(.5, .5)), .6))
pol_sf = st_sf(a=1, geom=pol)
plot(st_crop(pol, box))
plot(st_crop(pol_sf, st_bbox(box)))
  # alternative:
plot(st_crop(pol, xmin = 0, ymin = 0, xmax = 1, ymax = 1))
**st_crs**

*Retrieve coordinate reference system from object*

**Description**

Retrieve coordinate reference system from sf or sfc object

Set or replace retrieve coordinate reference system from object

**Usage**

```r
st_crs(x, ...)
```

```r
## S3 method for class 'sf'
st_crs(x, ...)
```

```r
## S3 method for class 'numeric'
st_crs(x, ...)
```

```r
## S3 method for class 'character'
st_crs(x, ...)
```

```r
## S3 method for class 'sfc'
st_crs(x, ..., parameters = FALSE)
```

```r
## S3 method for class 'bbox'
st_crs(x, ...)
```

```r
## S3 method for class 'CRS'
st_crs(x, ...)
```

```r
## S3 method for class 'crs'
st_crs(x, ...)
```

```r
st_crs(x) <- value
```

```r
## S3 replacement method for class 'sf'
st_crs(x) <- value
```

```r
## S3 replacement method for class 'sfc'
st_crs(x) <- value
```

```r
st_set_crs(x, value)
```

```r
NA_crs_
```

```r
## S3 method for class 'crs'
```
\texttt{is.na(x)}

\texttt{## S3 method for class 'crs'}
\texttt{x$name}

\texttt{## S3 method for class 'crs'}
\texttt{format(x, ...)}

\texttt{st_axis_order(authority_compliant = logical(0))}

**Arguments**

- \texttt{x} numeric, character, or object of class \texttt{sf} or \texttt{sfc}
- \texttt{...} ignored
- \texttt{parameters} logical; FALSE by default; if TRUE return a list of coordinate reference system parameters, with named elements \texttt{SemiMajor}, \texttt{InvFlattening}, \texttt{units_gdal}, \texttt{IsVertical}, \texttt{WktPretty}, and \texttt{Wkt}
- \texttt{value} one of (i) character: a string accepted by GDAL, (ii) integer, a valid EPSG value (numeric), or (iii) an object of class \texttt{crs}
- \texttt{name} element name
- \texttt{authority_compliant} logical; specify whether axis order should be handled compliant to the authority; if omitted, the current value is printed.

**Format**

An object of class \texttt{crs} of length 2.

**Details**

The \texttt{crs} functions create, get, set or replace the \texttt{crs} attribute of a simple feature geometry list-column. This attribute is of class \texttt{crs}, and is a list consisting of input (user input, e.g. "EPSG:4326" or "WGS84" or a \texttt{proj4string}), and \texttt{wkt}, an automatically generated \texttt{wkt} representation of the \texttt{crs}.

Comparison of two objects of class \texttt{crs} uses the GDAL function \texttt{OGRSpatialReference::IsSame}.

In case a coordinate reference system is replaced, no transformation takes place and a warning is raised to stress this.

\texttt{NA_crs_} is the \texttt{crs} object with missing values for \texttt{input} and \texttt{wkt}.

the $ method for \texttt{crs} objects retrieves named elements using the GDAL interface; named elements include "SemiMajor", "SemiMinor", "InvFlattening", "IsGeographic", "units_gdal", "IsVertical", "WktPretty", "Wkt", "Name", "proj4string", "epsg", "yx" and "ud_unit" (this may be subject to changes in future GDAL versions).

\texttt{format.crs} returns NA if the \texttt{crs} is missing valued, or else the name of a \texttt{crs} if it is different from "unknown", or else the user input if it was set, or else its "proj4string" representation;

\texttt{st_axis_order} can be used to get and set the axis order: TRUE indicates axes order according to the authority (e.g. EPSG:4326 defining coordinates to be latitude,longitude pairs), FALSE indicates the usual GIS (display) order (longitude,latitude). This can be useful when data are read, or have
to be written, with coordinates in authority compliant order. The return value is the current state of
this (FALSE, by default).

Value

If x is numeric, return crs object for EPSG:x; if x is character, return crs object for x; if x is of
class sf or sfc, return its crs object.

Object of class crs, which is a list with elements input (length-1 character) and wkt (length-1
character). Elements may be NA valued; if all elements are NA the CRS is missing valued, and
coordinates are assumed to relate to an arbitrary Cartesian coordinate system.

st_axis_order returns the (logical) current value if called without argument, or (invisibly) the
previous value if it is being set.

Examples

sfc = st_sfc(st_point(c(0,0)), st_point(c(1,1)))
sf = st_sf(a = 1:2, geom = sfc)
st_crs(sf) = 4326
st_geometry(sf)
sfc = st_sfc(st_point(c(0,0)), st_point(c(1,1)))
st_crs(sfc) = 4326
sfc
sfc = st_sfc(st_point(c(0,0)), st_point(c(1,1)))
library(dplyr)
x = sfc %>% st_set_crs(4326) %>% st_transform(3857)
x
st_crs("EPSG:3857")$input
st_crs(3857)$proj4string
st_crs(3857)$b  # numeric
st_crs(3857)$units # character
pt = st_sfc(st_point(c(0, 60)), crs = 4326)
# st_axis_order() only has effect in GDAL >= 2.5.0:
st_axis_order() # query default: FALSE means interpret pt as (longitude latitude)
st_transform(pt, 3857)[[1]]
old_value = FALSE
if (sf_extSoftVersion()["GDAL"] >= "2.5.0")
  (old_value = st_axis_order(TRUE))
# now interpret pt as (latitude longitude), as EPSG:4326 prescribes:
st_axis_order() # query current value
st_transform(pt, 3857)[[1]]
st_axis_order(old_value) # set back to old value

st_drivers

Get GDAL drivers

Description

Get a list of the available GDAL drivers
Usage

```r
st_drivers(what = "vector")
```

Arguments

- `what` character: "vector" or "raster", anything else will return all drivers.

Details

The drivers available will depend on the installation of GDAL/OGR, and can vary; the `st_drivers()` function shows all the drivers that are readable, and which may be written. The field `vsi` refers to the driver’s capability to read/create datasets through the VSI*L API. See GDAL website for additional details on driver support.

Value

A `data.frame` with driver metadata.

Examples

```r
st_drivers()
```

---

**st.geometry**

*Get, set, or replace geometry from an sf object*

Description

Get, set, or replace geometry from an sf object

Usage

```r
## S3 method for class 'sfc'
st_geometry(obj, ...)

st_geometry(obj, ...)

## S3 method for class 'sf'
st_geometry(obj, ...)

## S3 method for class 'sfg'
st_geometry(obj, ...)

## S3 method for class 'sfc'
st_geometry(x) <- value
```

st_set_geometry(x, value)

st_drop_geometry(x)

Arguments

obj                object of class sf or sfc
...
            ignored
x                object of class data.frame
value          object of class sfc, or character

Details

when applied to a data.frame and when value is an object of class sfc, st_set_geometry and
st_geometry<- will first check for the existence of an attribute sf_column and overwrite that, or
else look for list-columns of class sfc and overwrite the first of that, or else write the geometry list-
column to a column named geometry. In case value is character and x is of class sf, the "active"
geometry column is set to x[[value]].

the replacement function applied to sf objects will overwrite the geometry list-column, if value is
NULL, it will remove it and coerce x to a data.frame.

st_drop_geometry drops the geometry of its argument, and reclasses it accordingly

Value

st_geometry returns an object of class sfc, a list-column with geometries

st_geometry returns an object of class sfc. Assigning geometry to a data.frame creates an sf
object, assigning it to an sf object replaces the geometry list-column.

Examples

df = data.frame(a = 1:2)
sfc = st_sfc(st_point(c(3,4)), st_point(c(10,11)))

st_geometry(sfc)
st_geometry(df) <- sfc
class(df)
st_geometry(df)
st_geometry(df) <- sfc # replaces
st_geometry(df) <- NULL # remove geometry, coerce to data.frame
sfc <- st_set_geometry(df, sfc) # set geometry, return sfc
st_set_geometry(sfc, NULL) # remove geometry, coerce to data.frame
**st_geometry_type**

**Return geometry type of an object**

**Description**

Return geometry type of an object, as a factor

**Usage**

```r
st_geometry_type(x, by_geometry = TRUE)
```

**Arguments**

- `x`: object of class `sf` or `sfc`
- `by_geometry`: logical; if `TRUE`, return geometry type of each geometry, else return geometry type of the set

**Value**

a factor with the geometry type of each simple feature geometry in `x`, or that of the whole set

---

**st_graticule**

**Compute graticules and their parameters**

**Description**

Compute graticules and their parameters

**Usage**

```r
st_graticule(
  x = c(-180, -90, 180, 90),
  crs = st_crs(x),
  datum = st_crs(4326),
  ..., 
  lon = NULL,
  lat = NULL,
  ndiscr = 100,
  margin = 0.001
)
```
Arguments

- **x**: object of class `sf`, `sfc` or `sfg` or numeric vector with bounding box given as `c(minx, miny, maxx, maxy)`.
- **crs**: object of class `crs`, with the display coordinate reference system.
- **datum**: either an object of class `crs` with the coordinate reference system for the graticules, or `NULL` in which case a grid in the coordinate system of `x` is drawn, or `NA`, in which case an empty `sf` object is returned.
- **...**: ignored
- **lon**: numeric; degrees east for the meridians
- **lat**: numeric; degrees north for the parallels
- **ndiscr**: integer; number of points to discretize a parallel or meridian
- **margin**: numeric; small number to trim a longlat bounding box that touches or crosses +/-180 long or +/-90 latitude.

Value

an object of class `sf` with additional attributes describing the type (E: meridian, N: parallel) degree value, label, start and end coordinates and angle; see example.

Use of graticules

In cartographic visualization, the use of graticules is not advised, unless the graphical output will be used for measurement or navigation, or the direction of North is important for the interpretation of the content, or the content is intended to display distortions and artifacts created by projection. Unnecessary use of graticules only adds visual clutter but little relevant information. Use of coastlines, administrative boundaries or place names permits most viewers of the output to orient themselves better than a graticule.

Examples

```r
library(sf)
library(maps)

usa = st_as_sf(map("usa", plot = FALSE, fill = TRUE))
laea = st_crs("+proj=laea +lat_0=30 +lon_0=-95") # Lambert equal area
usa <- st_transform(usa, laea)

bb = st_bbox(usa)
bbox = st_linestring(rbind(c(bb[1],bb[2]),c(bb[3],bb[2]),
c(bb[3],bb[4]),c(bb[1],bb[4]),c(bb[1],bb[2])))

g = st_graticule(usa)
plot(usa, xlim = 1.2 * c(-2450853.4, 2186391.9))
plot(g[[1]], add = TRUE, col = 'grey')
plot(bbox, add = TRUE)
points(g$x_start, g$y_start, col = 'red')
points(g$x_end, g$y_end, col = 'blue')
```
invisible(lapply(seq_len(nrow(g)), function(i) {
    if (g$type[i] == "N" && g$x_start[i] - min(g$x_start) < 1000)
        text(g[i,"x_start"], g[i,"y_start"], labels = parse(text = g[i,"degree_label"]),
        srt = g$angle_start[i], pos = 2, cex = .7)
    if (g$type[i] == "E" && g$y_start[i] - min(g$y_start) < 1000)
        text(g[i,"x_start"], g[i,"y_start"], labels = parse(text = g[i,"degree_label"]),
        srt = g$angle_start[i] - 90, pos = 1, cex = .7)
    if (g$type[i] == "N" && g$x_end[i] - max(g$x_end) > -1000)
        text(g[i,"x_end"], g[i,"y_end"], labels = parse(text = g[i,"degree_label"]),
        srt = g$angle_end[i] - 90, pos = 1, cex = .7)
    if (g$type[i] == "E" && g$y_end[i] - max(g$y_end) > -1000)
        text(g[i,"x_end"], g[i,"y_end"], labels = parse(text = g[i,"degree_label"]),
        srt = g$angle_end[i] - 90, pos = 3, cex = .7)
}))

plot(usa, graticule = st_crs(4326), axes = TRUE, lon = seq(-60,-130,by=-10))

---

**st_interpolate_aw**  
Areal-weighted interpolation of polygon data

**Description**

Areal-weighted interpolation of polygon data

**Usage**

```r
st_interpolate_aw(x, to, extensive, ...)```

**Arguments**

- `x`: object of class sf, for which we want to aggregate attributes
- `to`: object of class sf or sfc, with the target geometries
- `extensive`: logical; if TRUE, the attribute variables are assumed to be spatially extensive (like population) and the sum is preserved, otherwise, spatially intensive (like population density) and the mean is preserved.
- `...`: ignored

**Examples**

```r
nc = st_read(system.file("shape/nc.shp", package="sf"))
g = st_make_grid(nc, n = c(20,10))
a1 = st_interpolate_aw(nc["BIR74"], g, extensive = FALSE)
sum(a1$BIR74) / sum(nc$BIR74) # not close to one: property is assumed spatially intensive
a2 = st_interpolate_aw(nc["BIR74"], g, extensive = TRUE)
# verify mass preservation (pycnophylactic) property:
sum(a2$BIR74) / sum(nc$BIR74)
a1$intensive = a1$BIR74
a1$extensive = a2$BIR74
plot(a1lc("intensive", "extensive"), key.pos = 4)```
st_is

test equality between the geometry type and a class or set of classes

Description

test equality between the geometry type and a class or set of classes

Usage

st_is(x, type)

Arguments

x  
object of class sf, sfc or sfg

type  
character; class, or set of classes, to test against

Examples

st_is(st_point(0:1), "POINT")
sfc = st_sfc(st_point(0:1), st_linestring(matrix(1:6,,2)))
  st_is(sfc, "POINT")
  st_is(sfc, "POLYGON")
  st_is(sfc, "LINESTRING")
  st_is(st_sf(a = 1:2, sfc), "LINESTRING")
  st_is(sfc, c("POINT", "LINESTRING"))

st_is_longlat

Assert whether simple feature coordinates are longlat degrees

Description

Assert whether simple feature coordinates are longlat degrees

Usage

st_is_longlat(x)

Arguments

x  
object of class sf or sfc, or otherwise an object of a class that has an st_crs method returning a crs object

Value

TRUE if x has geographic coordinates, FALSE if it has projected coordinates, or NA if is.na(st_crs(x)).
**st_jitter**  
*jitter geometries*

**Description**  

jitter geometries

**Usage**  

```
st_jitter(x, amount, factor = 0.002)
```

**Arguments**  

- `x`: object of class `sf` or `sfc`
- `amount`: numeric; amount of jittering applied; if missing, the amount is set to `factor` * the bounding box diagonal; units of coordinates.
- `factor`: numeric; fractional amount of jittering to be applied

**Details**  

Jitters coordinates with an amount such that `runif(1,-amount,amount)` is added to the coordinates. x- and y-coordinates are jittered independently but all coordinates of a single geometry are jittered with the same amount, meaning that the geometry shape does not change. For longlat data, a latitude correction is made such that jittering in East and North directions are identical in distance in the center of the bounding box of `x`.

**Examples**

```
nc = read_sf(system.file("gpkg/nc.gpkg", package="sf"))
pts = st_centroid(st_geometry(nc))
plot(pts)
plot(st_jitter(pts, .05), add = TRUE, col = 'red')
plot(st_jitter(st_geometry(nc), factor = .01), add = TRUE, col = '#ff8888')
```

---

**st_join**  
*spatial join, spatial filter*

**Description**  

spatial join, spatial filter
Usage

st_join(x, y, join, ...)

## S3 method for class 'sf'
st_join(
  x,
  y,
  join = st_intersects,
  ..., 
  suffix = c(".x", ".y"),
  left = TRUE,
  largest = FALSE 
)

st_filter(x, y, ...)

## S3 method for class 'sf'
st_filter(x, y, ..., .predicate = st_intersects)

Arguments

x object of class sf
y object of class sf
join geometry predicate function with the same profile as st_intersects; see details
... arguments passed on to the join or .predicate function, e.g. prepared, or a pattern for st_relate
suffix length 2 character vector; see merge
left logical; if TRUE return the left join, otherwise an inner join; see details. see also left_join
largest logical; if TRUE, return x features augmented with the fields of y that have the largest overlap with each of the features of x; see https://github.com/r-spatial/sf/issues/578
.predicate geometry predicate function with the same profile as st_intersects; see details

Details

alternative values for argument join are:

- st_contains_properly
- st_contains
- st_covered_by
- st_covers
- st_crosses
- st_disjoint
- st_equals_exact
- st_equals
A left join returns all records of the \( x \) object with \( y \) fields for non-matched records filled with NA values; an inner join returns only records that spatially match.

**Value**

An object of class \( \text{sf} \), joined based on geometry

**Examples**

```r
a = st_sf(a = 1:3,
  geom = st_sfc(st_point(c(1,1)), st_point(c(2,2)), st_point(c(3,3))))
b = st_sf(a = 11:14,
  geom = st_sfc(st_point(c(10,10)), st_point(c(2,2)), st_point(c(2,2)), st_point(c(3,3))))
st_join(a, b)
st_join(a, b, left = FALSE)
```

# two ways to aggregate \( y \)'s attribute values outcome over \( x \)'s geometries:

```r
library(dplyr)
st_join(a, b) %>% aggregate(list(.\$a.x), mean)
```

```r
library(dplyr)
st_join(a, b) %>% group_by(a.x) %>% summarise(mean(a.y))
```

# example of largest = TRUE:

```r
nc <- st_transform(st_read(system.file("shape/nc.shp", package="sf")), 2264)
gr = st_sf(
  label = apply(expand.grid(1:10, LETTERS[10:1])[,2:1], 1, paste0, collapse = " "),
  geom = st_make_grid(st_as_sfc(st_bbox(nc))))
gr$col = sf.colors(10, categorical = TRUE, alpha = .3)
```

# cut, to check, NA's work out:

```r
gr = gr[-(1:30),]
nc_j <- st_join(nc, gr, largest = TRUE)
```

# the two datasets:

```r
opar = par(mfrow = c(2,1), mar = rep(0,4))
plot(st_geometry(nc_j))
plot(st_geometry(gr), add = TRUE, col = gr$col)
text(st_coordinates(st_centroid(gr)), labels = gr$label)
```

# the joined dataset:

```r
plot(st_geometry(nc_j), border = 'black', col = nc_j$col)
text(st_coordinates(st_centroid(nc_j)), labels = nc_j$label, cex = .8)
plot(st_geometry(gr), border = 'green', add = TRUE)
par(opar)
```
**st_layers**  
*List layers in a datasource*

**Description**
List layers in a datasource

**Usage**
```
st_layers(dsn, options = character(0), do_count = FALSE)
```

**Arguments**
- **dsn**: data source name (interpretation varies by driver - for some drivers, dsn is a file name, but may also be a folder, or contain the name and access credentials of a database)
- **options**: character; driver dependent dataset open options, multiple options supported.
- **do_count**: logical; if TRUE, count the features by reading them, even if their count is not reported by the driver

---

**st_line_sample**  
*Sample points on a linear geometry*

**Description**
Sample points on a linear geometry

**Usage**
```
st_line_sample(x, n, density, type = "regular", sample = NULL)
```

**Arguments**
- **x**: object of class sf, sfc or sfg
- **n**: integer; number of points to choose per geometry; if missing, n will be computed as `round(density * st_length(geom))`.
- **density**: numeric; density (points per distance unit) of the sampling, possibly a vector of length equal to the number of features (otherwise recycled); density may be of class units.
- **type**: character; indicate the sampling type, either "regular" or "random"
- **sample**: numeric; a vector of numbers between 0 and 1 indicating the points to sample - if defined sample overrules n, density and type.
Example

```r
ls = st_sfc(st_linestring(rbind(c(0,0),c(0,1))),
              st_linestring(rbind(c(0,0),c(10,0))))
st_line_sample(ls, density = 1)
ls = st_sfc(st_linestring(rbind(c(0,0),c(0,1))),
              st_linestring(rbind(c(0,0),c(.1,0))), crs = 4326)
try(st_line_sample(ls, density = 1/1000)) # error
st_line_sample(st_transform(ls, 3857), n = 5) # five points for each line
st_line_sample(st_transform(ls, 3857), n = c(1, 3)) # one and three points
st_line_sample(st_transform(ls, 3857), density = 1/1000) # one per km
st_line_sample(st_transform(ls, 3857), density = c(1/1000, 1/10000)) # one per km, one per 10 km
st_line_sample(st_transform(ls, 3857), density = units::set_units(1, 1/km)) # one per km
# five equidistant points including start and end:
st_line_sample(st_transform(ls, 3857), sample = c(0, 0.25, 0.5, 0.75, 1))
```

Description

Create a square or hexagonal grid covering the bounding box of the geometry of an sf or sfc object

Usage

```r
st_make_grid(
  x,
  cellsize = c(diff(st_bbox(x)[c(1, 3)]), diff(st_bbox(x)[c(2, 4)]))/n,
  offset = st_bbox(x)[c("xmin", "ymin")],
  n = c(10, 10),
  crs = if (missing(x)) NA_crs else st_crs(x),
  what = "polygons",
  square = TRUE,
  flat_topped = FALSE
)
```

Arguments

- `x`: object of class sf or sfc
- `cellsize`: target cellsize
- `offset`: numeric of length 2; lower left corner coordinates (x, y) of the grid
- `n`: integer of length 1 or 2, number of grid cells in x and y direction (columns, rows)
- `crs`: object of class crs; coordinate reference system of the target of the target grid in case argument x is missing, if x is not missing, its crs is inherited.
- `what`: character; one of: "polygons", "corners", or "centers"
- `square`: logical; if FALSE, create hexagonal grid
- `flat_topped`: logical; if TRUE generate flat topped hexagons, else generate pointy topped
**Value**

Object of class `sfc` (simple feature geometry list column) with, depending on what and square, square or hexagonal polygons, corner points of these polygons, or center points of these polygons.

**Examples**

```r
plot(st_make_grid(what = "centers"), axes = TRUE)
plot(st_make_grid(what = "corners"), add = TRUE, col = 'green', pch=3)
sfc = st_sfc(st_polygon(list(rbind(c(0,0), c(1,0), c(1,1), c(0,0)))))
plot(st_make_grid(sfc, cellsize = .1, square = FALSE))
plot(sfc, add = TRUE)
# non-default offset:
plot(st_make_grid(sfc, cellsize = .1, square = FALSE, offset = c(0, .05 / (sqrt(3)/2))))
plot(sfc, add = TRUE)
nc = read_sf(system.file("shape/nc.shp", package="sf"))
g = st_make_grid(nc)
plot(g)
plot(st_geometry(nc), add = TRUE)
# g[nc] selects cells that intersect with nc:
plot(g[nc], col = '#ff000088', add = TRUE)
```

---

**st_m_range**

Return 'm' range of a simple feature or simple feature set

**Description**

Return 'm' range of a simple feature or simple feature set

**Usage**

```r
## S3 method for class 'm_range'
is.na(x)
st_m_range(obj, ...)

## S3 method for class 'POINT'
st_m_range(obj, ...)

## S3 method for class 'MULTIPOINT'
st_m_range(obj, ...)

## S3 method for class 'LINESTRING'
st_m_range(obj, ...)

## S3 method for class 'POLYGON'
st_m_range(obj, ...)

## S3 method for class 'MULTILINESTRING'
```
st_m_range(obj, ...)
## S3 method for class 'MULTIPOLYGON'
st_m_range(obj, ...)
## S3 method for class 'GEOMETRYCOLLECTION'
st_m_range(obj, ...)
## S3 method for class 'MULTISURFACE'
st_m_range(obj, ...)
## S3 method for class 'MULTICURVE'
st_m_range(obj, ...)
## S3 method for class 'CURVEPOLYGON'
st_m_range(obj, ...)
## S3 method for class 'COMPOUNDCURVE'
st_m_range(obj, ...)
## S3 method for class 'POLYHEDRALSURFACE'
st_m_range(obj, ...)
## S3 method for class 'TIN'
st_m_range(obj, ...)
## S3 method for class 'TRIANGLE'
st_m_range(obj, ...)
## S3 method for class 'CIRCULARSTRING'
st_m_range(obj, ...)
## S3 method for class 'sfc'
st_m_range(obj, ...)
## S3 method for class 'sf'
st_m_range(obj, ...)
## S3 method for class 'numeric'
st_m_range(obj, ..., crs = NA_crs_)

NA_m_range_

Arguments

x object of class m_range
obj object to compute the m range from
... ignored
crs

crs object of class crs, or argument to st_crs, specifying the CRS of this bounding box.

Format

An object of class m_range of length 2.

Details

NA_m_range_ represents the missing value for a m_range object

Value

a numeric vector of length two, with mmin and mmax values; if obj is of class sf or sfc the object if obj is of class sf or sfc the object returned has a class m_range

Examples

a = st_sf(a = 1:2, geom = st_sfc(st_point(0:3), st_point(1:4)), crs = 4326)
st_m_range(a)
st_m_range(c(mmin = 16.1, mmax = 16.6), crs = st_crs(4326))

st_nearest_feature

crds

crds get index of nearest feature

Description

get index of nearest feature

Usage

st_nearest_feature(x, y)

Arguments

x object of class sfg, sfc or sf

y object of class sfg, sfc or sf

Value

for each feature (geometry) in x the index of the nearest feature (geometry) in set y; empty geome-
tries result in NA indexes

See Also

st_nearest_points for finding the nearest points for pairs of feature geometries
Examples

```r
ls1 = st_linestring(rbind(c(0,0), c(1,0)))
ls2 = st_linestring(rbind(c(0,0.1), c(1,0.1)))
ls3 = st_linestring(rbind(c(0,1), c(1,1)))
(l = st_sfc(ls1, ls2, ls3))

p1 = st_point(c(0.1, -0.1))
p2 = st_point(c(0.1, 0.11))
p3 = st_point(c(0.1, 0.09))
p4 = st_point(c(0.1, 0.9))

(p = st_sfc(p1, p2, p3, p4))
try(st_nearest_feature(p, l))
try(st_nearest_points(p, l[[st_nearest_feature(p,l)]], pairwise = TRUE))
```

```r
r = sqrt(2)/10
b1 = st_buffer(st_point(c(.1,.1)), r)
b2 = st_buffer(st_point(c(.9,.9)), r)
b3 = st_buffer(st_point(c(.9,.1)), r)
circles = st_sfc(b1, b2, b3)
plot(circles, col = NA, border = 2:4)
pts = st_sfc(st_point(c(.3,.1)), st_point(c(.6,.2)), st_point(c(.6,.6)), st_point(c(.4,.8)))
plot(pts, add = TRUE, col = 1)
# draw points to nearest circle:
nearest = try(st_nearest_feature(pts, circles))
if (inherits(nearest, "try-error")) # GEOS 3.6.1 not available
   nearest = c(1, 3, 2, 2)
ls = st_nearest_points(pts, circles[nearest], pairwise = TRUE)
plot(ls, col = 5:8, add = TRUE)
```

---

**st_nearest_points**

*get nearest points between pairs of geometries*

**Description**

get nearest points between pairs of geometries

**Usage**

```r
st_nearest_points(x, y, ...)

## S3 method for class 'sfc'
st_nearest_points(x, y, ..., pairwise = FALSE)

## S3 method for class 'sfg'
st_nearest_points(x, y, ...)

## S3 method for class 'sf'
st_nearest_points(x, y, ...)
```
Arguments

- **x**: object of class `sfg`, `sfc` or `sf`  
- **y**: object of class `sfg`, `sfc` or `sf`  
- **...**: ignored  
- **pairwise**: logical; if `FALSE` (default) return nearest points between all pairs, if `TRUE`, return nearest points between subsequent pairs.

Details

In case `x` lies inside `y`, when using S2, the end points are on polygon boundaries, when using GEOS the end point are identical to `x`.

Value

An `sfc` object with all two-point `LINESTRING` geometries of point pairs from the first to the second geometry, of length `x * y`, with `y` cycling fastest. See examples for ideas how to convert these to `POINT` geometries.

See Also

- `st_nearest_feature` for finding the nearest feature

Examples

```r
r = sqrt(2)/10
pt1 = st_point(c(.1,.1))
pt2 = st_point(c(.9,.9))
pt3 = st_point(c(.9,.1))
b1 = st_buffer(pt1, r)
b2 = st_buffer(pt2, r)
b3 = st_buffer(pt3, r)
(ls0 = st_nearest_points(b1, b2)) # sfg
(ls = st_nearest_points(st_sfc(b1), st_sfc(b2, b3))) # sfc
plot(b1, xlim = c(-.2,1.2), ylim = c(-.2,1.2), col = NA, border = 'green')
plot(st_sfc(b2, b3), add = TRUE, col = NA, border = 'blue')
plot(ls, add = TRUE, col = 'red')
nc = read_sf(system.file("gpkg/nc.gpkg", package="sf"))
plot(st_geometry(nc))
ls = st_nearest_points(nc[1,], nc)
plot(ls, col = 'red', add = TRUE)
pts = st_cast(ls, "POINT") # gives all start & end points
# starting, "from" points, corresponding to x:
plot(pts[seq(1, 200, 2)], add = TRUE, col = 'blue')
# ending, "to" points, corresponding to y:
plot(pts[seq(2, 200, 2)], add = TRUE, col = 'green')
```
**st_normalize**

**Normalize simple features**

**Description**

`st_normalize` transforms the coordinates in the input feature to fall between 0 and 1. By default the current domain is set to the bounding box of the input, but other domains can be used as well.

**Usage**

```r
st_normalize(x, domain = st_bbox(x), ...)
```

**Arguments**

- `x`: object of class sf, sfc or sfg
- `domain`: The domain `x` should be normalized from as a length 4 vector of the form `c(xmin,ymin,xmax,ymax)`. Defaults to the bounding box of `x`
- `...`: ignored

**Examples**

```r
p1 = st_point(c(7,52))
st_normalize(p1, domain = c(0, 0, 10, 100))

p2 = st_point(c(-30,20))
sfc = st_sfc(p1, p2, crs = 4326)
sfc
sfc_norm <- st_normalize(sfc)
st_bbox(sfc_norm)
```

---

**st_precision**

**Get precision**

**Description**

Get precision

Set precision

**Usage**

```r
st_precision(x)

st_set_precision(x, precision)

st_precision(x) <- value
```
Arguments

- \( x \) : object of class \( \text{sfc} \) or \( \text{sf} \)
- \( \text{precision} \) : numeric, or object of class \( \text{units} \) with distance units (but see details); see \text{st_as_binary} for how to do this.
- \( \text{value} \) : precision value

Details

If \( \text{precision} \) is a \( \text{units} \) object, the object on which we set precision must have a coordinate reference system with compatible distance units.

Setting a precision has no direct effect on coordinates of geometries, but merely set an attribute tag to an \( \text{sfc} \) object. The effect takes place in \text{st_as_binary} or, more precise, in the C++ function \text{CPL_write_wkb}, where simple feature geometries are being serialized to well-known-binary (WKB). This happens always when routines are called in GEOS library (geometrical operations or predicates), for writing geometries using \text{st_write} or \text{write_sf}, \text{st_make_valid} in package \text{lwgeom}; also \text{aggregate} and \text{summarise} by default union geometries, which calls a GEOS library function. Routines in these libraries receive rounded coordinates, and possibly return results based on them. \text{st_as_binary} contains an example of a roundtrip of \( \text{sfc} \) geometries through WKB, in order to see the rounding happening to R data.

The reason to support precision is that geometrical operations in GEOS or liblwgeom may work better at reduced precision. For writing data from R to external resources it is harder to think of a good reason to limiting precision.

See Also

\text{st_as_binary} for an explanation of what setting precision does, and the examples therein.

Examples

```r
x <- st_sfc(st_point(c(pi, pi)))
st_precision(x)
st_precision(x) <- 0.01
st_precision(x)
```

---

\textbf{st_read}

\textit{Read simple features or layers from file or database}

\textbf{Description}

Read simple features from file or database, or retrieve layer names and their geometry type(s)

Read PostGIS table directly through DBI and RPostgreSQL interface, converting Well-Know Binary geometries to \text{sfc}
Usage

```r
st_read(dsn, layer, ...)
```

```r
## S3 method for class 'character'

st_read(
  dsn,
  layer,
  ...,
  query = NA,
  options = NULL,
  quiet = FALSE,
  geometry_column = 1L,
  type = 0,
  promote_to_multi = TRUE,
  stringsAsFactors = sf_stringsAsFactors(),
  int64_as_string = FALSE,
  check_ring_dir = FALSE,
  fid_column_name = character(0),
  drivers = character(0),
  wkt_filter = character(0)
)
```

```r
read_sf(..., quiet = TRUE, stringsAsFactors = FALSE, as_tibble = TRUE)
```

```r
## S3 method for class 'DBIOObject'

st_read(
  dsn = NULL,
  layer = NULL,
  query = NULL,
  EWKB = TRUE,
  quiet = TRUE,
  as_tibble = FALSE,
  geometry_column = NULL,
  ...
)
```

Arguments

dsn
  data source name (interpretation varies by driver - for some drivers, dsn is a file
  name, but may also be a folder, or contain the name and access credentials of
  a database); in case of GeoJSON, dsn may be the character string holding the
  geojson data. It can also be an open database connection.

layer
  layer name (varies by driver, may be a file name without extension); in case
  layer is missing, st_read will read the first layer of dsn, give a warning and
  (unless quiet = TRUE) print a message when there are multiple layers, or give
  an error if there are no layers in dsn. If dsn is a database connection, then layer
  can be a table name or a database identifier (see Id). It is also possible to omit
  layer and rather use the query argument.
... parameter(s) passed on to st_as_sf

query
SQL query to select records; see details

options
character; driver dependent dataset open options, multiple options supported. For possible values, see the "Open options" section of the GDAL documentation of the corresponding driver, and https://github.com/r-spatial/st/issues/1157 for an example.

quiet
logical; suppress info on name, driver, size and spatial reference, or signaling no or multiple layers

geometry_column
integer or character; in case of multiple geometry fields, which one to take?

type
integer; ISO number of desired simple feature type; see details. If left zero, and promote_to_multi is TRUE, in case of mixed feature geometry types, conversion to the highest numeric type value found will be attempted. A vector with different values for each geometry column can be given.

promote_to_multi
logical; in case of a mix of Point and MultiPoint, or of LineString and MultiLineString, or of Polygon and MultiPolygon, convert all to the Multi variety; defaults to TRUE

stringsAsFactors
logical; logical: should character vectors be converted to factors? Default for read_sf or R version >= 4.1.0 is FALSE, for st_read and R version < 4.1.0 equal to default.stringsAsFactors()

int64_as_string
logical; if TRUE, Int64 attributes are returned as string; if FALSE, they are returned as double and a warning is given when precision is lost (i.e., values are larger than 2^53).

check_ring_dir
logical; if TRUE, polygon ring directions are checked and if necessary corrected (when seen from above: exterior ring counter clockwise, holes clockwise)

fid_column_name
character; name of column to write feature IDs to; defaults to not doing this

drivers
character; limited set of driver short names to be tried (default: try all)

wkt_filter
character; WKT representation of a spatial filter (may be used as bounding box, selecting overlapping geometries); see examples

as_tibble
logical; should the returned table be of class tibble or data.frame?

EWKB
logical; is the WKB of type EWKB? if missing, defaults to TRUE

Details

for geometry_column, see also https://trac.osgeo.org/gdal/wiki/rfc41_multiple_geometry_fields

for values for type see https://en.wikipedia.org/wiki/Well-known_text#Well-known_binary, but note that not every target value may lead to successful conversion. The typical conversion from POLYGON (3) to MULTIPOLYGON (6) should work; the other way around (type=3), secondary rings from MULTIPOLYGONs may be dropped without warnings. promote_to_multi is handled on a per-geometry column basis; type may be specified for each geometry column.
Note that stray files in data source directories (such as *.dbf) may lead to spurious errors that accompanying *.shp are missing.

In case of problems reading shapefiles from USB drives on OSX, please see https://github.com/r-spatial/sf/issues/252.

For query with a character dsn the query text is handed to ’ExecuteSQL’ on the GDAL/OGR data set and will result in the creation of a new layer (and layer is ignored). See ’OGRSQL’ https://gdal.org/user/ogr_sql_dialect.html for details. Please note that the ’FID’ special field is driver-dependent, and may be either 0-based (e.g. ESRI Shapefile), 1-based (e.g. MapInfo) or arbitrary (e.g. OSM). Other features of OGRSQL are also likely to be driver dependent. The available layer names may be obtained with st_layers. Care will be required to properly escape the use of some layer names.

read_sf and write_sf are aliases for st_read and st_write, respectively, with some modified default arguments. read_sf and write_sf are quiet by default: they do not print information about the data source. read_sf returns an sf-tibble rather than an sf-data.frame. write_sf delete layers by default: it overwrites existing files without asking or warning.

if table is not given but query is, the spatial reference system (crs) of the table queried is only available in case it has been stored into each geometry record (e.g., by PostGIS, when using EWKB)

The function will automatically find the ‘geometry’ type columns for drivers that support it. For the other drivers, it will try to cast all the character columns, which can be slow for very wide tables.

Value

object of class sf when a layer was successfully read; in case argument layer is missing and data source dsn does not contain a single layer, an object of class sf_layers is returned with the layer names, each with their geometry type(s). Note that the number of layers may also be zero.

Note

The use of system.file in examples make sure that examples run regardless where R is installed: typical users will not use system.file but give the file name directly, either with full path or relative to the current working directory (see getwd). "Shapefiles" consist of several files with the same basename that reside in the same directory, only one of them having extension .shp.

See Also

st_layers, st_drivers

Examples

cmp = st_read(system.file("shape/nc.shp", package="sf"))
summary(nc)  # note that AREA was computed using Euclidian area on lon/lat degrees

## only three fields by select clause
## only two features by where clause
nc_sql = st_read(system.file("shape/nc.shp", package="sf"),
                query = "SELECT NAME, SID74, FIPS FROM \"nc\" WHERE BIR74 > 20000")

## Not run:
library(sp)
example(meuse, ask = FALSE, echo = FALSE)
try(st_write(st_as_sf(meuse), "PG:dbname=postgis", "meuse", layer_options = "OVERWRITE=true"))
try(st_meuse <- st_read("PG:dbname=postgis", "meuse"))
if (exists("st_meuse"))
  summary(st_meuse)

## End(Not run)

## Not run:
## note that we need special escaping of layer within single quotes (nc.gpkg)
## and that geom needs to be included in the select, otherwise we don't detect it
layer <- st_layers(system.file("gpkg/nc.gpkg", package = "sf"))$name[1]
nc_gpkg_sql = st_read(system.file("gpkg/nc.gpkg", package = "sf"),
  query = sprintf("SELECT NAME, SID74, FIPS, geom FROM\"%s\" WHERE BIR74 > 20000", layer))

## End(Not run)
# spatial filter, as wkt:
wkt = st_as_text(st_geometry(nc[1,]))
# filter by (bbox overlaps of) first feature geometry:
read_sf(system.file("gpkg/nc.gpkg", package="sf"), wkt_filter = wkt)
# read geojson from string:
geojson_txt <- paste("\{"type":"MultiPoint","coordinates":",
"[[3.2,4],[3.4,6],[3.8,4.4],[3.5,3.8],[3.4,3.6],[3.9,4.5]]\}"
)x = read_sf(geojson_txt)
x

## End(Not run)
library(RPostgreSQL)
try(conn <- dbConnect(PostgreSQL(), dbname = "postgis"))
if (exists("conn") && !inherits(conn, "try-error")) {
  x = st_read(conn, "meuse", query = "select * from meuse limit 3;")
  x = st_read(conn, table = "public.meuse")
  print(st_crs(x)) # SRID resolved by the database, not by GDAL!
  dbDisconnect(conn)
}

## End(Not run)

### st_relate

**st_relate**

Compute DE9-IM relation between pairs of geometries, or match it to a given pattern

---

**Description**

Compute DE9-IM relation between pairs of geometries, or match it to a given pattern

**Usage**

st_relate(x, y, pattern = NA_character_, sparse = !is.na(pattern))
Arguments

- **x**: object of class sf, sfc or sfg
- **y**: object of class sf, sfc or sfg
- **pattern**: character; define the pattern to match to, see details.
- **sparse**: logical; should a sparse matrix be returned (TRUE) or a dense matrix?

Value

In case **pattern** is not given, **st_relate** returns a dense character matrix; element [i,j] has nine characters, referring to the DE9-IM relationship between x[i] and y[j], encoded as IxIy,IxBy,IxEy,BxIy,BxBy,BxEy,ExIy,ExBy,ExEy where I refers to interior, B to boundary, and E to exterior, and e.g. BxIy the dimensionality of the intersection of the the boundary of x[i] and the interior of y[j], which is one of 0,1,2,F, digits denoting dimensionality, F denoting not intersecting. When **pattern** is given, a dense logical matrix or sparse index list returned with matches to the given pattern; see **st_intersection** for a description of the returned matrix or list. See also [https://en.wikipedia.org/wiki/DE-9IM](https://en.wikipedia.org/wiki/DE-9IM) for further explanation.

Examples

```r
p1 = st_point(c(0,0))
p2 = st_point(c(2,2))
pol1 = st_polygon(list(rbind(c(0,0),c(1,0),c(1,1),c(0,1),c(0,0)))) - 0.5
pol2 = pol1 + 1
pol3 = pol1 + 2
st_relate(st_sfc(p1, p2), st_sfc(pol1, pol2, pol3))
sfc = st_sfc(st_point(c(0,0)), st_point(c(3,3)))
grd = st_make_grid(sfc, n = c(3,3))
sts_intersects(grd)
st_relate(grd, pattern = "****1****") # sides, not corners, internals
sts_relate(grd, pattern = "****0****") # only corners touch
sts_rook = function(a, b = a) st_relate(a, b, pattern = "F***1****")
st_rook(grd)
# queen neighbours, see [https://github.com/r-spatial/sf/issues/234#issuecomment-300511129](https://github.com/r-spatial/sf/issues/234#issuecomment-300511129)
st_queen <- function(a, b = a) st_relate(a, b, pattern = "F***T****")
```

### st_sample

**sample points on or in (sets of) spatial features**

**Description**

Sample points on or in (sets of) spatial features. By default, returns a pre-specified number of points that is equal to **size** (if **type** = "random" and **exact** = TRUE) or an approximation of **size** otherwise. spatstat methods are interfaced and do not use the **size** argument, see examples.
Usage

```r
st_sample(x, size, ...)
```

```r
# S3 method for class 'sf'
st_sample(x, size, ...)
```

```r
# S3 method for class 'sfc'
st_sample(
x,
size,
...

type = "random",
exact = TRUE,
warn_if_not_integer = TRUE,
by_polygon = FALSE
)
```

```r
# S3 method for class 'sfg'
st_sample(x, size, ...)
```

Arguments

- **x** object of class sf or sfc
- **size** sample size(s) requested; either total size, or a numeric vector with sample sizes for each feature geometry. When sampling polygons, the returned sampling size may differ from the requested size, as the bounding box is sampled, and sampled points intersecting the polygon are returned.
- **type** character; indicates the spatial sampling type; one of random, hexagonal (triangular really), regular, or one of the spatstat methods such as Thomas for calling spatstat::rThomas (see Details).
- **exact** logical; should the length of output be exactly the same as specified by size? TRUE by default. Only applies to polygons, and when type = "random".
- **warn_if_not_integer** logical; if FALSE then no warning is emitted if size is not an integer
- **by_polygon** logical; for MULTIPOLYGON geometries, should the effort be split by POLYGON? See https://github.com/r-spatial/sf/issues/1480https://github.com/r-spatial/sf/issues/1480 the same as specified by size?

Details

The function is vectorised: it samples size points across all geometries in the object if size is a single number, or the specified number of points in each feature if size is a vector of integers equal in length to the geometry of x.

If x has dimension 2 (polygons) and geographical coordinates (long/lat), uniform random sampling on the sphere is applied, see e.g. http://mathworld.wolfram.com/SpherePointPicking.html
For regular or hexagonal sampling of polygons, the resulting size is only an approximation. As parameter called offset can be passed to control ("fix") regular or hexagonal sampling: for polygons a length 2 numeric vector (by default: a random point from st_bbox(x)); for lines use a number like runif(1).

Sampling methods from package spatstat are interfaced (see examples), and need their own parameters to be set. For instance, to use spatstat::rThomas(), set type = "Thomas".

Value
an sfc object containing the sampled POINT geometries

Examples

nc = st_read(system.file("shape/nc.shp", package="sf"))
p1 = st_sample(nc[1:3, ], 6)
p2 = st_sample(nc[1:3, ], 1:3)
plot(st_geometry(nc)[1:3])
plot(p1, add = TRUE)
plot(p2, add = TRUE, pch = 2)
x = st_sfc(st_polygon(list(rbind(c(0,0),c(90,0),c(90,90),c(0,90),c(0,0)))), crs = st_crs(4326))
plot(x, axes = TRUE, graticule = TRUE)
if (sf_extSoftVersion()["proj.4"] >= "4.9.0")
  plot(p <- st_sample(x, 1000), add = TRUE)
x2 = st_transform(st_segmentize(x, 1e4), st_crs("+proj=ortho +lat_0=30 +lon_0=45"))
g = st_transform(st_graticule(), st_crs("+proj=ortho +lat_0=30 +lon_0=45"))
plot(x2, graticule = g)
if (sf_extSoftVersion()["proj.4"] >= "4.9.0") {
  p2 = st_transform(p, st_crs("+proj=ortho +lat_0=30 +lon_0=45"))
  plot(p2, add = TRUE)
}
x = st_sfc(st_polygon(list(rbind(c(0,0),c(90,0),c(90,10),c(0,90),c(0,0)))) # NOT long/lat:
plot(x)
p_exact = st_sample(x, 1000, exact = TRUE)
p_not_exact = st_sample(x, 1000, exact = FALSE)
length(p_exact); length(p_not_exact)
plot(st_sample(x, 1000), add = TRUE)
x = st_sfc(st_polygon(list(rbind(c(-180,-90),c(180,-90),c(180,90),c(-180,90),c(-180,-90))))
  crs=st_crs(4326))
#if (sf_extSoftVersion()["proj.4"] >= "4.9.0") {
  # p = st_sample(x, 1000)
  # st_sample(p, 3)
  #}
  # hexagonal:
sfc = st_sfc(st_polygon(list(rbind(c(0,0), c(1,0), c(1,1), c(0,0)))))
plot(sfc)
h = st_sample(sfc, 100, type = "hexagonal")
h1 = st_sample(sfc, 100, type = "hexagonal")
plot(h, add = TRUE)
plot(h1, col = 'red', add = TRUE)
c(length(h), length(h1)) # approximate!
pt = st_multipoint(matrix(1:20,2))
st_shift_longitude

Shift or re-center geographical coordinates for a Pacific view

Description

All longitudes < 0 are added to 360, to avoid for instance parts of Alaska being represented on the far left and right of a plot because they have values straddling 180 degrees. In general, using a projected coordinate reference system is to be preferred, but this method permits a geographical coordinate reference system to be used. This is the sf equivalent of recenter in the sp package and ST_ShiftLongitude in PostGIS.

Usage

st_shift_longitude(x)

## S3 method for class 'sfc'
st_shift_longitude(x, ...)

## S3 method for class 'sf'
st_shift_longitude(x, ...)

Arguments

x
object of class sf or sfc

... ignored

Examples

## sfc
pt1 = st_point(c(-170, 50))
pt2 = st_point(c(170, 50))
(sfc = st_sfc(pt1, pt2))
sfc = st_set_crs(sfc, 4326)
st_shift_longitude(sfc)

## sf
d = st_as_sf(data.frame(id = 1:2, geometry = sfc))
st_shift_longitude(d)

---

**st_transform**  
*Transform or convert coordinates of simple feature*

**Description**

Transform or convert coordinates of simple feature

**Usage**

```
st_transform(x, crs, ...)  
```

```r  
## S3 method for class "sfc"
st_transform(  
  x,  
  crs = st_crs(x),  
  ...,  
  aoi = numeric(0),  
  pipeline = character(0),  
  reverse = FALSE,  
  partial = TRUE,  
  check = FALSE  
)
```

```r  
## S3 method for class "sf"
st_transform(x, crs = st_crs(x), ...)  
```

```r  
## S3 method for class "sfg"
st_transform(x, crs = st_crs(x), ...)  
```

```r  
sf_proj_info(type = "proj", path)  
```

```r  
st_wrap_dateline(x, options, quiet)  
```

```r  
## S3 method for class "sfc"
st_wrap_dateline(x, options = "WRAPDATELINE=YES", quiet = TRUE)  
```

```r  
## S3 method for class "sf"
st_wrap_dateline(x, options = "WRAPDATELINE=YES", quiet = TRUE)  
```

```r  
## S3 method for class "sfg"
st_wrap_dateline(x, options = "WRAPDATELINE=YES", quiet = TRUE)  
```
st_transform

Arguments

- **x**: object of class sf, sfc or sfg
- **crs**: coordinate reference system: integer with the EPSG code, or character with proj4-string
- **...**: ignored
- **aoi**: area of interest, in degrees: WestLongitude, SouthLatitude, EastLongitude, NorthLatitude
- **pipeline**: character; proj4 or WKT coordinate operation, to override the default operation
- **reverse**: boolean; if TRUE, the inverse operation of the pipeline is applied
- **partial**: logical; allow for partial projection, if not all points of a geometry can be projected (corresponds to setting environment variable `OGR_ENABLE_PARTIAL_REPROJECTION` to TRUE)
- **check**: logical; perform a sanity check on resulting polygons?
- **type**: character; one of `have_datum_files`, `proj`, `ellps`, `datum`, `units` or `prime_meridians`; see Details.
- **path**: character; PROJ search path to be set
- **options**: character; should have "WRAPDATELINE=YES" to function; another parameter that is used is "DATELINEOFFSET=10" (where 10 is the default value)
- **quiet**: logical; print options after they have been parsed?

Details

Transforms coordinates of object to new projection. Features that cannot be transformed are returned as empty geometries.

Projecting to projections not supported by GDAL may be done by `st_transform_proj`, part of package lwgeom.

The `st_transform` method for sfg objects assumes that the CRS of the object is available as an attribute of that name.

`sf_proj_info` lists the available projections, ellipses, datums, units, or data search path of the PROJ library when `type` is equal to `proj`, `ellps`, `datum`, `units` or `path`; when `type` equals `have_datum_files` a boolean is returned indicating whether datum files are installed and accessible (checking for conus).

for PROJ >= 6, `sf_proj_info` does not provide option `type = "datums"`. PROJ < 6 does not provide the option `type = "prime_meridians"`.

for PROJ >= 7.1.0, the "units" query of `sf_proj_info` returns the `to_meter` variable as numeric, previous versions return a character vector containing a numeric expression.

For a discussion of using options, see [https://github.com/r-spatial/sf/issues/280](https://github.com/r-spatial/sf/issues/280) and [https://github.com/r-spatial/sf/issues/541](https://github.com/r-spatial/sf/issues/541)
st_viewport

Create viewport from sf, sfc or sfg object

Description

Create viewport from sf, sfc or sfg object

Usage

st_viewport(x, ..., bbox = st_bbox(x), asp)

Arguments

x

object of class sf, sfc or sfg object

... parameters passed on to viewport

bbox

the bounding box used for aspect ratio

asp

numeric; target aspect ratio (y/x), see Details
Details

Parameters width, height, xscale and yscale are set such that aspect ratio is honoured and plot size is maximized in the current viewport; others can be passed as ...

If asp is missing, it is taken as 1, except when isTRUE(st_is_longlat(x)), in which case it is set to $1.0 / \cos(y)$, with $y$ the middle of the latitude bounding box.

Value

The output of the call to viewport

Examples

```r
library(grid)
nc = st_read(system.file("shape/nc.shp", package="sf"))
grid.newpage()
pushViewport(viewport(width = 0.8, height = 0.8))
pushViewport(st_viewport(nc))
invisible(lapply(st_geometry(nc), function(x) grid.draw(st_as_grob(x, gp = gpar(fill = "red")))))
```

Description

Write simple features object to file or database

Usage

```r
st_write(obj, dsn, layer, ...)
```

```
## S3 method for class 'sfc'
st_write(obj, dsn, layer, ...)

## S3 method for class 'sf'
st_write(
  obj,
  dsn,
  layer = NULL,
  ...,
  driver = guess_driver_can_write(dsn),
  dataset_options = NULL,
  layer_options = NULL,
  quiet = FALSE,
  factorsAsCharacter = TRUE,
  append = NA,
  delete_dsn = FALSE,
  delete_layer = !is.na(append) && !append,
```


```r

cid_column_name = NULL
)

## S3 method for class 'data.frame'
st_write(obj, dsn, layer = NULL, ...)
write_sf(..., quiet = TRUE, append = FALSE, delete_layer = TRUE)

## S4 method for signature 'PostgreSQLConnection,character,sf'
dbWriteTable(
  conn,
  name,
  value,
  ...
  row.names = FALSE,
  overwrite = FALSE,
  append = FALSE,
  field.types = NULL,
  factorsAsCharacter = TRUE,
  binary = TRUE
)

## S4 method for signature 'DBIObject,character,sf'
dbWriteTable(
  conn,
  name,
  value,
  ...
  row.names = FALSE,
  overwrite = FALSE,
  append = FALSE,
  field.types = NULL,
  factorsAsCharacter = TRUE,
  binary = TRUE
)

Arguments

obj object of class sf or sfc

dsn data source name (interpretation varies by driver - for some drivers, dsn is a
file name, but may also be a folder or contain a database name) or a Database
Connection (currently official support is for RPostgreSQL connections)

layer layer name (varies by driver, may be a file name without extension); if layer is
missing, the basename of dsn is taken.

... other arguments passed to dbWriteTable when dsn is a Database Connection

driver character; name of driver to be used; if missing and dsn is not a Database Con-
nection, a driver name is guessed from dsn; st_drivers() returns the drivers
```
that are available with their properties; links to full driver documentation are found at https://gdal.org/ogr_formats.html.

dataset_options
character; driver dependent dataset creation options; multiple options supported.

layer_options
character; driver dependent layer creation options; multiple options supported.

quiet
logical; suppress info on name, driver, size and spatial reference

factorsAsCharacter
logical; convert factor objects into character strings (default), else into numbers by as.numeric.

append
Append rows to existing table; default FALSE.

delete_dsn
logical; delete data source dsn before attempting to write?

delete_layer
logical; delete layer layer before attempting to write?

fid_column_name
character, name of column with feature IDs; if specified, this column is no longer written as feature attribute.

conn
DBIOObject

name
character vector of names (table names, fields, keywords).

value
a data.frame.

row.names
Add a row. name column, or a vector of length nrow(obj) containing row.names; default FALSE.

overwrite
Will try to drop table before writing; default FALSE.

field.types
default NULL. Allows to override type conversion from R to PostgreSQL. See dbDataType() for details.

binary
Send geometries serialized as Well-Known Binary (WKB); if FALSE, uses Well-Known Text (WKT). Defaults to TRUE (WKB).

Details

Columns (variables) of a class not supported are dropped with a warning.

When updating an existing layer, records are appended to it if the updating object has the right variable names and types. If names don’t match an error is raised. If types don’t match, behaviour is undefined: GDAL may raise warnings or errors or fail silently.

When deleting layers or data sources is not successful, no error is emitted. delete_dsn and delete_layer should be handled with care; the former may erase complete directories or databases.

Value

obj, invisibly; in case obj is of class sfc, it is returned as an sf object.

See Also

st_drivers
Examples

```r
nc = st_read(system.file("shape/nc.shp", package="sf"))
st_write(nc, paste0(tempdir(), "/", "nc.shp"))
st_write(nc, paste0(tempdir(), "/", "nc.shp"), delete_layer = TRUE) # overwrites
data(meuse, package = "sp") # loads data.frame from sp
meuse_sf = st_as_sf(meuse, coords = c("x", "y"), crs = 28992)
# writes X and Y as columns:
st_write(meuse_sf, paste0(tempdir(), "/", "meuse.csv"), layer_options = "GEOMETRY=AS_XY")
st_write(meuse_sf, paste0(tempdir(), "/", "meuse.csv"), layer_options = "GEOMETRY=AS_WKT",
          delete_dsn=TRUE) # overwrites
## Not run:
library(sp)
example(meuse, ask = FALSE, echo = FALSE)
try(st_write(st_as_sf(meuse), "PG:dbname=postgis", "meuse_sf",
            layer_options = c("OVERWRITE=yes", "LAUNDER=true")))
demo(nc, ask = FALSE)
try(st_write(nc, "PG:dbname=postgis", "sids", layer_options = "OVERWRITE=true"))
## End(Not run)
```

---

**st_zm**  
Drop or add Z and/or M dimensions from feature geometries

**Description**  
Drop Z and/or M dimensions from feature geometries, resetting classes appropriately

**Usage**  
```
st_zm(x, ..., drop = TRUE, what = "ZM")
```

**Arguments**  
- **x** object of class sfg, sfc or sf
- **...** ignored
- **drop** logical; drop, or (FALSE) add?
- **what** character which dimensions to drop or add

**Details**  
Only combinations drop=TRUE, what = "ZM", and drop=FALSE, what="Z" are supported so far. In case add=TRUE, x should have XY geometry, and zero values are added for Z.
Examples

```r
st_zm(st_linestring(matrix(1:32,8)))
x = st_sfc(st_linestring(matrix(1:32,8)), st_linestring(matrix(1:8,2)))
st_zm(x)
a = st_sf(a = 1:2, geom=x)
st_zm(a)
```

---

### Description

Return 'z' range of a simple feature or simple feature set

### Usage

```r
# S3 method for class 'z_range'

st_z_range(obj, ...)
```

```r
# S3 method for class 'POINT'

st_z_range(obj, ...)
```

```r
# S3 method for class 'MULTIPOINT'

st_z_range(obj, ...)
```

```r
# S3 method for class 'LINESTRING'

st_z_range(obj, ...)
```

```r
# S3 method for class 'POLYGON'

st_z_range(obj, ...)
```

```r
# S3 method for class 'MULTILINESTRING'

st_z_range(obj, ...)
```

```r
# S3 method for class 'MULTIPOLYGON'

st_z_range(obj, ...)
```

```r
# S3 method for class 'GEOMETRYCOLLECTION'

st_z_range(obj, ...)
```

```r
# S3 method for class 'MULTISURFACE'

st_z_range(obj, ...)
```

```r
# S3 method for class 'MULTICURVE'

st_z_range(obj, ...)
```
## S3 method for class 'CURVEPOLYGON'
st_z_range(obj, ...)

## S3 method for class 'COMPOUNDUCRVE'
st_z_range(obj, ...)

## S3 method for class 'POLYHEDRALSURFACE'
st_z_range(obj, ...)

## S3 method for class 'TIN'
st_z_range(obj, ...)

## S3 method for class 'TRIANGLE'
st_z_range(obj, ...)

## S3 method for class 'CIRCULARSTRING'
st_z_range(obj, ...)

## S3 method for class 'sfc'
st_z_range(obj, ...)

## S3 method for class 'sf'
st_z_range(obj, ...)

## S3 method for class 'numeric'
st_z_range(obj, ..., crs = NA_crs_)

NA_z_range_

### Arguments

- **x**
  - object of class z_range
- **obj**
  - object to compute the z range from
- **...**
  - ignored
- **crs**
  - object of class crs, or argument to st_crs, specifying the CRS of this bounding box.

### Format

An object of class z_range of length 2.

### Details

NA_z_range_ represents the missing value for a z_range object
**Value**

a numeric vector of length two, with zmin and zmax values; if \( \text{obj} \) is of class \( \text{sf} \) or \( \text{sfc} \) the object returned has a class \( \text{z_range} \)

**Examples**

\[
\begin{align*}
\text{a} &= \text{st}\_\text{sf}(a = 1:2, \text{geom} = \text{st}\_\text{sfc}((0:2), (1:3)), \text{crs} = 4326) \\
\text{st}\_\text{z}\_\text{range}(\text{a}) \\
\text{st}\_\text{z}\_\text{range}(\text{c}(\text{zmin} = 16.1, \text{zmax} = 16.6), \text{crs} = \text{st}\_\text{crs}(4326))
\end{align*}
\]

---

### summary.sfc

*Summarize simple feature column*

**Description**

Summarize simple feature column

**Usage**

```r
## S3 method for class 'sfc'
summary(object, ..., maxsum = 7L, maxp4s = 10L)
```

**Arguments**

- `object`: object of class `sfc`
- `...`: ignored
- `maxsum`: maximum number of classes to summarize the simple feature column to
- `maxp4s`: maximum number of characters to print from the PROJ string

---

### tibble

*Summarize simple feature type for tibble*

**Description**

Summarize simple feature type for tibble

**Usage**

```r
tibble
```

**Description**

Summarize simple feature type for tibble

**Usage**

```r
summary.sfc(x, ...) \\
obj_sum.sfc(x) \\
pillar_shaft.sfc(x, ...)
```
Arguments

x object of class sfc
...

Details

see type_sum

Description

Tidyverse methods for sf objects. Geometries are sticky, use as.data.frame to let dplyr’s own methods drop them. Use these methods without the .sf suffix and after loading the tidyverse package with the generic (or after loading package tidyverse).

Usage

filter.sf(.data, ..., .dots)
arrange.sf(.data, ..., .dots)

	group_by.sf(.data, ..., add = FALSE)
ungenp.sf(x, ...)

mutate.sf(.data, ..., .dots)
transmute.sf(.data, ..., .dots)

select.sf(.data, ...)
rename.sf(.data, ...)

slice.sf(.data, ..., .dots)

summarise.sf(.data, ..., .dots, do_union = TRUE)

distinct.sf(.data, ..., .keep_all = FALSE)

gather.sf(
  data,
  key,
  value,
  ...,
tidyverse

na.rm = FALSE,
convert = FALSE,
factor_key = FALSE

)

spread.sf(
  data,
  key,
  value,
  fill = NA,
  convert = FALSE,
  drop = TRUE,
  sep = NULL
)

sample_n.sf(tbl, size, replace = FALSE, weight = NULL, .env = parent.frame())

sample_frac.sf(
  tbl,
  size = 1,
  replace = FALSE,
  weight = NULL,
  .env = parent.frame()
)

nest.sf(.data, ...)

separate.sf(
  data,
  col,
  into,
  sep = "[^[:alnum:]]+",
  remove = TRUE,
  convert = FALSE,
  extra = "warn",
  fill = "warn",
  ...
)

separate_rows.sf(data, ..., sep = "[^[:alnum:]]+", convert = FALSE)

unite.sf(data, col, ..., sep = ",", remove = TRUE)

unnest.sf(data, ..., .preserve = NULL)

inner_join.sf(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), ...)

left_join.sf(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), ...)
right_join.sf(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), ...)

full_join.sf(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), ...)

semi_join.sf(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), ...)

anti_join.sf(x, y, by = NULL, copy = FALSE, suffix = c(".x", ".y"), ...)

Arguments

.data data object of class sf

... other arguments

.dots see corresponding function in package dplyr

add see corresponding function in dplyr

x A pair of data frames, data frame extensions (e.g. a tibble), or lazy data frames (e.g. from dbplyr or dtplyr). See Methods, below, for more details.

do_union logical; in case summary does not create a geometry column, should geometries be created by unioning using st_union, or simply by combining using st_combine? Using st_union resolves internal boundaries, but in case of unioning points, this will likely change the order of the points; see Details.

.keep_all see corresponding function in dplyr

data see original function docs

key see original function docs

value see original function docs

na.rm see original function docs

convert see separate_rows

factor_key see original function docs

fill see original function docs

drop see original function docs

sep see separate_rows

tbl see original function docs

size see original function docs

replace see original function docs

weight see original function docs

.env see original function docs

col see separate

into see separate

remove see separate

extra see separate

.preserve see unnest
A pair of data frames, data frame extensions (e.g. a tibble), or lazy data frames (e.g. from dbplyr or dplyr). See *Methods*, below, for more details.

A character vector of variables to join by.

If NULL, the default, *_join() will perform a natural join, using all variables in common across x and y. A message lists the variables so that you can check they’re correct; suppress the message by supplying by explicitly.

To join by different variables on x and y, use a named vector. For example, by = c("a" = "b") will match x$a to y$b.

To join by multiple variables, use a vector with length > 1. For example, by = c("a", "b") will match x$a to y$a and x$b to y$b. Use a named vector to match different variables in x and y. For example, by = c("a" = "b", "c" = "d") will match x$a to y$b and x$c to y$d.

To perform a cross-join, generating all combinations of x and y, use by = character().

If x and y are not from the same data source, and copy is TRUE, then y will be copied into the same src as x. This allows you to join tables across srcs, but it is a potentially expensive operation so you must opt into it.

If there are non-joined duplicate variables in x and y, these suffixes will be added to the output to disambiguate them. Should be a character vector of length 2.

Details

select keeps the geometry regardless whether it is selected or not; to deselect it, first pipe through `as.data.frame` to let dplyr’s own select drop it.

In case one or more of the arguments (expressions) in the summarise call creates a geometry list-column, the first of these will be the (active) geometry of the returned object. If this is not the case, a geometry column is created, depending on the value of do_union.

In case do_union is FALSE, summarise will simply combine geometries using `c.sfg`. When polygons sharing a boundary are combined, this leads to geometries that are invalid; see for instance https://github.com/r-spatial/sf/issues/681.

distinct gives distinct records for which all attributes and geometries are distinct; `st_equals` is used to find out which geometries are distinct.

nest assumes that a simple feature geometry list-column was among the columns that were nested.

Value

an object of class `sf`

Examples

```r
library(dplyr)
nc = st_read(system.file("shape/nc.shp", package="sf"))
nc %>% filter(AREA > .1) %>% plot()
# plot 10 smallest counties in grey:
st_geometry(nc) %>% plot()
nc %>% select(AREA) %>% arrange(AREA) %>% slice(1:10) %>% plot(add = TRUE, col = "grey")
title("the ten counties with smallest area")
nc$area_cl = cut(nc$AREA, c(0, .1, .12, .15, .25))
```
transform.sf

transform method for sf objects

Description

Can be used to create or modify attribute variables; for transforming geometries see st_transform, and all other functions starting with st_.

Usage

## S3 method for class 'sf'
transform(`_data`, ...)

Arguments

_data object of class sf

... Further arguments of the form new_variable=expression
Examples

```r
a = data.frame(x1 = 1:3, x2 = 5:7)
st_geometry(a) = st_sfc(st_point(c(0,0)), st_point(c(1,1)), st_point(c(2,2)))
transform(a, x1_sq = x1^2)
transform(a, x1_x2 = x1*x2)
```

valid  

---

valid  

Check validity or make an invalid geometry valid

Description

Checks whether a geometry is valid, or makes an invalid geometry valid

Usage

```r
st_is_valid(x, ...)
```

## S3 method for class 'sfc'

```r
st_is_valid(x, ..., NA_on_exception = TRUE, reason = FALSE)
```

## S3 method for class 'sf'

```r
st_is_valid(x, ...)
```

## S3 method for class 'sfg'

```r
st_is_valid(x, ...)
```

```r
st_make_valid(x)
```

## S3 method for class 'sfg'

```r
st_make_valid(x)
```

Arguments

- `x`  
  object of class sfg, sfg or sf
- `...`  
  passed on to sfc method
- `NA_on_exception`  
  logical; if TRUE, for polygons that would otherwise raise a GEOS error (exception, e.g. for a POLYGON having more than zero but less than 4 points, or a LINESTRING having one point) return an NA rather than raising an error, and suppress warning messages (e.g. about self-intersection); if FALSE, regular GEOS errors and warnings will be emitted.
- `reason`  
  logical; if TRUE, return a character with, for each geometry, the reason for invalidity, NA on exception, or "Valid Geometry" otherwise.

Details

`st_make_valid` uses the lwgeom_makevalid method also used by the PostGIS command `ST_makevalid` if the GEOS version linked to is smaller than 3.8.0, and otherwise the version shipped in GEOS.


Value

`st_is_valid` returns a logical vector indicating for each geometries of `x` whether it is valid.
Object of the same class as `x`.

Examples

```r
p1 = st_as_sfc("POLYGON((0 0, 0 10, 10 0, 10 10, 0 0))")
st_is_valid(p1)
st_is_valid(st_sfc(st_point(0:1), p1[[1]]), reason = TRUE)
library(sf)
x = st_sfc(st_polygon(list(rbind(c(0,0),c(0.5,0),c(0.5,0.5),c(0.5,0),c(1,0),c(1,1),c(0,1),c(0,0)))))
suppressWarnings(st_is_valid(x))
y = st_make_valid(x)
st_is_valid(y)
y %>% st_cast()
```

---

Description

vcors methods for sf objects

Usage

```r
vec_ptype2.sfc(x, y, ...)
```

```
## Default S3 method:
vec_ptype2.sfc(x, y, ..., x_arg = "x", y_arg = "y")
```

```
## S3 method for class 'sfc'
vec_ptype2.sfc(x, y, ...)
```

```
vec_cast.sfc(x, to, ...)
```

```
## S3 method for class 'sfc'
vec_cast.sfc(x, to, ...)
```

```
## Default S3 method:
vec_cast.sfc(x, to, ...)
```

Arguments

- `x` Vector types.
- `y` Vector types.
- `...` These dots are for future extensions and must be empty.
- `x_arg, y_arg` Argument names for `x` and `y`.
- `to` Type to cast to. If NULL, `x` will be returned as is.
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