Vector Operations Part 1I

HES 505 Fall 2022: Session 9

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Your final project

- At least 5 datasets total (1 tabular, 1 vector, 1 raster, and 2 of your choosing)
- Choose 1 statistical approach to address your research question
- Visualizations - minimum of 3. 1 location map; the others should help address your question
- Submission formats
- A note about your discussion

Today's Plan

E 47th St
47th Street (Kenwood)
E Hyde Park Blvd
51st / 53rd Street (Hyde Park)
E 53rd St
E 55th St
55th - 56th - 57th Street
E 57th St
59th Street, University of Chicago
Washington Park
E Garfield Blvd
Morgan Dr
S Cottage Grove Ave
S Woodlawn Ave
S Dr Martin Luther King Jr Dr
South Michigan Avenue
S Indiana Avenue
S State St
Midway Plaisance

Objectives

By the end of today, you should be able to:

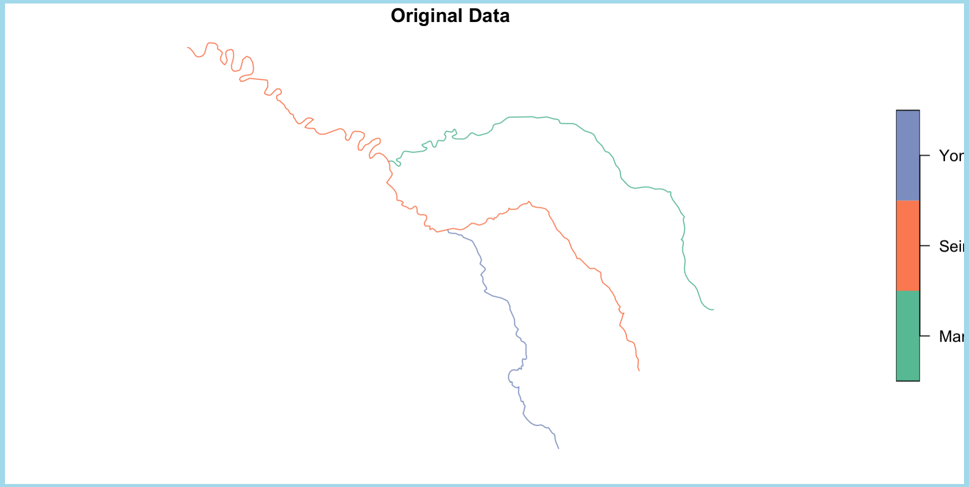
- Complete a workflow for identifying and remedying invalid geometries
- Describe the various unary, binary, and n-ary transformers
- Use predicates and `dplyr::filter` to subset spatial data

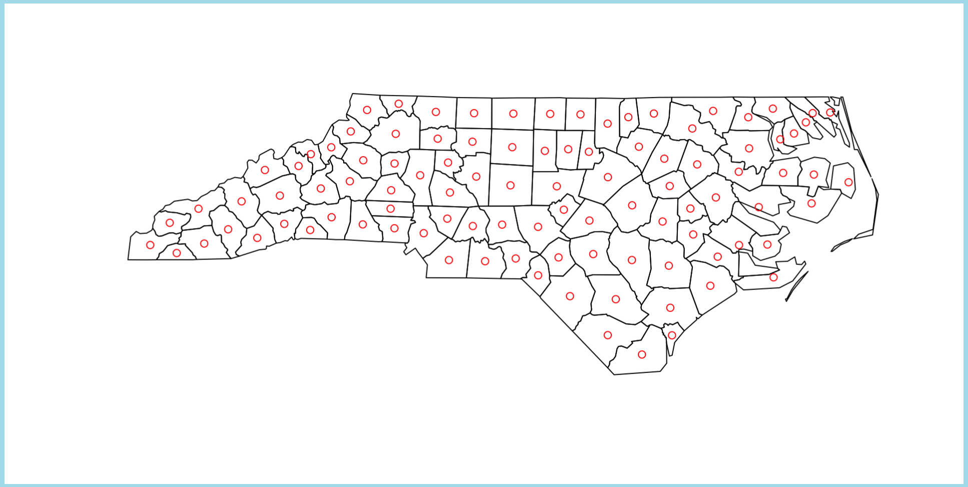
Revisiting `predicates` and `measures`

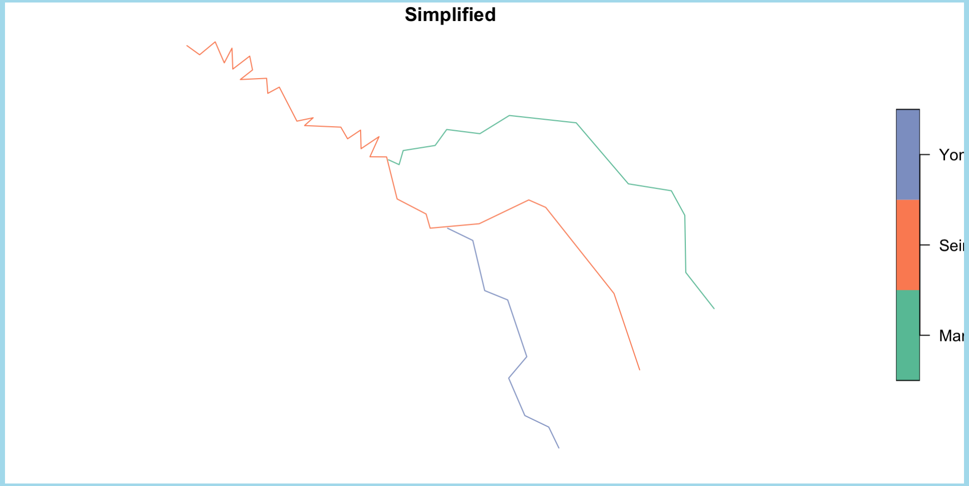
- **Predicates**: evaluate a logical statement asserting that a property is TRUE
- **Measures**: return a numeric value with units based on the units of the CRS
- Unary, binary, and n-ary distinguish how many geometries each function accepts and returns

Transformations

- **Transformations**: create new geometries based on input geometries


Original Data
Yor
Sei
Mar




Simplified
Yor
Sei
Mar

Unary Transformations

transformer	**returns a geometry …**
`centroid`	of type `POINT` with the geometry's centroid
`buffer`	that is this larger (or smaller) than the input geometry, depending on the buffer size
`jitter`	that was moved in space a certain amount, using a bivariate uniform distribution
`wrap_dateline`	cut into pieces that do no longer cover the dateline
`boundary`	with the boundary of the input geometry
`convex_hull`	that forms the convex hull of the input geometry
`line_merge`	after merging connecting `LINESTRING` elements of a `MULTILINESTRING` into longer `LINESTRING`s.
`make_valid`	that is valid
`node`	with added nodes to linear geometries at intersections without a node; only works on individual linear geometries
`point_on_surface`	with a (arbitrary) point on a surface
`polygonize`	of type polygon, created from lines that form a closed ring

Unary Transformations (cont'd)

transformer	returns a geometry …
`segmentize`	a (linear) geometry with nodes at a given density or minimal distance
`simplify`	simplified by removing vertices/nodes (lines or polygons)
`split`	that has been split with a splitting linestring
`transform`	transformed or convert to a new coordinate reference system (chapter @ref(cs))
`triangulate`	with Delauney triangulated polygon(s) (figure @ref(fig:vor))
`voronoi`	with the Voronoi tessellation of an input geometry (figure @ref(fig:vor))
`zm`	with removed or added `Z` and/or `M` coordinates
`collection_extract`	with subgeometries from a `GEOMETRYCOLLECTION` of a particular type
`cast`	that is converted to another type
`+`	that is shifted over a given vector
`*`	that is multiplied by a scalar or matrix

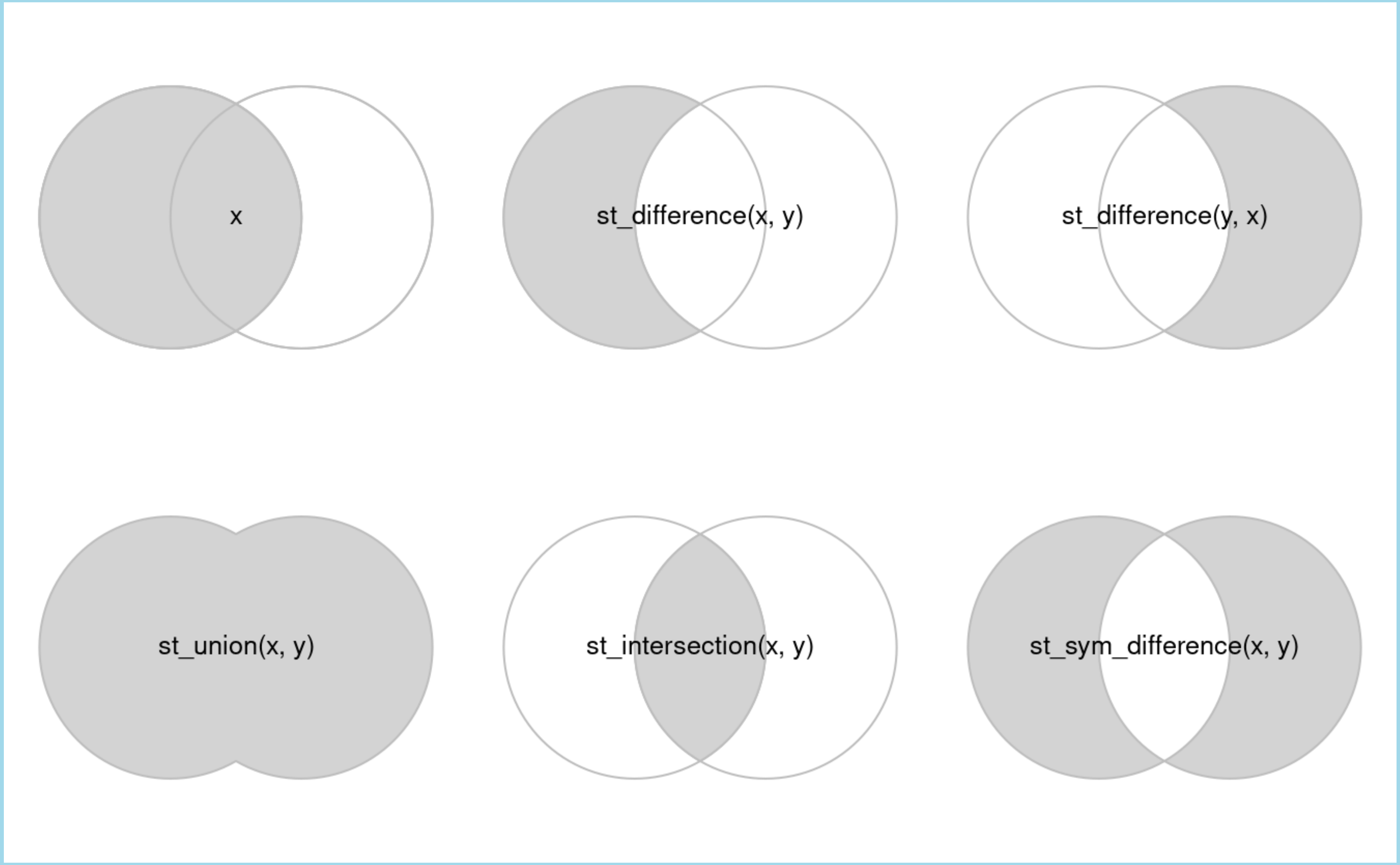
Common uses of Unary Transformers

- Creating valid geometries
- Reprojecting your data
- Combining or changing geometries

Binary Transformers

function	returns	infix operator
`intersection`	the overlapping geometries for pair of geometries	`&`
`union`	the combination of the geometries; removes internal boundaries and duplicate points, nodes or line pieces	`|`
`difference`	the geometries of the first after removing the overlap with the second geometry	`/`
`sym_difference`	the combinations of the geometries after removing where they intersect; the negation (opposite) of `intersection`	`%/%`
`crop`	crop an sf object to a specific rectangle	

Binary Transformers



Common Uses of Binary Transformers

- Relating partially overlapping datasets to each other
- Reducing the extent of vector objects

N-ary Transformers

- Similar to Binary (except `st_crop`)
- `union` can be applied to a set of geometries to return its geometrical union
- `intersection` and `difference` take a single argument, but operate (sequentially) on all pairs, triples, quadruples, etc.

Subsetting Data

Subsetting Data

- Often want to restrict analyses to particular locations
- Can combine `predicates` with `[]` to subset based on geography
- Can also use `dplyr::filter` and `dplyr::select` to subset using attributes

Using `predicates`

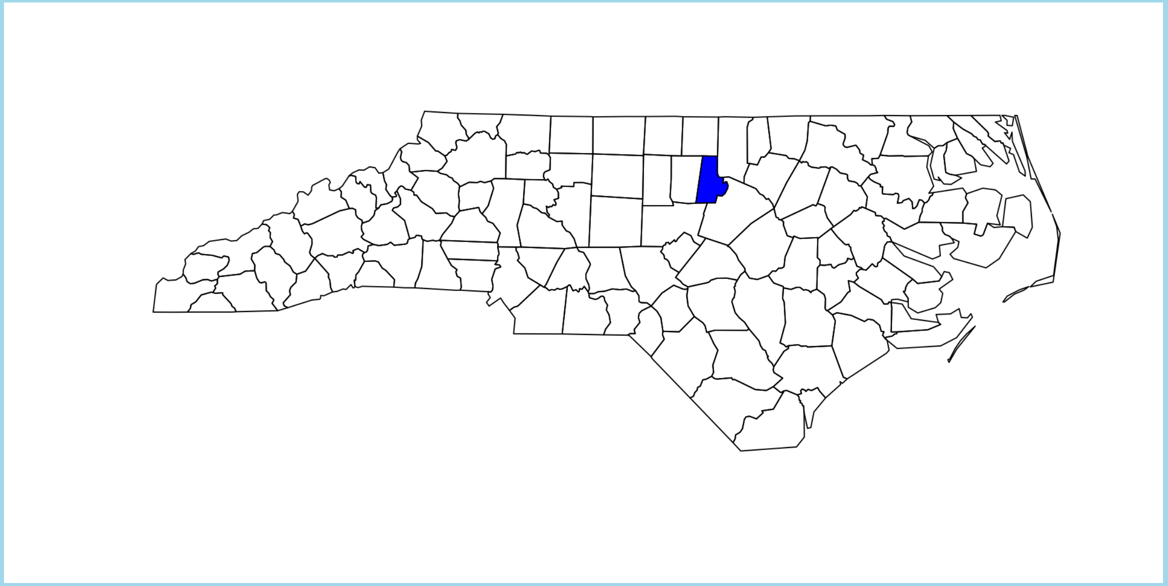
- Can combine `predicates` with `[]` to subset based on topological relations
- `x[y, , op = st_intersects]`
- `st_filter( x = x, y = y, .predicate = st_intersects)`

Using `dplyr`

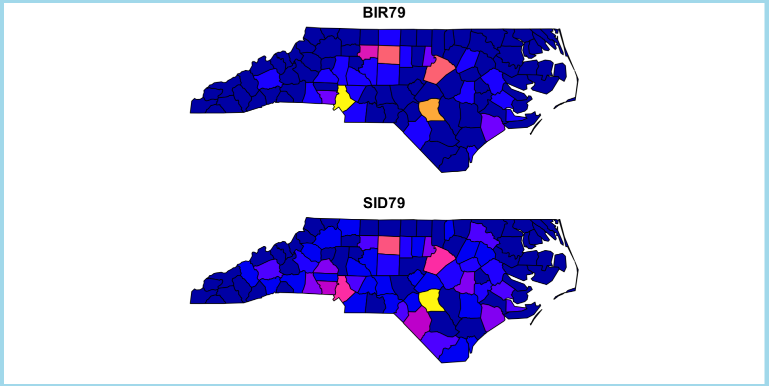
- `filter` returns rows that match a criteria
- `select` returns columns

```r
library(tidyverse)
durham.cty <- nc %>%
  filter(., NAME == "Durham")
## We can also use the bracket approach
durham.cty2 <- nc[nc$NAME == "Durham",]

plot(st_geometry(nc))
plot(st_geometry(durham.cty), add=TRUE, co
```



```r
nc.select <- nc %>%
  select(., c("BIR79", "SI
plot(nc.select)
```


BIR79
SID79