



LEAFLET & LEAFLETPROXY

OUTLINE

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LEAFLET

FOR INTERACTIVE MAPS

Motivation



Map of the 1854 Cholera outbreak - John Snow

*“‘I have the same problem’ is a famous
last post in many forum-threads on the
esri forum.”*

—[sebastian](#)

**NOT SURE IF ARCMAP IS
LOADING**

OR IF IT CRASHED

“R and Leaflet are free and open-source, ArcMap is very much not.”

—Geoffrey Arnold

Shapefiles

In R

PACKAGES

- ▶ Install these packages:

- ▶ rgdal:

- <https://github.com/cran/rgdal/blob/master/inst/README>

- ▶ rgeos

- ▶ sf

- ▶ leaflet

- ▶ leaflet.extras

WHAT IS LEAFLET?

- ▶ R version of the Javascript API of Leaflet
- ▶ One of the ways to get interactive maps
 - ▶ Others include: tmap, mapview and plotly
- ▶ Documentation: <https://rstudio.github.io/leaflet/>

Getting spatial
data loaded into R

LOADING SPATIAL DATA

- ▶ Sometimes your source data will be a data frame which you will need to join to spatial data, other times it will be included
- ▶ It may also be a CSV with coordinates, in those instances no further cleaning needs to take place



DEMO

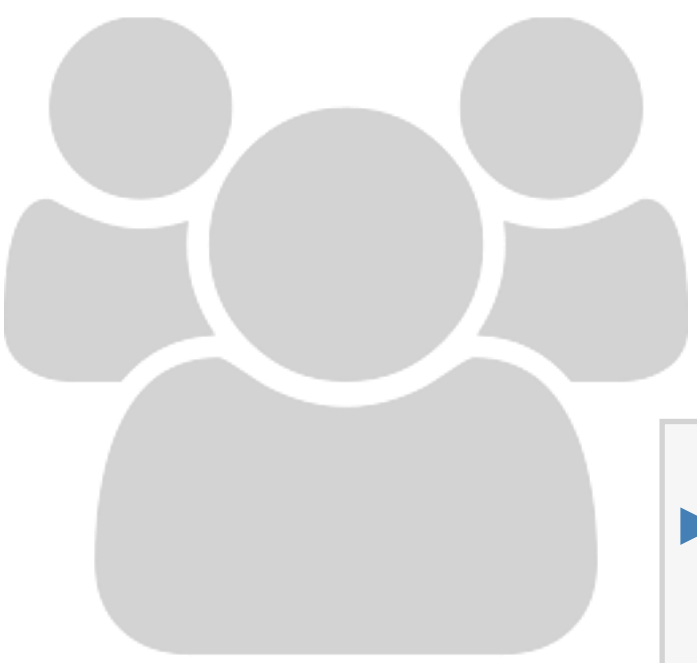
leaflet_examples.Rmd
Go to loading code chunk

Shapes

TYPICAL ARGUMENTS

- ▶ lng (if a column)
- ▶ lat (if a column)
- ▶ layerId
- ▶ group (for layerControls)
- ▶ stroke (boolean, shape outline)
- ▶ color (outline color, hex values)
- ▶ weight (outline width)
- ▶ opacity (alpha of the line)
- ▶ fill (boolean)
- ▶ fillColor (hex color)
- ▶ fillOpacity (alpha of fill)
- ▶ And more!

EXERCISE



- ▶ Using the example cds to create a polygon layer
 - ▶ Make sure to include a basemap

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SOLUTION

See leaflet_exercises_solutions.Rmd

```
leaflet(data = cds) %>%  
  addProviderTiles("Stamen.Toner") %>%  
  addPolygons()
```


PALETTES

- ▶ `palette` (color brewer palette)
- ▶ `domain` (values to be colored)
- ▶ `na.color`
- ▶ `alpha`
- ▶ `reverse` (values of palette)
- ▶ `bins`
- ▶ `pretty`
- ▶ `right` (for cutting)
- ▶ `n` (number of quantities)
- ▶ `probs`
- ▶ `levels`
- ▶ `ordered`

LEGENDS

- ▶ `position` (“bottomright” etc...)
- ▶ `pal` (palette from `colorBrewer`)
- ▶ `values` (domain from data)
- ▶ `na.labels`
- ▶ `bins` (buckets)
- ▶ `colors`
- ▶ `labFormat` (separate function `labelFormat`)
- ▶ `title`
- ▶ `className` (for custom CSS to apply)
- ▶ `layerId` (for input usage)
- ▶ `group` (for `layerControls`)
- ▶ `digits`
- ▶ `big.mark`
- ▶ `transform` (function to be applied to labels)

EXERCISE



- ▶ Choropleth Polygon map with
 - ▶ Create a color palette for Life Expectancy at Birth (years) column in the merged Congressional District data.
 - ▶ addPolygons to a leaflet map and apply palette to column
 - ▶ Stretch goal: Add a legend

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Hint: <https://rstudio.github.io/leaflet/choropleths.html>

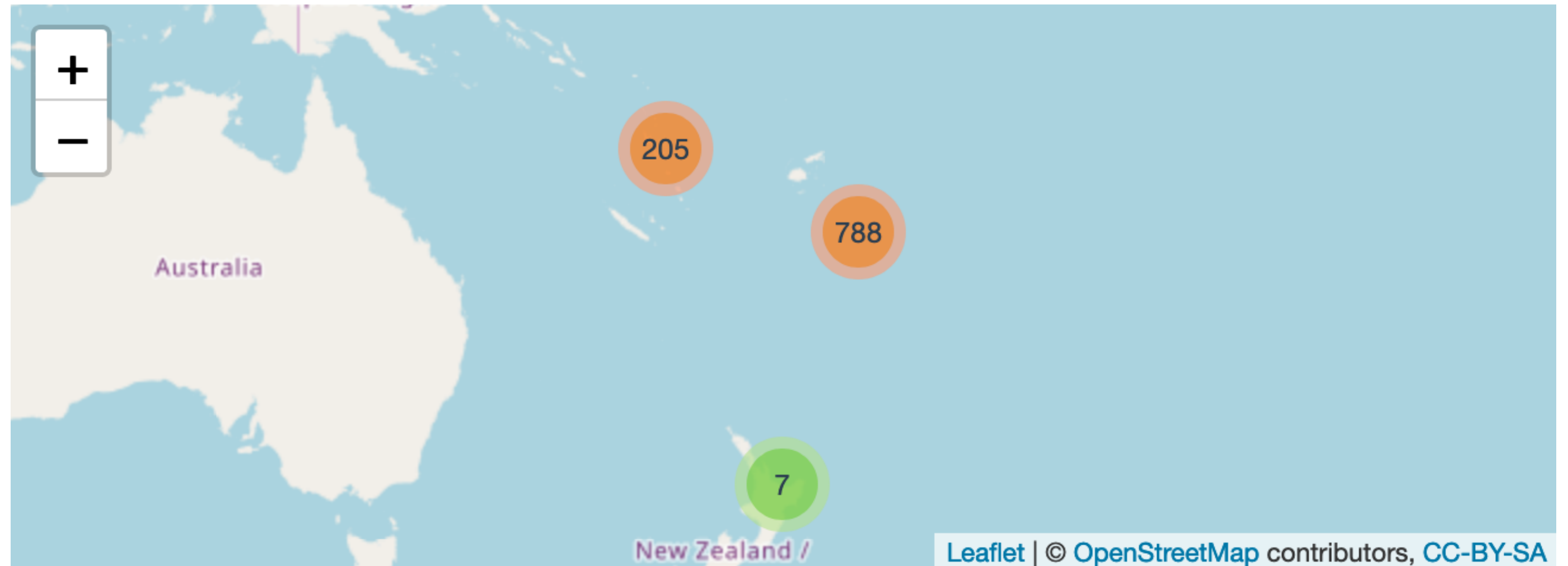


DEMO

leaflet_examples_solutions.Rmd
(uploaded to GitHub after class)
Go to polygon code chunk

CLUSTERS

```
leaflet(quakes) %>%  
  addTiles() %>%  
  addMarkers(  
    clusterOptions =  
    markerClusterOptions()  
  )
```



WHY CLUSTERS?

- ▶ Sometimes there's just a ton of data to show and trying to visualize them will bring any browser window it a crawl.
- ▶ Example:
<https://pittsburghpa.shinyapps.io/TreesNAt/>

EXERCISE



- ▶ Go to leaflet_exercises.Rmd clusters code chunk
 - ▶ Use 311 data to create a cluster map
 - ▶ Create a factor palette
 - ▶ Create a legend
 - ▶ Make sure to include a basemap

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Hint: <https://rstudio.github.io/leaflet/markers.html>



SOLUTION

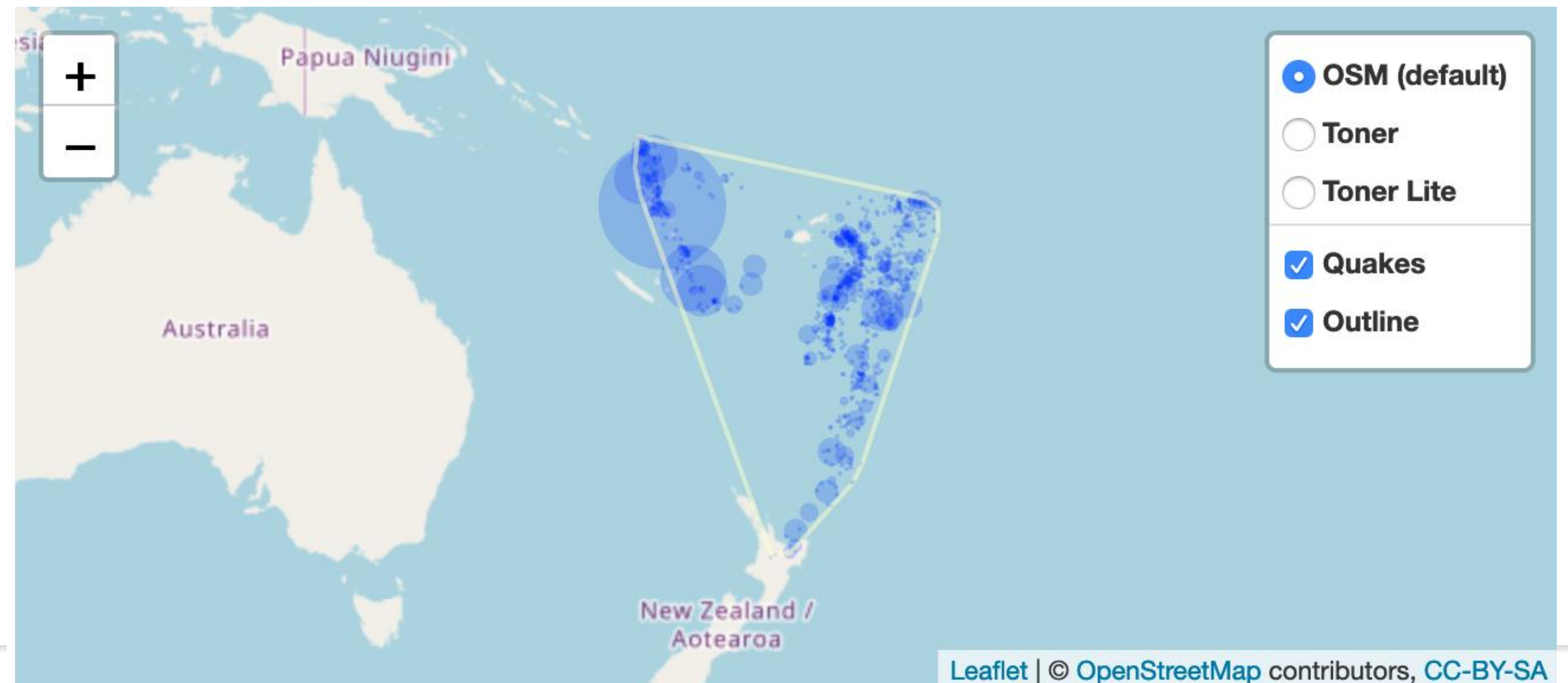
Go to `leaflet_exercises_solutions.Rmd`

GROUP CONTROLS

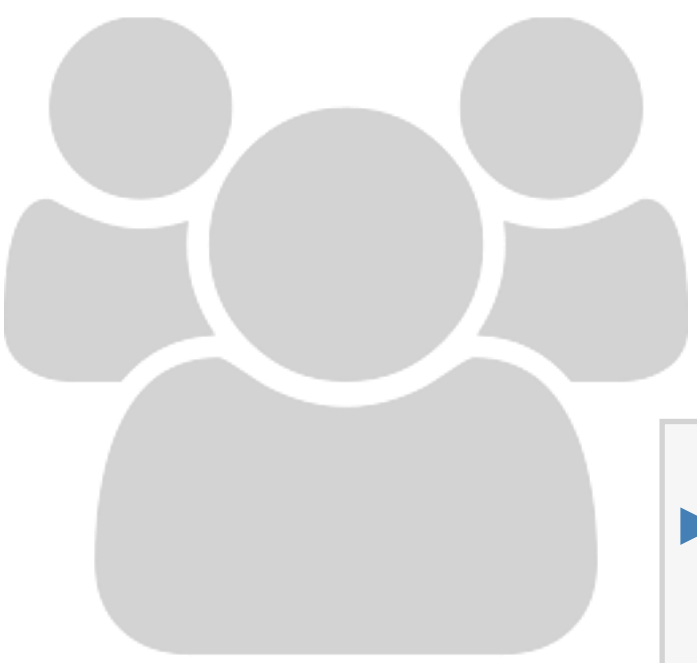
In leaflet you can add groups and give them a name.

Group names are what show up in the layer control

```
addProviderTiles(providers$Stamen.Toner, group = "Toner") %>%  
addLayersControl(  
  baseGroups = c("OSM (default)", "Toner", "Toner Lite"),  
  overlayGroups = c("Quakes", "Outline"),  
  options = layersControlOptions(collapsed = FALSE)  
)
```



EXERCISE



- ▶ Create a map with layer controls
 - ▶ Get basemap provider names from here: <https://leaflet-extras.github.io/leaflet-providers/preview/>
 - ▶ Create 3 named basemap groups
 - ▶ Add a layer control that has the named base groups

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SOLUTION

Go to `leaflet_exercises_solutions.Rmd`

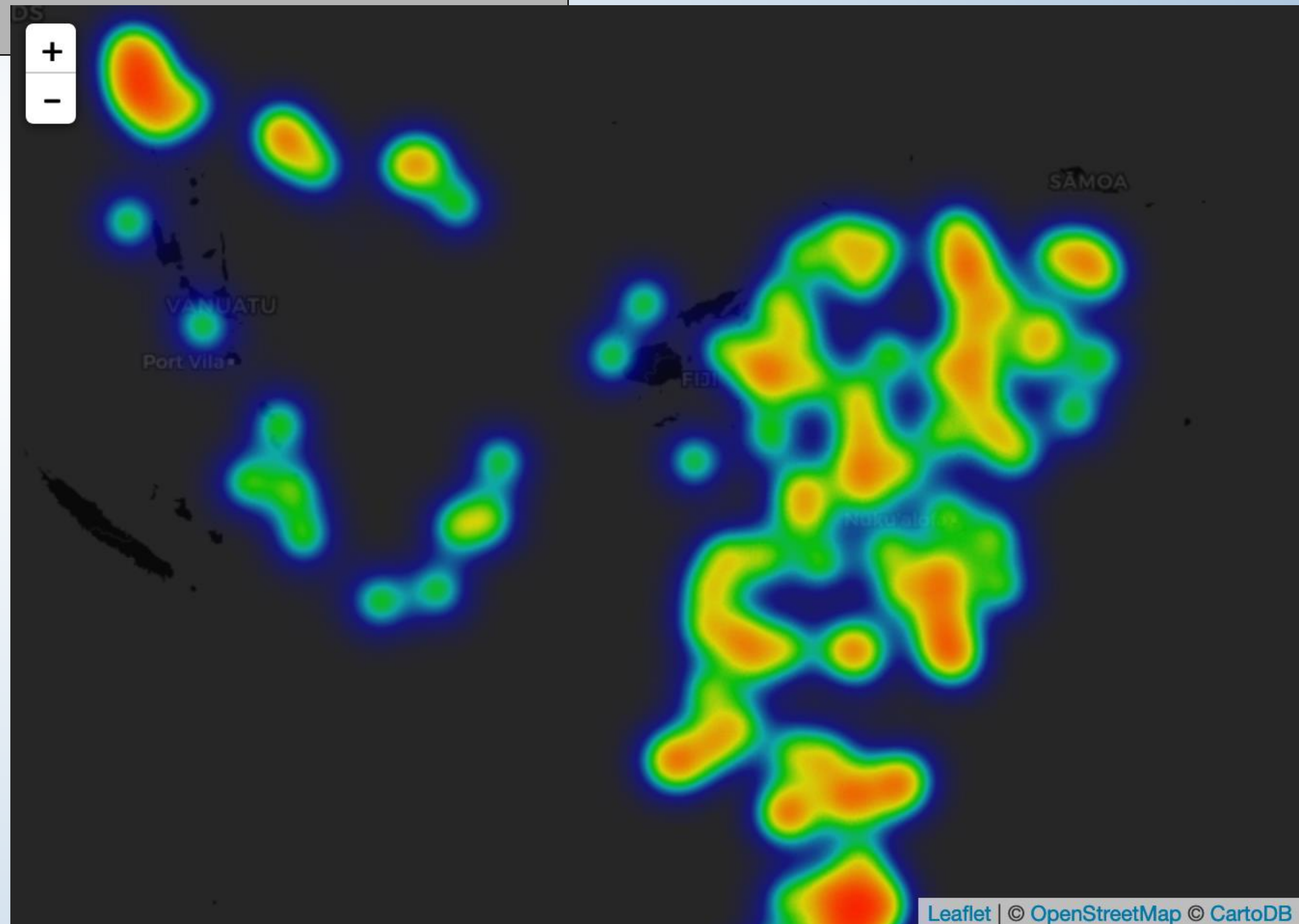
leaflet

.extras

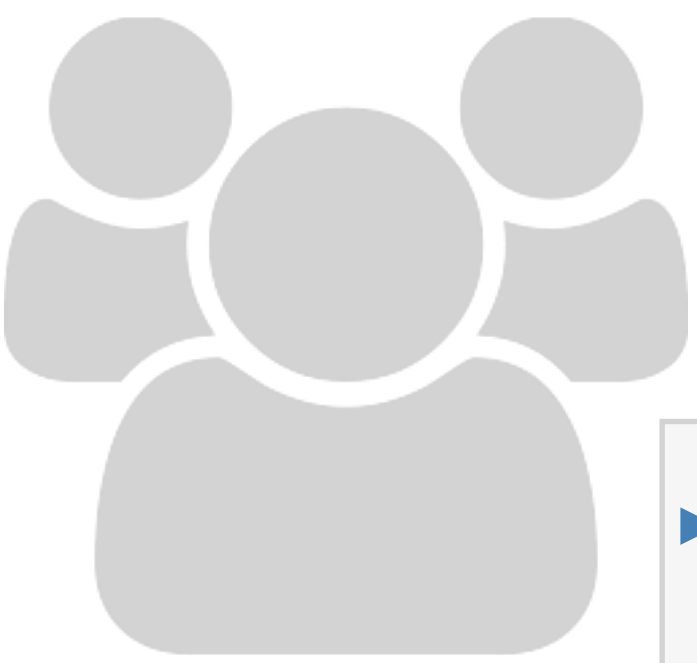
LEAFLET.EXTRAS

- ▶ Adds some pretty nice functions to complement leaflet
 - ▶ Tile caching: <http://rpubs.com/bhaskarvk/TileLayer-Caching>
 - ▶ weather icons: <http://rpubs.com/bhaskarvk/leaflet-weather>
 - ▶ Pulse icons: <http://rpubs.com/bhaskarvk/leaflet-pulseicon>
 - ▶ and heat maps!


```
leaflet(quakes) %>%  
addProviderTiles(providers$CartoDB.DarkMatter) %>%  
  setView( 178, -20, 5 ) %>%  
  addHeatmap(lng = ~long, lat = ~lat, intensity = ~mag,  
    blur = 20, max = 0.05, radius = 15)
```



EXERCISE



- ▶ Using the pothole data create a heat map
 - ▶ This won't be very different from your cluster map from before.
 - ▶ Play around with the arguments for heat maps and find a radius that looks good.
- ▶ Compare your outcome with your neighbor

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LEAFLETPROXY

Leaflet

In Shiny

JUST LIKE ANY OTHER OUTPUT

- ▶ You need a render function and a subsequent output in the UI
- ▶ Reacts to reactive functions and inputs like any other plot
- ▶ However, it will take much longer to render than a typical ggplot2 graph.

What we know
about reactivity

REVIEW: OBSERVERS

- Use to execute actions based on changing reactive values and other reactive expressions.
- Doesn't return a value. So performing side effects is usually the only reason you'd want to create one of these.
- Eagerly executed by Shiny.

```
observe({  
  print(paste("The value of x is", input$x))  
})
```

```
## [1] The value of x is 10  
## [1] The value of x is 16  
## [1] The value of x is 9
```

OBSERVERS IN LEAFLET

Observers in leaflet can do a number of thing

- ▶ Move the map (fitBounds,)
- ▶ Remove specific markers/shapes/lines (removeShape...)
- ▶ Remove entire groups
- ▶ Change the basemap
- ▶ And more!

LEAFLET PROXY

- ▶ Inside an observer target the map with the `leafletProxy()` function
- ▶ Clear the group before re-adding it
- ▶ Note: This doesn't really work well with `clusterOptions`.

```
leafletProxy("map") %>% # this should be the main map id  
  clearGroup("groupName") %>%  
  addMarkers(markersReactive(), group = "groupName" ...)
```


EXERCISE



- ▶ Open `/apps/green_inf.R`
 - ▶ Right now this application re-runs the entire map every time a change is made to an input.
 - ▶ Make a new observer expression that only edits the layer of green infrastructure projects, and does not reload the entire map itself.

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SOLUTION

apps/green_inf_proxy_01.R

WHAT ABOUT SHAPES?

- ▶ You can do this with shapes too!
- ▶ It works the same way as points. This is also true for any other layer type, lines, heat maps etc.

EXERCISE



- ▶ Open `/apps/green_inf_proxy_01.R`
 - ▶ Add a new reactive expression that selects the polygon of the selected borough
 - ▶ Add a new observer that adds the selected borough to the map as well.

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SOLUTION

apps/green_inf_proxy_02.R

Inputs and Events

USES FOR INPUTS

- ▶ Sometimes you might need to have things happen based off of user inputs or map bounds
- ▶ Charts showing information based off of what is within the map bounds
- ▶ Showing details/plots of a selected item

Inputs/Events

Object Events

Object event names generally use this pattern:

input\$MAPID_OBJCATEGORY_EVENTNAME.

Trigger an event changes the value of the Shiny input at this variable.

Valid values for **OBJCATEGORY** are *marker*, *shape*, *geojson* and *topojson*.

Valid values for **EVENTNAME** are *click*, *mouseover* and *mouseout*.

All of these events are set to either *NULL* if the event has never happened, or a *list()* that includes:

- * *lat* The latitude of the object, if available; otherwise, the mouse cursor
- * *lng* The longitude of the object, if available; otherwise, the mouse cursor
- * *id* The *layerId*, if any

GeoJSON events also include additional properties:

- * *featureId* The feature ID, if any
- * *properties* The feature properties

Map Events

- input\$MAPID_click** *when the map background or basemap is clicked*
value -- a list with lat and lng
- input\$MAPID_bounds** *provide the lat/lng bounds of the visible map area*
value -- a list with north, east, south and west
- input\$MAPID_zoom** *an integer indicates the zoom level*

leaflet.pdf cheatsheet

INPUTS GENERATED

In all of these examples “leaflet” is whatever you called your (ie: `output$leaflet`). These are the kinds of things you may want to hide from your bookmarking.

- `input$leaflet_center`
 - `$lat`, `$lng`
- `input$leaflet_zoom`
- `input$leaflet_bounds`
 - `$north`, `$east`, `$south`, `$west`
- `input$leaflet_marker_mouseout$`
 - `$id`, `$group`, `$lat`, `$lng`
- `input$leaflet_marker_click$`
 - `$id`, `$group`, `$lat`, `$lng`
- `input$leaflet_groups` (list of active group names)



DEMO

<http://shiny.rstudio.com/gallery/superzip-example.html>

USING PROXY

- ▶ Unlike ggplot2 compute time for a leaflet map is time consuming.
- ▶ The leafletProxy function and observers allow us to only change the parts of the map that are necessary
 - ▶ This saves computing power and speeds up rendering
 - ▶ It also keeps the user from having to deal with a resetting map

EXERCISE



- ▶ Open apps/green_inf_proxy_02.R
 - ▶ Let's create a UI element that shows the user the number of projects they are viewing.
 - ▶ Hint: Check the code from [superzip](#) and see how they used the bounds input
 - ▶ Note: I added some lines to this app that creates the coordinates as variables in the @data frame.

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SOLUTION

```
apps/green_inf_proxy_03.R
```


REACTIVE VALUES REVIEW

- Like an R environment object (or what other languages call a hash table or dictionary), but reactive
- Like the `input` object, but not read-only

```
rv <- reactiveValues(x = 10)  
rv$x <- 20  
rv$y <- mtcars
```

REACTIVE VALUES REVIEW CONT.

- Reading a value from a `reactiveValues` object is a reactive operation.
 - The act of reading it means the current reactive conductor or endpoint will be notified the next time the value changes.
- Maybe surprisingly, setting/updating a value on a `reactiveValues` object is *not* in itself a reactive operation, meaning no relationship is established between the current reactive conductor or endpoint (if any!) and the `reactiveValues` object.

EXERCISE



- ▶ Open `/apps/green_inf_proxy_03.R`
 - ▶ Add a reactive list to store removed projects
 - ▶ Edit the reactive expression to remove projects that have been removed by the user
 - ▶ Hint: append stored values in a reactive list
- ▶ Stretch Goal: add a function that restores the

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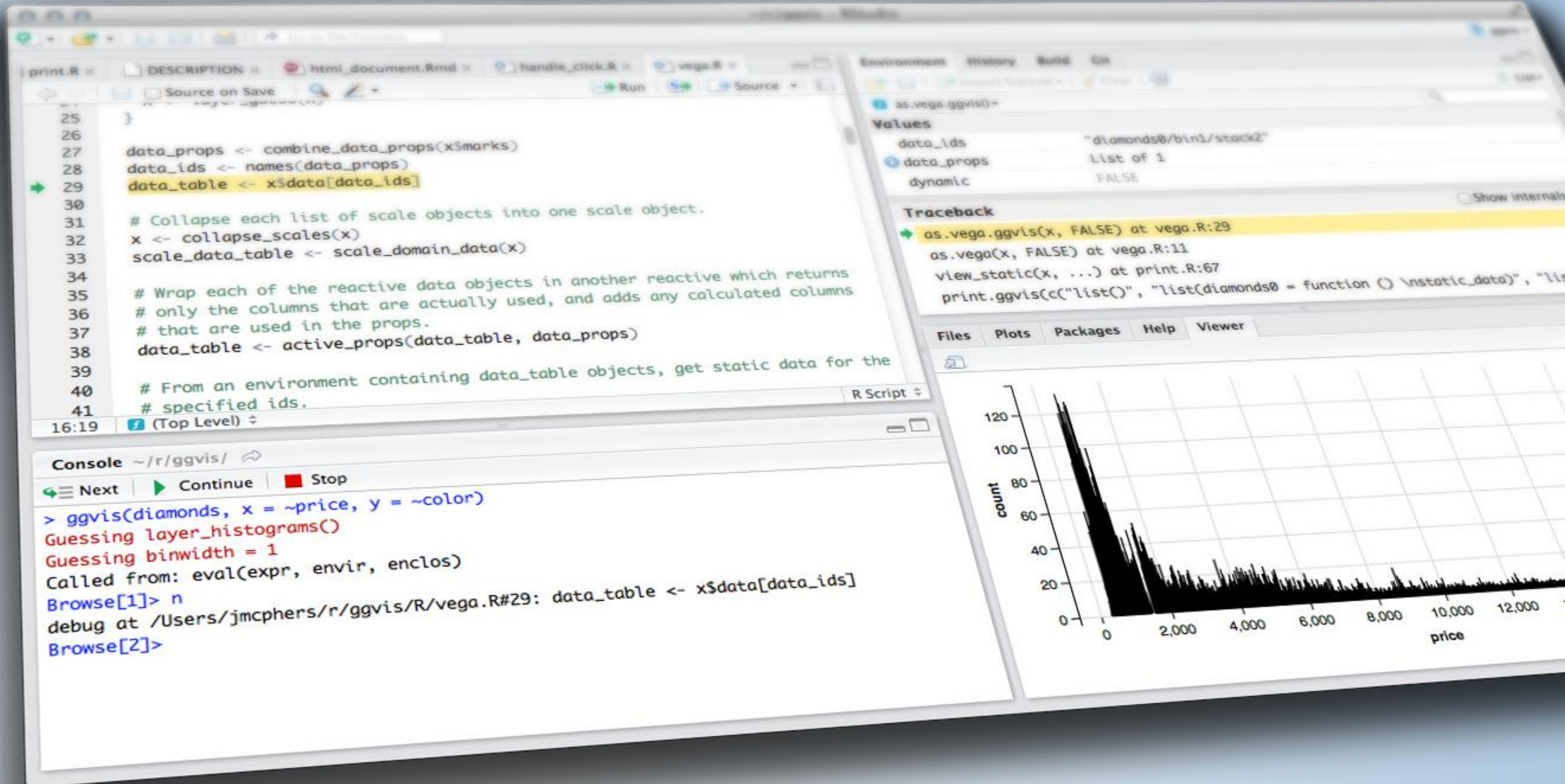


SOLUTION

apps/green_inf_proxy_04.R

OTHER CONCEPTS TO RECALL

- ▶ Refresh limits on LeafletProxy maps are a very good idea
- ▶ Keep in mind that add ons like layer controls mean you don't have to build tons of functionality into your app
- ▶ You can target individual shapes if you give them an id, just like row number in DT package



LEAFLETPROXY

FINAL PROJECT



[Final Project](#)