Web Map Layer Cake
Teaching Web Mapping Skills with Leaflet for R

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NUTRITION INFORMATION

Web maps, or interactive maps, are tools for both data exploration and communication. Leaflet is a popular JavaScript library for interactive maps; however, to master it, users need basic knowledge of HTML, CSS, and JavaScript. In this session, students learn Leaflet for R, an R package that makes it easy to integrate and control Leaflet maps in R without knowledge of JavaScript. They learn how to create an interactive web map and, equally importantly, are encouraged to think critically about the decisions they make that determine the way a web map is designed, displayed, and communicated. As a result of this process, they will choose a final format that suits their purposes: for example, an R Markdown file or an HTML file.

TARGET AUDIENCE AND NUMBER SERVED

Graduate students across disciplines who are familiar with the R environment and interested in creating web maps to explore data and communicate their research. Number served: about 20.

LEARNING OUTCOMES

After this workshop, students will be able to
- describe introductory concepts of web mapping, including map tiles and pop-ups
- create a simple interactive web map using Leaflet for R
- create an R Markdown file and publish it as a GitHub page (see figure 1)
- identify and defend standard decisions

Your First Leaflet Map in R!

Here are the core components: - a basemap - your data (markers, pop ups, points/lines/polygons, raster images, analysis)

Let's start with a basemap and a marker with a popup.

```
m <- leaflet() %>% # Creates a leaflet map widget
  addTiles() %>%   # Adds a default OpenStreetMap map tiles as the basemap
  addMarkers(lng=-123.085269, lat=49.281178, popup="Prototype Cafe; on the want-to-try list") # Adds the marker and the popup together
m  # Prints out the map
```
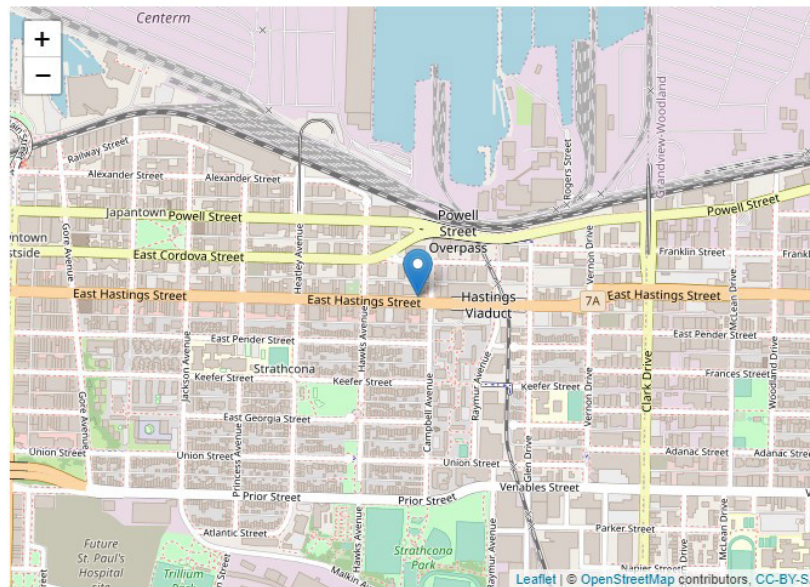
FIGURE 1
Screenshot of the finished GitHub page (converted from a R Markdown file and hosted on GitHub)

made when publishing a web map, e.g. who the target audience is and what the most suitable format for communicating the map to the target audience is

COOKING TIME
Prep time: 120 minutes for instructor, 10 minutes for students
Cook time: 120 minutes
Total time: 250 minutes

DIETARY GUIDELINES
The session ties into the frames Information Creation as a Process and Scholarship as Conversation from ACRL's *Framework for Information Literacy for Higher Education*, with necessary adaptation to the geospatial data context. Information Creation as a Process recognizes the evolving landscape of information creation and formats of research delivery. Leaflet, a web mapping API, is a new(ish) way of creating information and sharing research in the form of web maps. This workshop supports many of the concepts within this frame.

Leaflet also allows students to step away from being information consumers and to assume the role of creators and to learn by doing. This also allows students to "see themselves as contributors to scholarship rather than only consumers of it,"[1] which is one of the dispositions of the frame Scholarship as Conversation.

INGREDIENTS
• Presentation slides

• Access to R and RStudio on lab or students' personal computers
• An R Markdown file (.Rmd) that contains code chunks, text explaining the code, and web maps
• A GitHub repository that contains an R Markdown file and an HTML file that the .Rmd file is converted to, shapefiles or other data sets
• A web page published as a GitHub page (same contents as the R Markdown file)

PREPARATION
Instructor:
• Find a shapefile from an open data portal (e.g., https://opendata.vancouver.ca/pages/home/, which is also linked from the GitHub page included in this chapter).
• In RStudio, create an R Markdown file (.Rmd) that contains code chunks, text explaining the code, and web maps.
• In RStudio, knit the R Markdown file to a HTML file.
• Create a GitHub repository (repo), upload the .Rmd file, HTML file, and shapefile or other data sets to the repo.
• Rename the HTML file as index.html.
• Publish the repo as a GitHub page.

Students:
• Install RStudio and R.
• Install the package Leaflet for R.
• Register for a GitHub account.

INSTRUCTIONS
1. Provide a short theoretical introduction to basic concepts: web maps and how they differ from other maps, map tiles and geojson, Leaflet and Leaflet for R.
2. Working in RStudio, demonstrate the following and have the students complete each step along with you:
   » how to write code
   » how to initiate a Leaflet Map in R
   » how to tweak Map Attributes (including zoom levels, pop-ups, and basemap) (See figure 2)
   » how to change a marker
   » how to add data (WMS and shapefile)
3. Ask students to create an R Markdown file in RStudio and add code chunks, text, and headings.
4. Knit the R Markdown file to an HTML file and have the students do the same.
5. Lead the students through the following: Create a GitHub repository (repo), upload the .Rmd file, HTML file, and the shapefile or other data sets to the repo; rename the HTML file as index.html; publish the repo as a GitHub page.
6. Mix in the following active learning activity to explore the decisions a researcher makes when creating a web map:

Think-Pair-Share
• Instruct students to *think* about the following for a few minutes on their own, writing down some notes:

   Think about the target audience for your web map. Is this a map for the general public or for other researchers who are experts in your subject area? How does the

Tweaking Map Attributes

Let's talk about zoom levels on a tile. For Open Street Maps, these levels run from 0 to 20

```
t1 <- leaflet(options = leafletOptions(minZoom = 7, maxZoom = 18)) %>%
  addTiles() %>%
  addMarkers(lng=-123.085269, lat=49.281178, popup="Prototype Cafe; on the want-to-try list")
t1
```
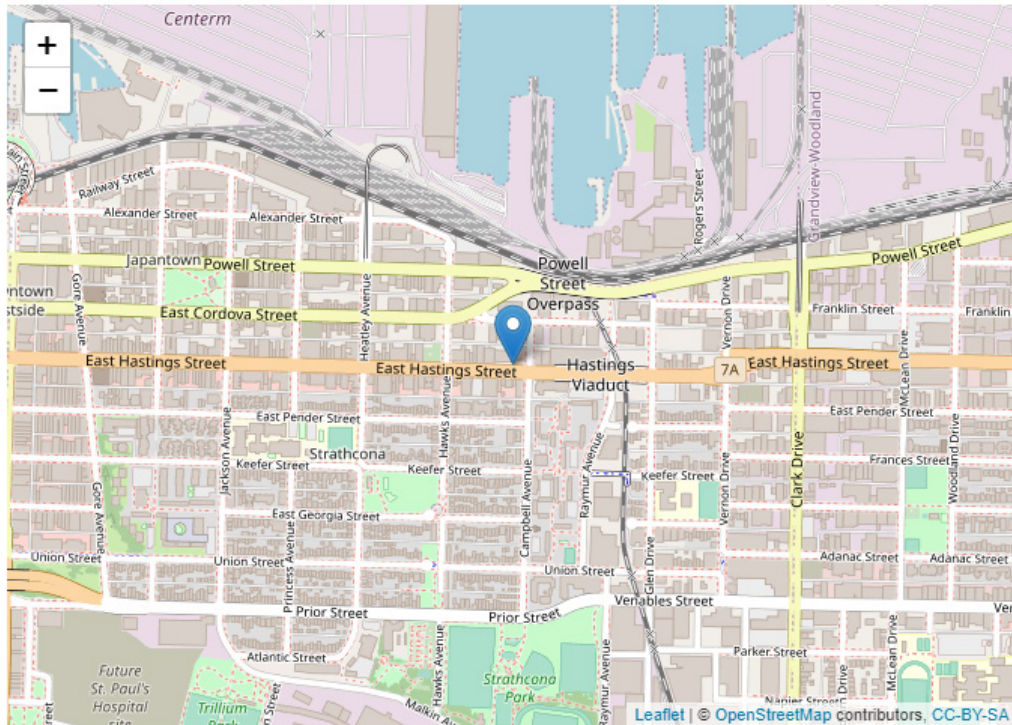

FIGURE 2
Screenshot of the finished GitHub page: how to tweak Map Attributes (zoom levels)

intended audience impact how you design, display, and communicate your web map?

- *Pair.* Have the students pair up and share and discuss their thoughts with a partner.

- *Share.* Facilitate a mini-discussion where pairs share what they discussed.

If conversations stall, add prompting questions to the mix:

– How can an R Markdown file (or a web page when knitted to HTML and hosted on GitHub) facilitate communication with other researchers?

– Would the above approach suit the purpose of communicating with the general public? If not, how would you use your web map?

– What other elements should you consider in designing a web map? For example, how much information in a pop-up should you include? Would you include working data?

REVIEWS/ASSESSMENT STRATEGY

Have the students access a Google Form at the end of the session with the following questions:
Think about today's session…

1. What is one thing you learned today?
2. Is there anything you are confused about? If yes, what?
3. What is one thing you want to learn more about?

CHEF'S NOTES

For each chunk of demoing and playing around with code, leave enough time for students to try out the code and ask questions. The session is designed in a way that makes sure that students with minimal R experience can succeed.

The recipe preparation for this workshop—creating an R Markdown file, knitting it to HTML, and hosting it as a GitHub page—serves two purposes:

1. It provides all the code so that any stu-

dents struggling to have a chunk of code yield expected results can copy and paste the code into RStudio and actually create something without giving up.
2. It provides an example of the end product of the workshop, demonstrating how to use an R Markdown file containing web maps for communication.

Please refer to "Web Mapping with R" by Aateka Shashank for reference.

ADAPTING THE RECIPE
This workshop can be delivered in person or online.

ADDITIONAL RESOURCES
Shashank, Aateka "Web Mapping with R." November 27, 2020. https://aticup.github.io/webmapr/.

NOTE
1.   Association of College and Research Libraries, *Framework for Information Literacy for Higher Education*, (Chicago: Association of College and Research Libraries, 2016), https://www.ala.org/acrl/standards/ilframework.