

Creating web apps for interactive data visualization with R Shiny

A Tufts TIDAL workshop from the Data Intensive Studies Center (DISC)

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<https://karink520.github.io/intro-r-shiny-workshop/>

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If you're here early, check out examples of Shiny apps at: <https://shiny.rstudio.com/gallery/>

“Shiny makes it **incredibly easy** to build **interactive web applications** with R. Automatic **"reactive"** binding between inputs and outputs and extensive **prebuilt widgets** make it possible to build **beautiful, responsive, and powerful applications with minimal effort.**”

— the Shiny documentation

TO DO:

1. Open the workshop page and keep the materials handy throughout the session:

<https://karink520.github.io/intro-r-shiny-workshop/>

2. Open RStudio and install Shiny using the command:

```
install.packages("shiny")
```

STRUCTURE OF A SHINY APP

```
library(shiny)
```

```
ui <- ... # Appearance and layout of app
```

```
server <- ... # Code the server needs to run,  
              e.g. draw plots and process data
```

```
shinyApp(ui = ui, server = server)
```

A BASIC TEMPLATE

```
ui <- fluidPage(  
  
)  
  
server <- function(input, output, session) {  
  
}  
  
shinyApp(ui = ui, server = server)
```

LAYOUT AND PANEL FUNCTIONS TO STRUCTURE

- Content as arguments, separated by commas
- Start with `fluidPage()`, `navbarPage()`, or `fixedPage()`
- See [fluidRow\(\)/fluidPage\(\)](#) and [column\(\)](#) docs for more flexibility laying out page on a 12-column grid
- Bootstrap framework

CREATE HTML WITH SHINY

Many html tags have their own Shiny helper function, e.g.:

`a`, `div`, `h1...h6`, `img`, `p`, `span`

HTML tags can also be created with `tags`, e.g.:

`tags$a`, `tags$code`

Some HTML tags have names that would conflict with native R functions so must be accessed within `tags`, rather than with their name alone

CUSTOMIZING CSS

Put a CSS file in WWW subdirectory (contents sent to user's browser)

```
ui = fluidPage( includeCSS("stylesheet.css"),  
  ...
```

ADDING A THEME

```
install.packages("shinythemes")
```

Add a theme argument to fluidPage, e.g:

```
ui = fluidPage(theme = shinytheme("darkly"),  
  ...
```

More about themes: <https://rstudio.github.io/shinythemes/>

BASIC REACTIVITY WITH *INPUT, *OUTPUT, RENDER*

Add inputs (e.g. premade widgets) and outputs to `ui`, each with an id

Inputs and outputs are passed to the server function in a list, accessed by their ids

Connect inputs and outputs with `render*` in the server function

When an input used within `render*` changes, code block re-runs.

WIDGET EXAMPLES

Buttons

Action

Submit

Single checkbox

☒ Choice A

Checkbox group

☒ Choice 1

☐ Choice 2

☐ Choice 3

Date input

2014-01-01

Date range

2017-06-21 to 2017-06-21

File input

Browse... No file selected

Help text

Note: help text isn't a true widget, but it provides an easy way to add text to accompany other widgets.

Numeric input

1

Radio buttons

☒ Choice 1

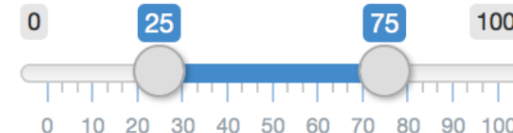
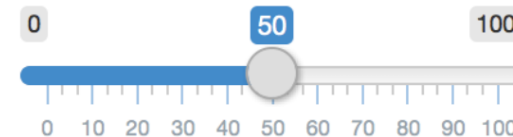
☐ Choice 2

☐ Choice 3

Select box

Choice 1

Sliders



Text input

Enter text...

YOU TRY (EXERCISES)

QUESTIONS, RECAP, PAUSE

NEXT: A DEEPER DIVE INTO REACTIVITY

Including additional functions for more control over reactive behavior

REACTIVITY

- Track dependencies
- Update output when (ideally **only** when!) values that it depends on change
- Reactive code runs in an order depending on the *reactive graph*, the structure of how inputs and outputs are connected

REACTIVITY

- Elements of `input` are *reactive values* created by `*Input` functions. Reactive values get used inside reactive functions like `render*`
- When reactive values are changed they *invalidate*, and code that depends on them may re-run, depending on how it is written.
- Recall that code in a render function reruns whenever anything inside it invalidates

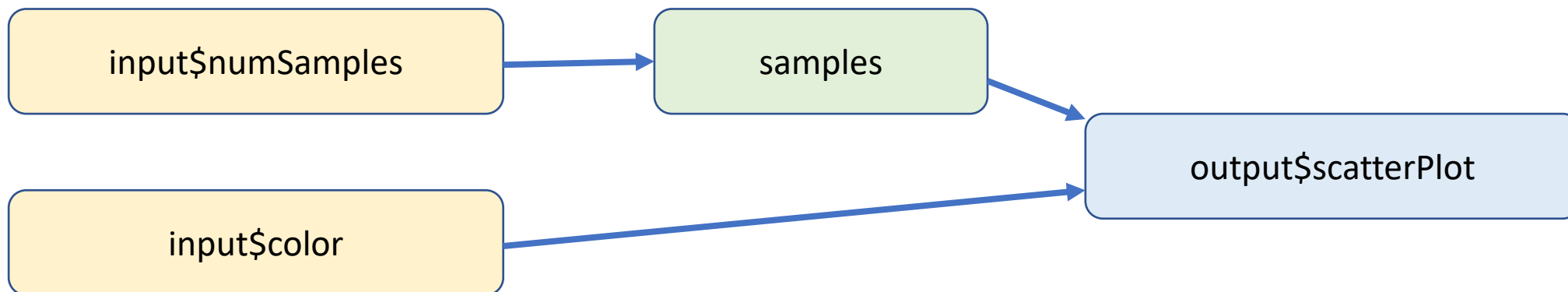
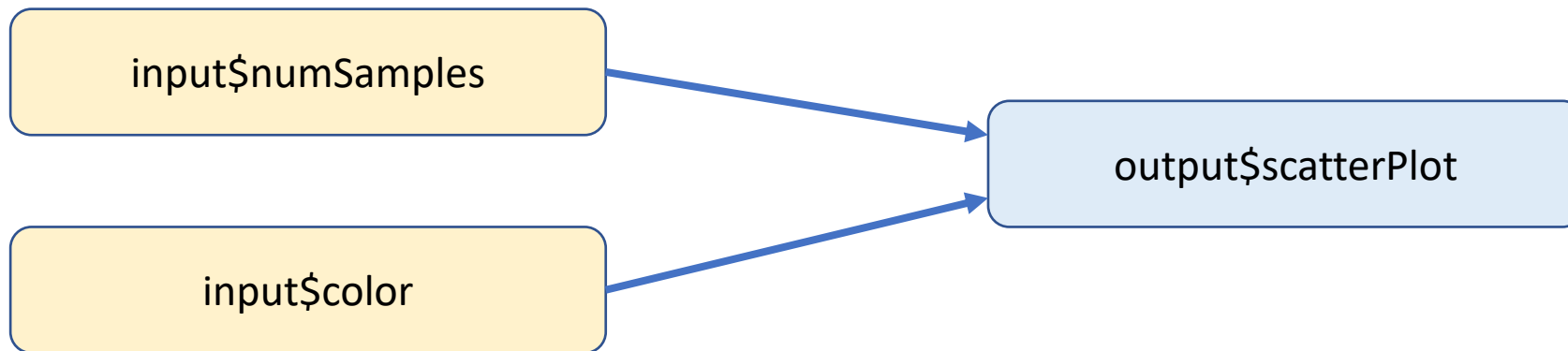
REACTIVE()

Creates and returns a reactive expression

Reactive expression caches its value; reruns if any values it depends on invalidate

Reactive expressions are accessed with function notation - with ():
 name_of_reactive_expression()

Reactive expressions and values must be used inside reactive functions



EVENTREACTIVE()

```
eventReactive(reactiveValue, {code} )
```

Creates and returns a reactive expression

Only reruns if one of the specified reactive values invalidates

Common use case: delaying events

ISOLATE()

Creates a non-reactive value

	Run some code on the server	Create and return something to display
Rerun when <i>*any*</i> reactive value(s) within it change	observe()	render*()
Rerun when <i>*certain*</i> reactive value(s) within it change	observeEvent()	N/A (but you could use isolate() within render* to prevent invalidation of reactive values inside isolate from making the code in render* rerun.)

	Create and return a reactive expression
Invalidates when <i>*any*</i> reactive values within it invalidate	reactive()
Invalidates when <i>*certain*</i> reactive values within it change	eventReactive()
Automatically invalidates after a specified time interval (ms)	reactiveTimer()

Create a non-reactive value
isolate()

Create a list of reactive values
reactiveValues()

DEPLOYING YOUR APP

Shinyapps.io (easiest option, includes free and paid tiers)

Shiny Server (host yourself)

RStudio connect (paid option with more features)

RESOURCES - SHINY

- Tutorials and more: <https://shiny.rstudio.com/tutorial/>
- Function reference: <https://shiny.rstudio.com/reference/shiny/1.4.0/>
- “Cheat Sheet”: <https://rstudio.com/resources/cheatsheets/>
- Book by Hadley Wickham: <https://mastering-shiny.org/>
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RESOURCES – DATA VISUALIZATION

- Fundamentals of Data Visualization by Claus Wilke (general principles, but examples are created in R with ggplot2)
- Data Visualization: A Practical Introduction by Kieran Healy (more explicitly R and ggplot2 focused)