# Interactive Web Applications with RStudio and Shiny

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Big Data Ignite 2016
Grand Rapids, MI

HELLO

my name is

~~Garrett~~

Randy

Strata+Hadoop WORLD

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RStudio

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# Interactive Shiny Applications

built on Big Data

Slides at: bit.ly/rday-nyc-strata15

Shiny

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September 2015

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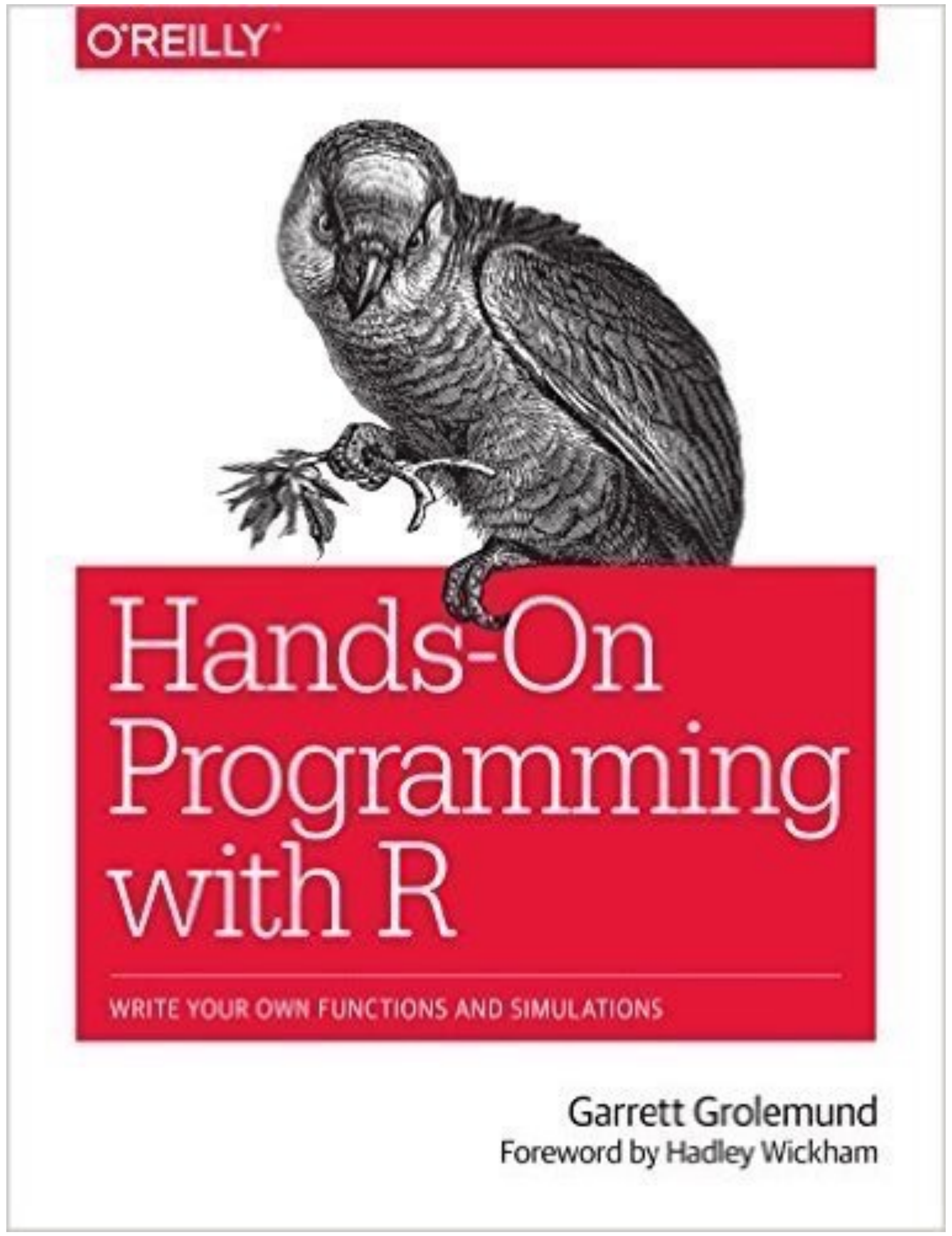
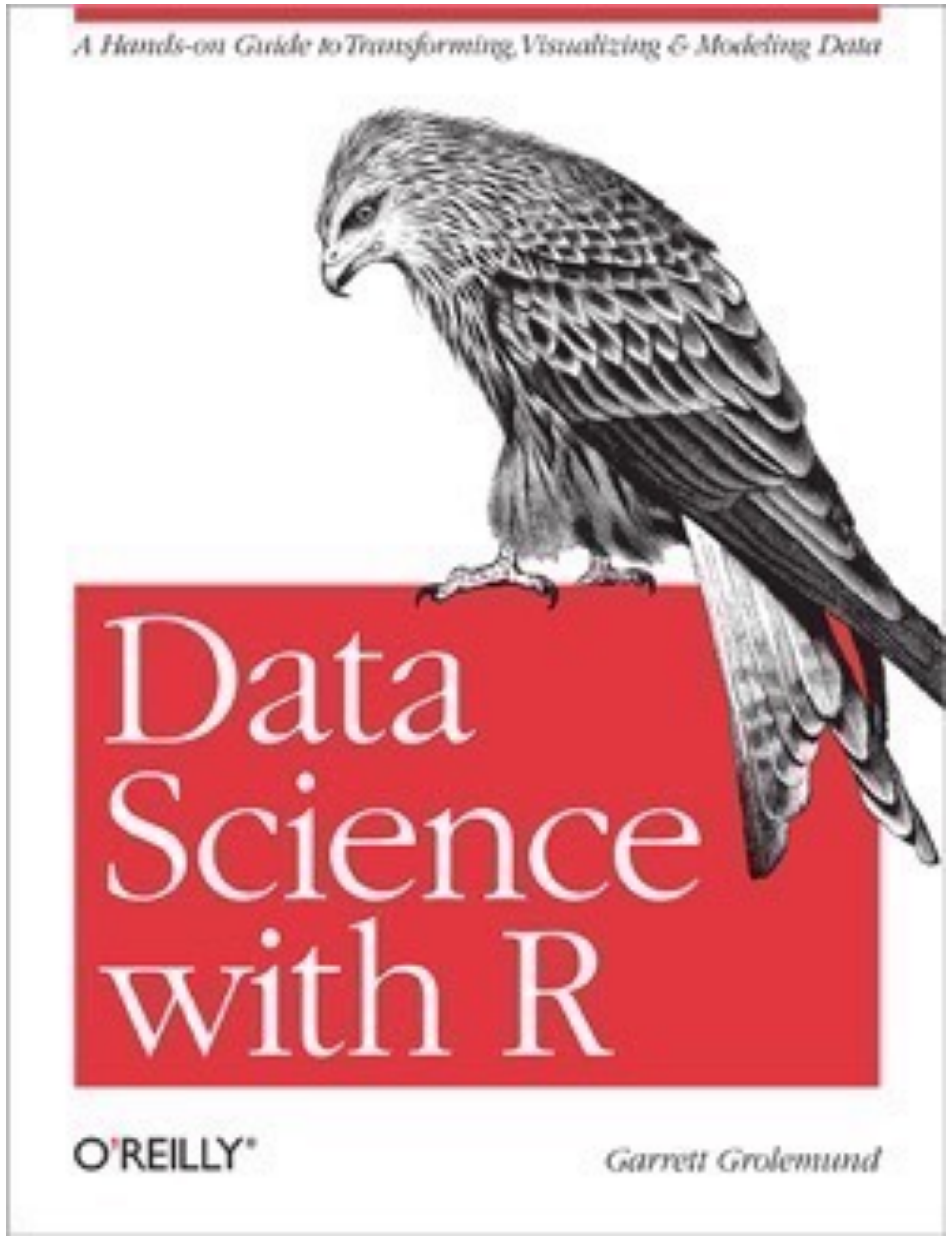
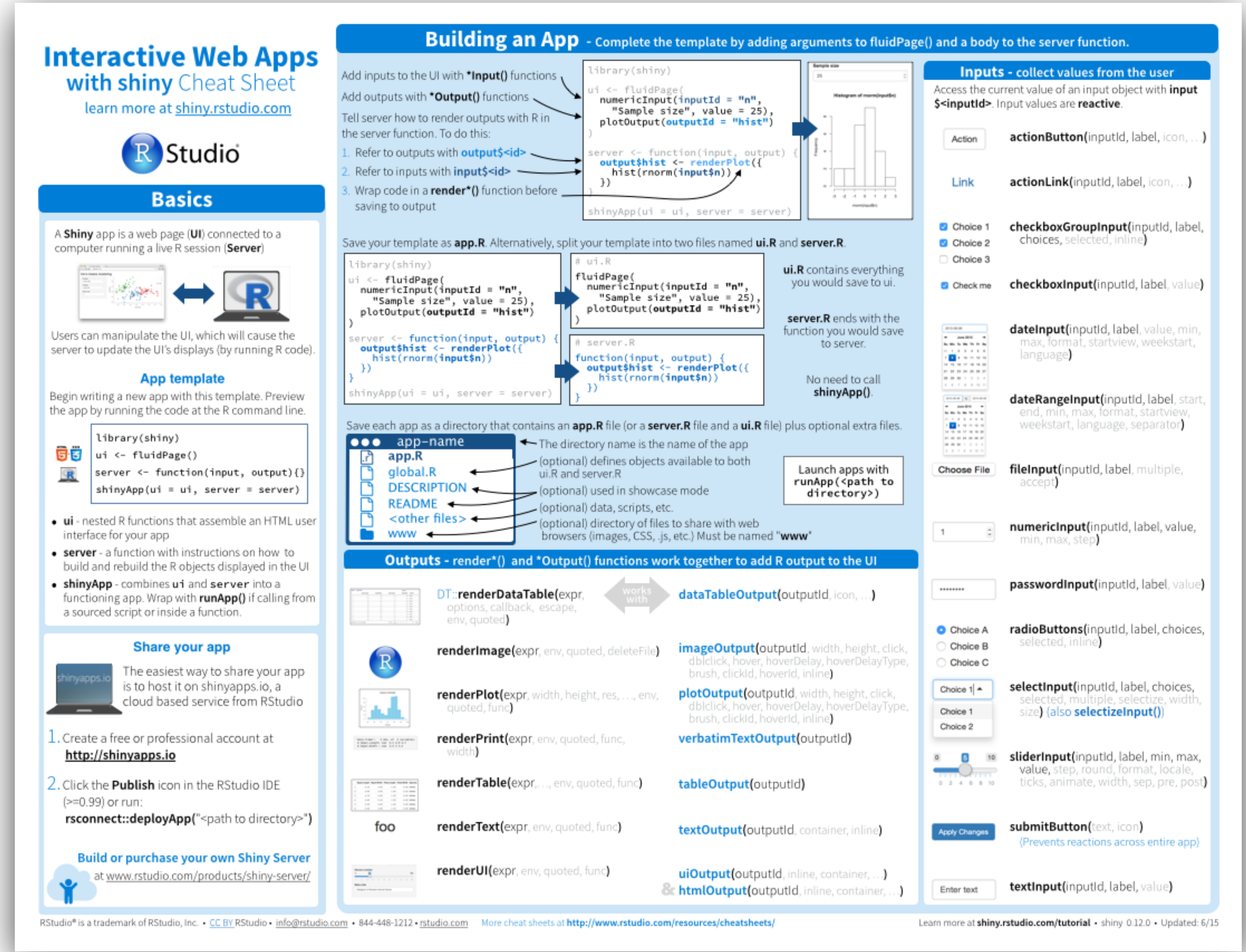

O'REILLY
Hands-On Programming with R
WRITE YOUR OWN FUNCTIONS AND SIMULATIONS
Garrett Grolemund
Foreword by Hadley Wickham


A Hands-on Guide to Transforming, Visualizing & Modeling Data
Data Science with R
O'REILLY
Garrett Grolemund

# The Shiny Cheat Sheet

www.rstudio.com/resources/cheatsheets/



**Interactive Web Apps with shiny** Cheat Sheet
learn more at shiny.rstudio.com

RStudio

## Basics

A **Shiny** app is a web page (**UI**) connected to a computer running a live R session (**Server**)

Users can manipulate the UI, which will cause the server to update the UI's displays (by running R code).

### App template

Begin writing a new app with this template. Preview the app by running the code at the R command line.

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

- **ui** - nested R functions that assemble an HTML user interface for your app
- **server** - a function with instructions on how to build and rebuild the R objects displayed in the UI
- **shinyApp** - combines ui and server into a functioning app. Wrap with **runApp()** if calling from a sourced script or inside a function.

### Share your app

The easiest way to share your app is to host it on shinyapps.io, a cloud based service from RStudio

1. Create a free or professional account at http://shinyapps.io
2. Click the **Publish** icon in the RStudio IDE (>=0.99) or run:
   **rsconnect::deployApp(**"<path to directory>"**)**

**Build or purchase your own Shiny Server**
at www.rstudio.com/products/shiny-server/

## Building an App - Complete the template by adding arguments to fluidPage() and a body to the server function.

Add inputs to the UI with ***Input()** functions

Add outputs with ***Output()** functions

Tell server how to render outputs with R in the server function. To do this:

1. Refer to outputs with **output$<id>**
2. Refer to inputs with **input$<id>**
3. Wrap code in a **render*()** function before saving to output

```
library(shiny)

ui <- fluidPage(
  numericInput(inputId = "n",
    "Sample size", value = 25),
  plotOutput(outputId = "hist")
)

server <- function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$n))
  })
}

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

Save your template as **app.R**. Alternatively, split your template into two files named **ui.R** and **server.R**.

```
library(shiny)
ui <- fluidPage(
  numericInput(inputId = "n",
    "Sample size", value = 25),
  plotOutput(outputId = "hist")
)
server <- function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$n))
  })
}
shinyApp(ui = ui, server = server)
```

```
# ui.R
fluidPage(
  numericInput(inputId = "n",
    "Sample size", value = 25),
  plotOutput(outputId = "hist")
)
```

**ui.R** contains everything you would save to ui.

```
# server.R
function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$n))
  })
}
```

**server.R** ends with the function you would save to server.

No need to call **shinyApp()**.

Save each app as a directory that contains an **app.R** file (or a **server.R** file and a **ui.R** file) plus optional extra files.

| app-name | |
|---|---|
| | The directory name is the name of the app |
| app.R | |
| global.R | (optional) defines objects available to both ui.R and server.R |
| DESCRIPTION | (optional) used in showcase mode |
| README | (optional) used in showcase mode |
| <other files> | (optional) data, scripts, etc. |
| www | (optional) directory of files to share with web browsers (images, CSS, .js, etc.) Must be named "**www**" |

Launch apps with `runApp(<path to directory>)`

## Outputs - render*() and *Output() functions work together to add R output to the UI

| | works with | |
|---|---|---|
| DT::**renderDataTable(**expr, options, callback, escape, env, quoted**)** | | **dataTableOutput(**outputId, icon, ...**)** |
| **renderImage(**expr, env, quoted, deleteFile**)** | | **imageOutput(**outputId, width, height, click, dblclick, hover, hoverDelay, hoverDelayType, brush, clickId, hoverId, inline**)** |
| **renderPlot(**expr, width, height, res, ..., env, quoted, func**)** | | **plotOutput(**outputId, width, height, click, dblclick, hover, hoverDelay, hoverDelayType, brush, clickId, hoverId, inline**)** |
| **renderPrint(**expr, env, quoted, func, width**)** | | **verbatimTextOutput(**outputId**)** |
| **renderTable(**expr, ..., env, quoted, func**)** | | **tableOutput(**outputId**)** |
| foo **renderText(**expr, env, quoted, func**)** | | **textOutput(**outputId, container, inline**)** |
| **renderUI(**expr, env, quoted, func**)** | | **uiOutput(**outputId, inline, container, ...**)** & **htmlOutput(**outputId, inline, container, ...**)** |

## Inputs - collect values from the user

Access the current value of an input object with **input $<inputId>**. Input values are **reactive**.

| | |
|---|---|
| Action | **actionButton(**inputId, label, icon, ...**)** |
| Link | **actionLink(**inputId, label, icon, ...**)** |
| ☑ Choice 1 ☑ Choice 2 ☐ Choice 3 | **checkboxGroupInput(**inputId, label, choices, selected, inline**)** |
| ☑ Check me | **checkboxInput(**inputId, label, value**)** |
| | **dateInput(**inputId, label, value, min, max, format, startview, weekstart, language**)** |
| | **dateRangeInput(**inputId, label, start, end, min, max, format, startview, weekstart, language, separator**)** |
| Choose File | **fileInput(**inputId, label, multiple, accept**)** |
| 1 | **numericInput(**inputId, label, value, min, max, step**)** |
| ········ | **passwordInput(**inputId, label, value**)** |
| ● Choice A ○ Choice B ○ Choice C | **radioButtons(**inputId, label, choices, selected, inline**)** |
| Choice 1 / Choice 1 / Choice 2 | **selectInput(**inputId, label, choices, selected, multiple, selectize, width, size**)** (also **selectizeInput()**) |
| 0 5 10 | **sliderInput(**inputId, label, min, max, value, step, round, format, locale, ticks, animate, width, sep, pre, post**)** |
| Apply Changes | **submitButton(**text, icon**)** (Prevents reactions across entire app) |
| Enter text | **textInput(**inputId, label, value**)** |

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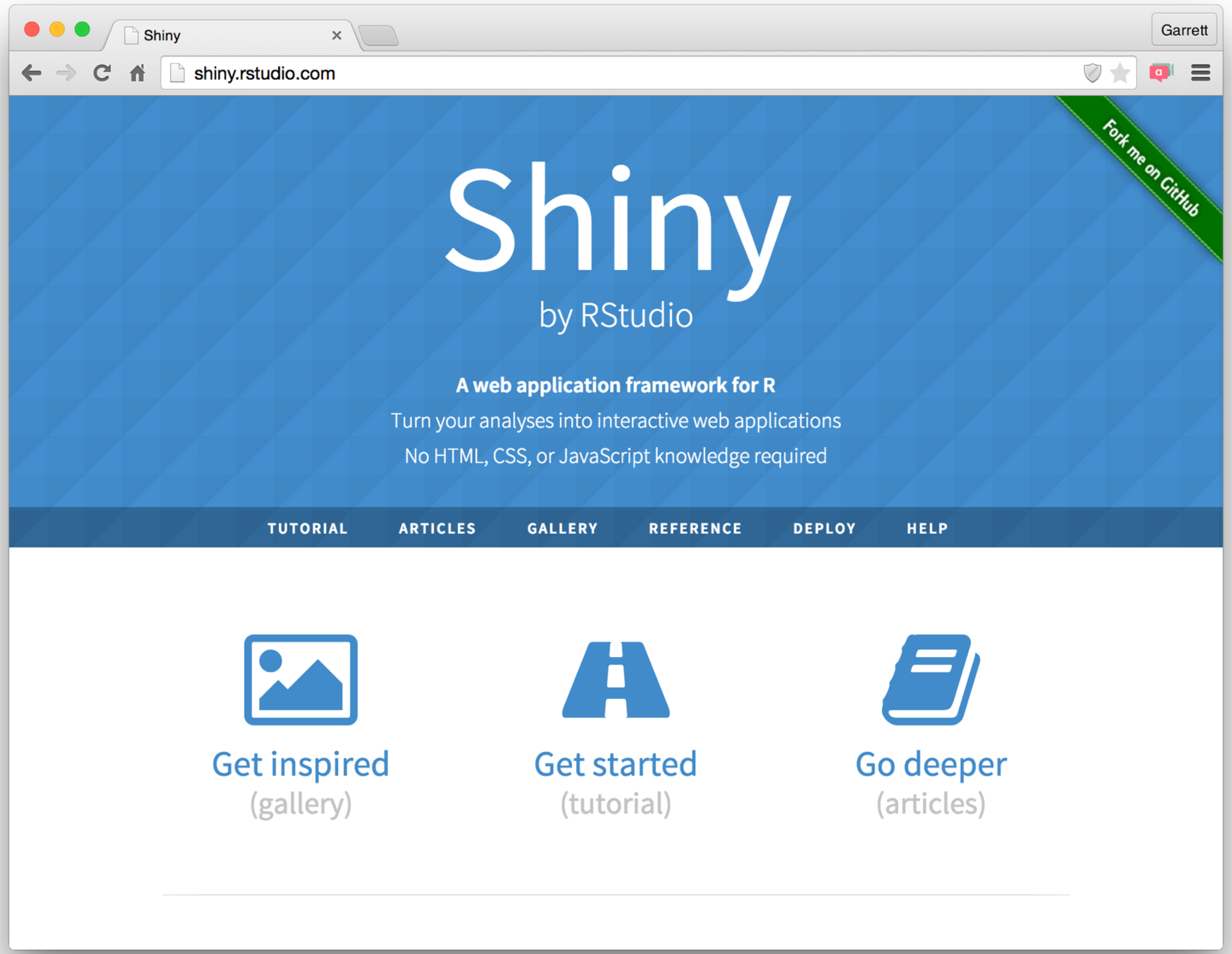
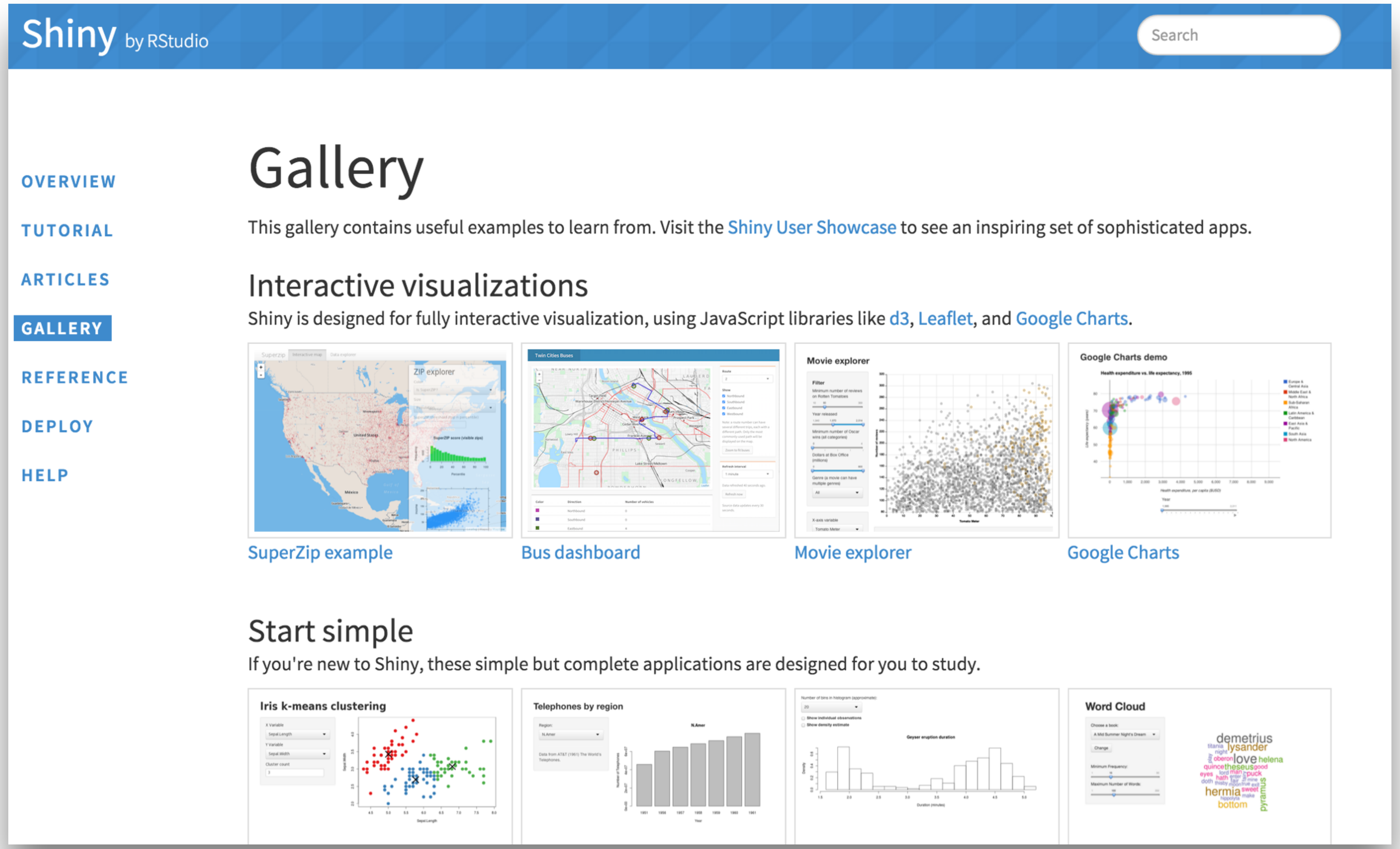
# The Shiny Development Center

shiny.rstudio.com



Shiny
by RStudio
A web application framework for R
Turn your analyses into interactive web applications
No HTML, CSS, or JavaScript knowledge required



Gallery

This gallery contains useful examples to learn from. Visit the Shiny User Showcase to see an inspiring set of sophisticated apps.

Interactive visualizations

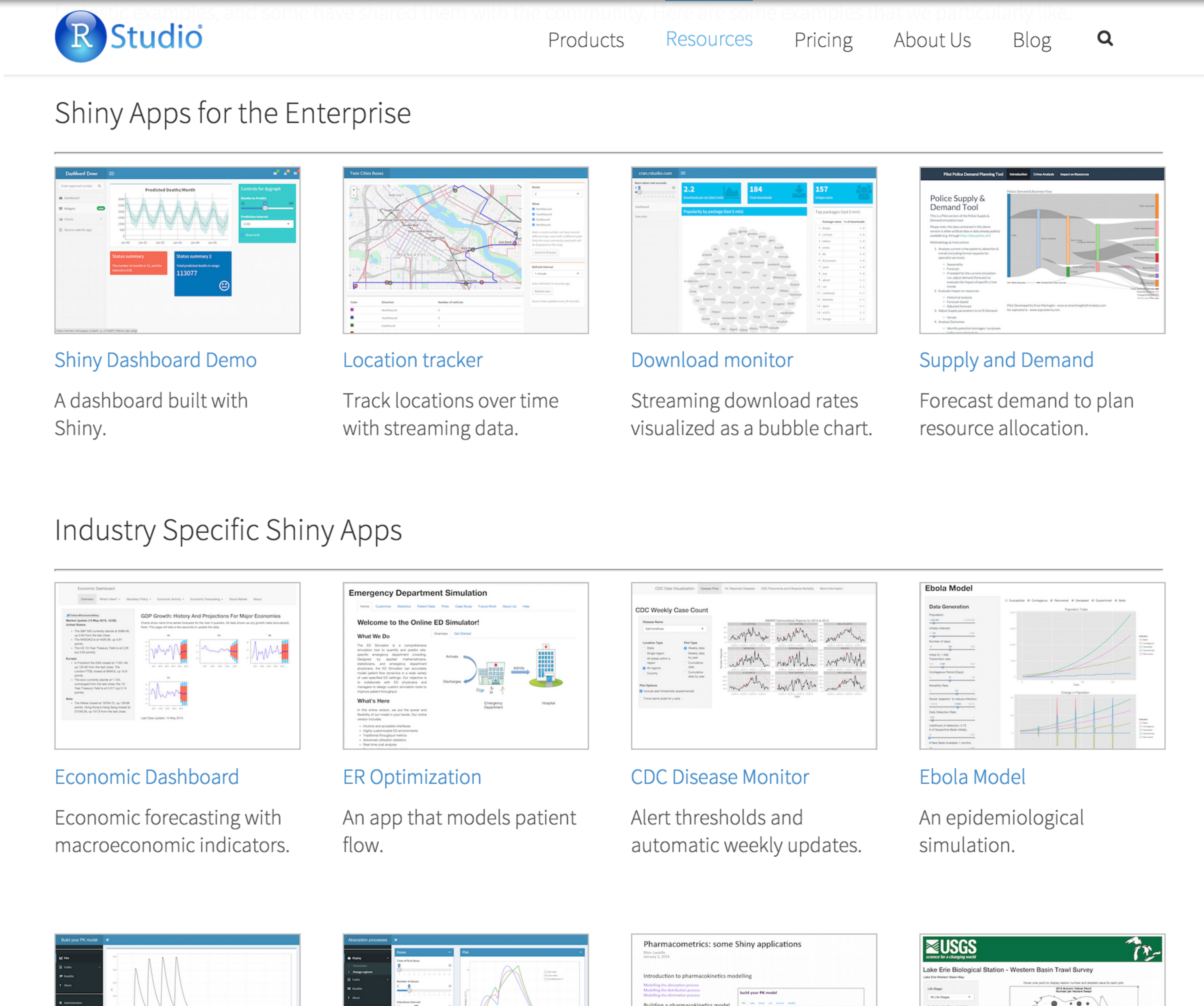
Shiny is designed for fully interactive visualization, using JavaScript libraries like d3, Leaflet, and Google Charts.

Start simple

If you're new to Shiny, these simple but complete applications are designed for you to study.

## Shiny Showcase

[www.rstudio.com/products/shiny/shiny-user-showcase/](http://www.rstudio.com/products/shiny/shiny-user-showcase/)



Shiny Apps for the Enterprise

Shiny Dashboard Demo
A dashboard built with Shiny.

Location tracker
Track locations over time with streaming data.

Download monitor
Streaming download rates visualized as a bubble chart.

Supply and Demand
Forecast demand to plan resource allocation.

Industry Specific Shiny Apps

Economic Dashboard
Economic forecasting with macroeconomic indicators.

ER Optimization
An app that models patient flow.

CDC Disease Monitor
Alert thresholds and automatic weekly updates.

Ebola Model
An epidemiological simulation.

HELLO

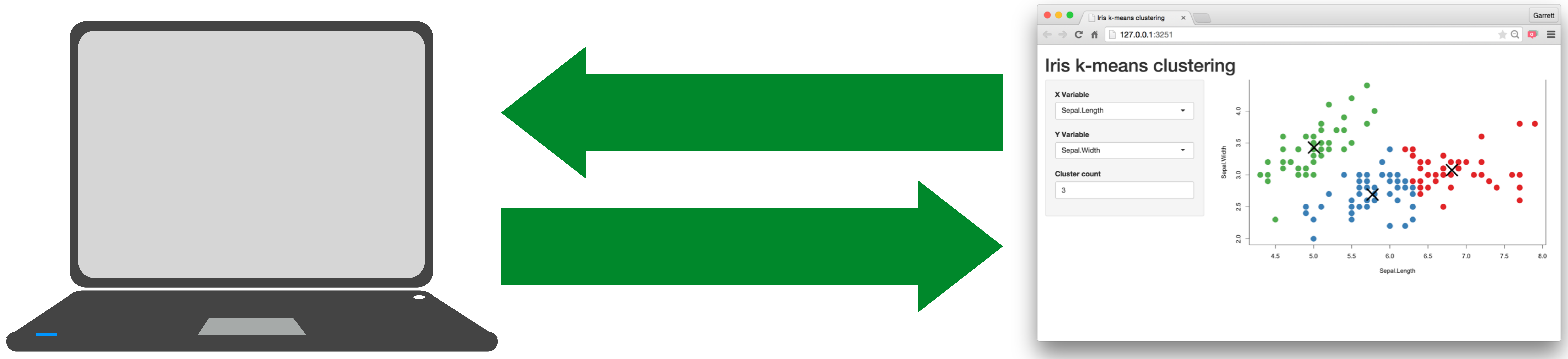
my name is

~~Garrett~~

Randy

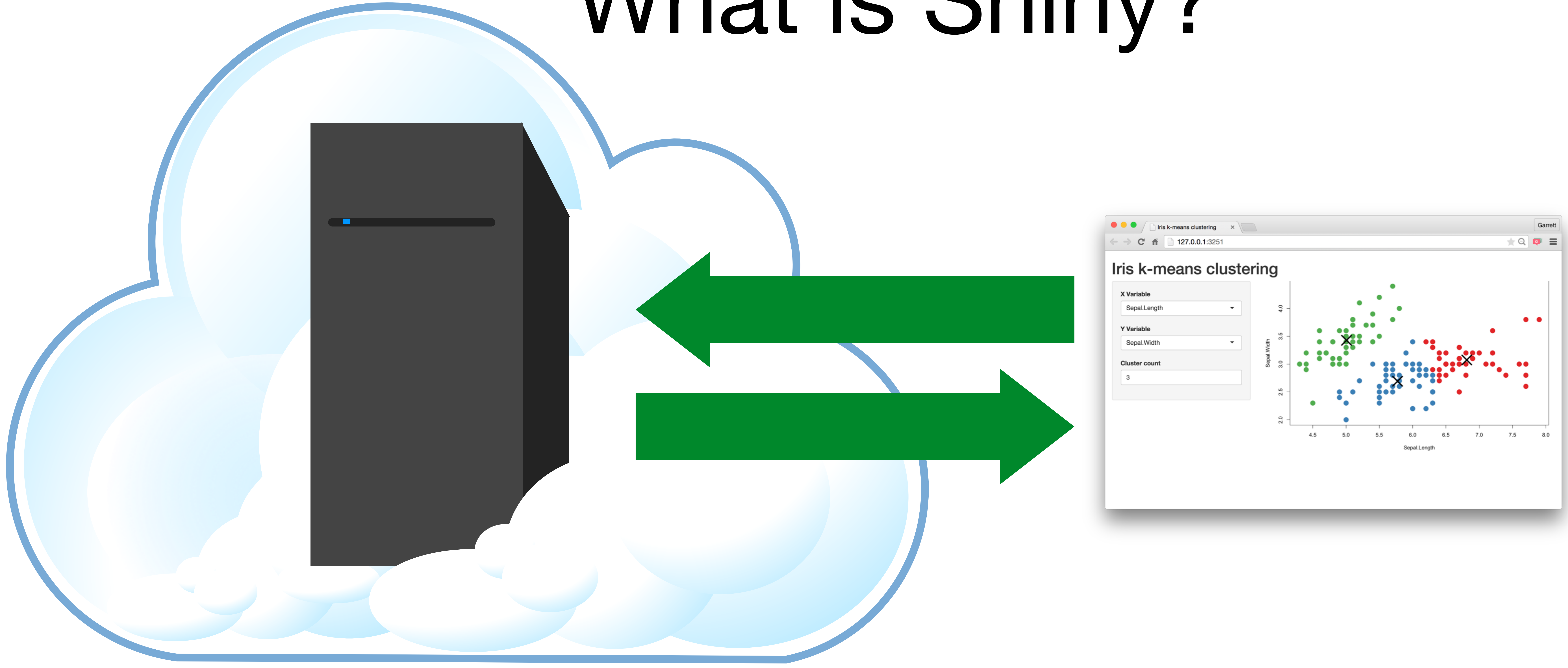
# What is Shiny?

- shiny
  - R package that provides toolkit for creating shiny apps in R
  - `install.packages("shiny")`



Every Shiny app is maintained by a computer running R

# What is Shiny?



Iris k-means clustering

X Variable: Sepal.Length

Y Variable: Sepal.Width

Cluster count: 3

Every Shiny app is maintained by a computer running R

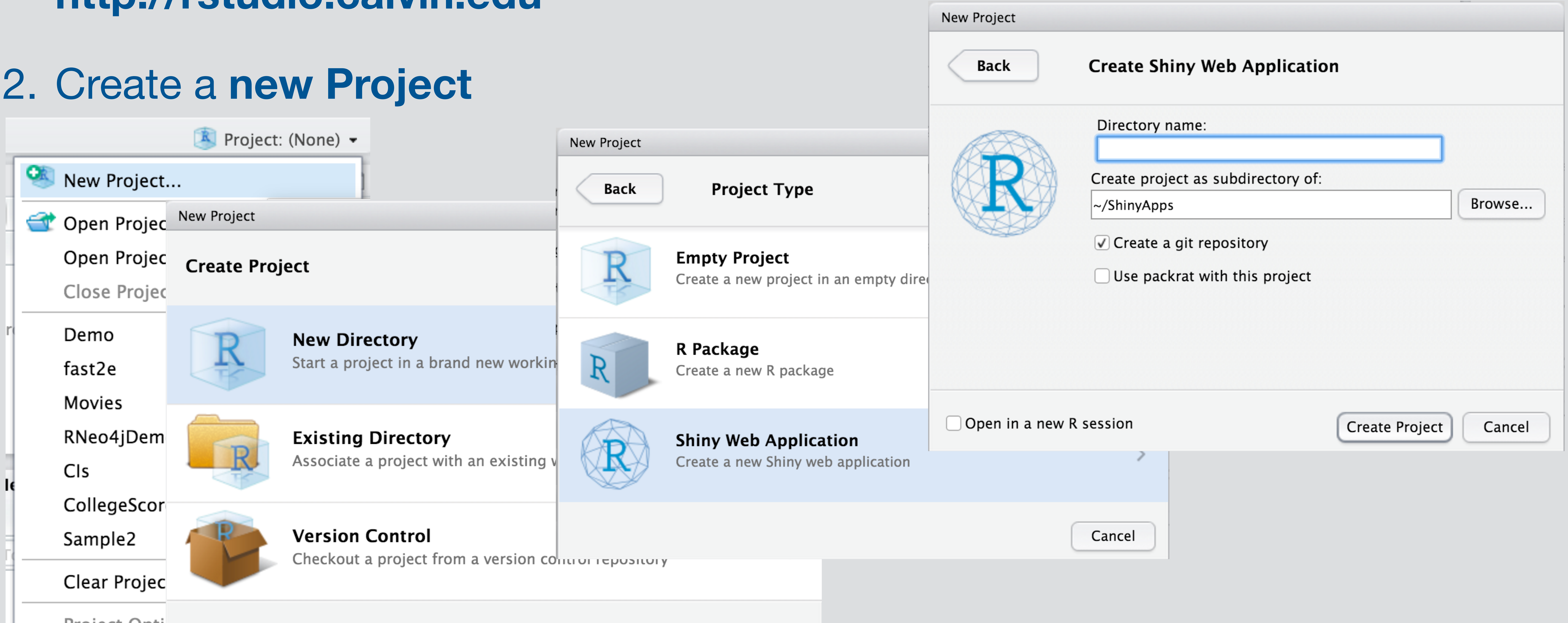
## What is Shiny?

- shiny
  - R package that provides toolkit for creating shiny apps in R
  - `install.packages(“shiny”)`
- shiny-server
  - put apps on the web (free and pro versions available)
- shiny.io
  - RStudio can host your apps (free and pro accounts)

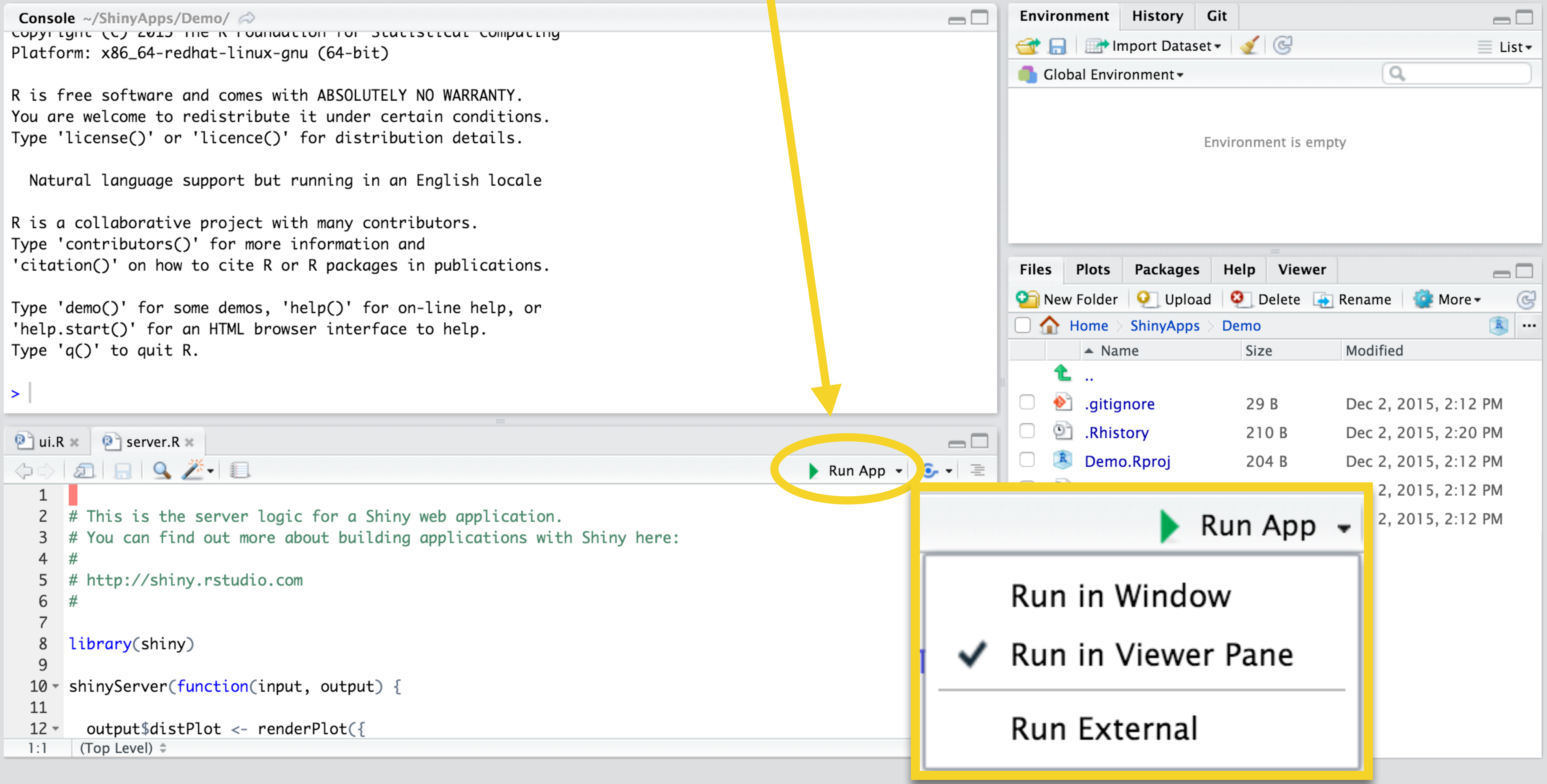
# Your Turn

1. Log into the RStudio server and open a new R Project.
   **http://rstudio.calvin.edu**

2. Create a **new Project**



# Run Your App

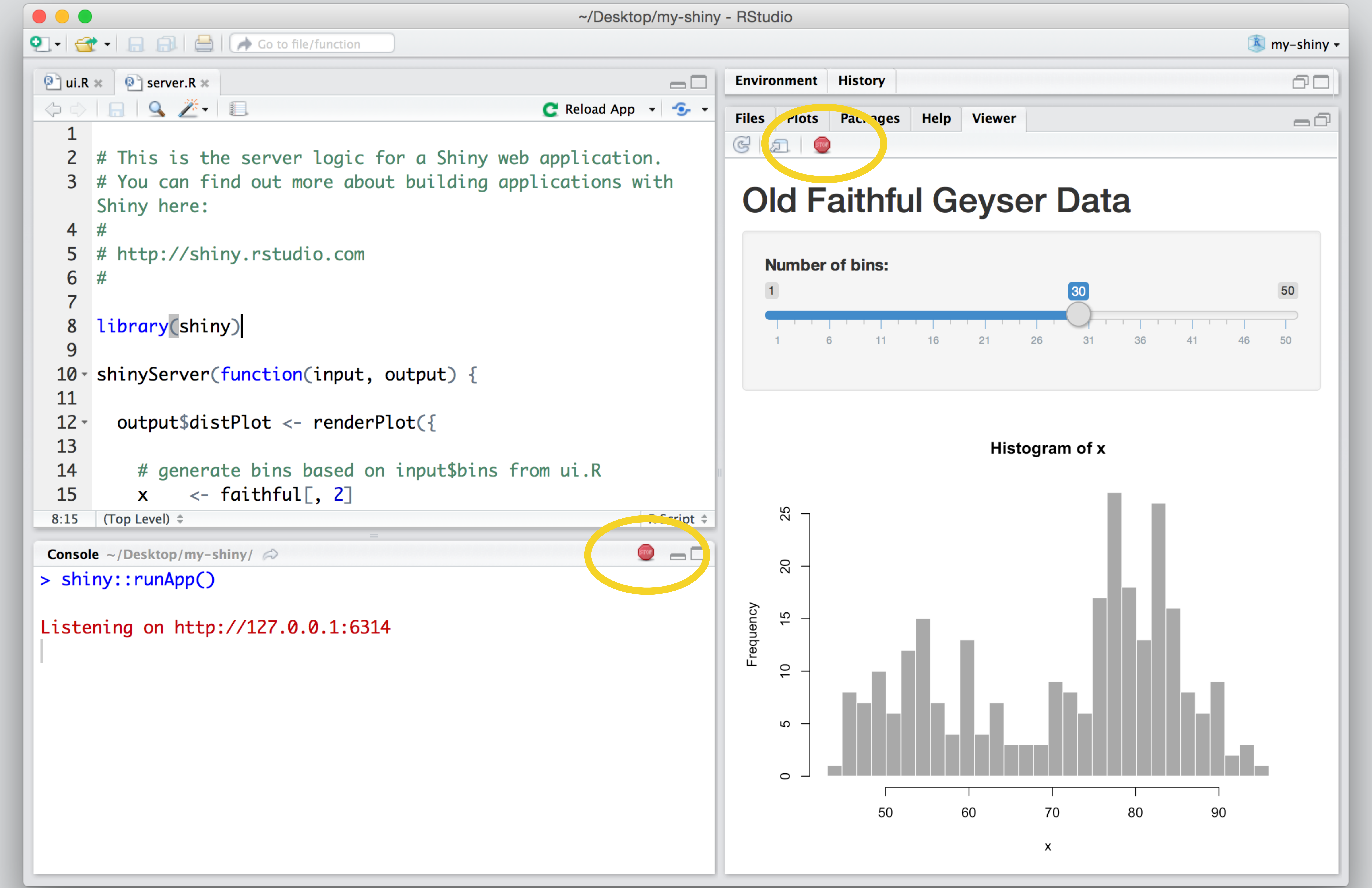


```
Platform: x86_64-redhat-linux-gnu (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

>
```

| | Name | Size | Modified |
|---|---|---|---|
| | .. | | |
| | .gitignore | 29 B | Dec 2, 2015, 2:12 PM |
| | .Rhistory | 210 B | Dec 2, 2015, 2:20 PM |
| | Demo.Rproj | 204 B | Dec 2, 2015, 2:12 PM |
| | | | 2, 2015, 2:12 PM |
| | | | 2, 2015, 2:12 PM |

```r

# This is the server logic for a Shiny web application.
# You can find out more about building applications with Shiny here:
#
# http://shiny.rstudio.com
#

library(shiny)

shinyServer(function(input, output) {

  output$distPlot <- renderPlot({
```

# Close your app



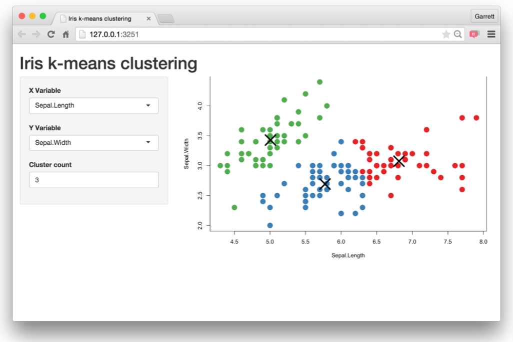
```
# This is the server logic for a Shiny web application.
# You can find out more about building applications with Shiny here:
#
# http://shiny.rstudio.com
#

library(shiny)

shinyServer(function(input, output) {

  output$distPlot <- renderPlot({

    # generate bins based on input$bins from ui.R
    x    <- faithful[, 2]
```

```
> shiny::runApp()

Listening on http://127.0.0.1:6314
```

Old Faithful Geyser Data

Number of bins: 30

## Outline



1. Components of an app
2. Reactivity
3. Interactive Plots

4. Sharing
5. Big Data

## Components of an app

# App template

The shortest viable shiny app

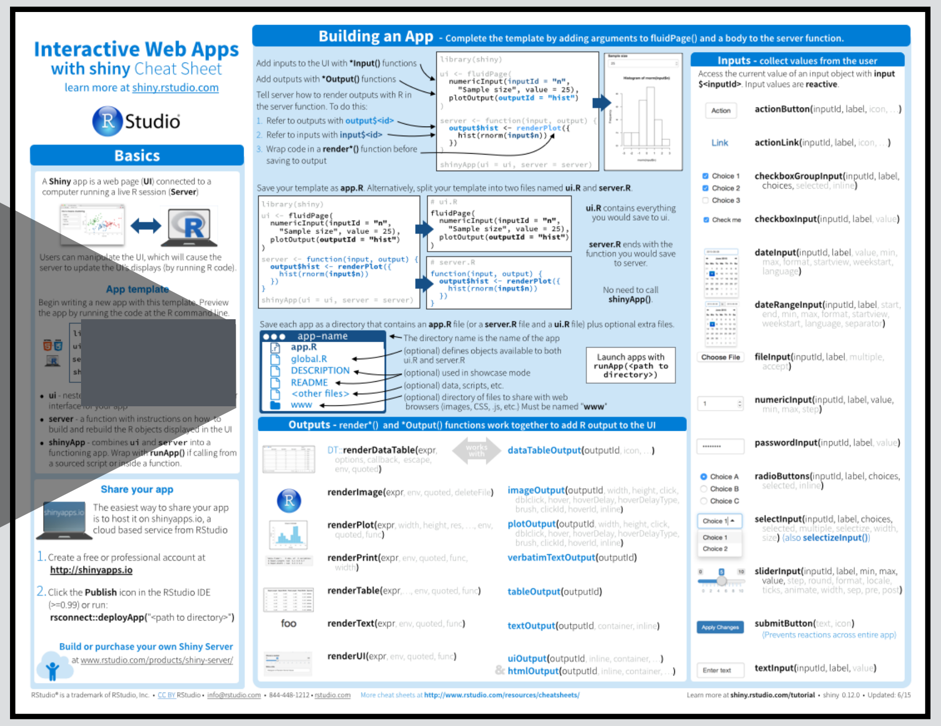
```
library(shiny)

ui <- fluidPage()


server <- function(input, output) {}


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

Communication b/w UI and server

## Starting from Scratch

1. Delete ui.R and server.R
2. Open a new R Script [File > New > RScript]
3. Write the code below in your R script and save as **app.R**
4. Hit Run App

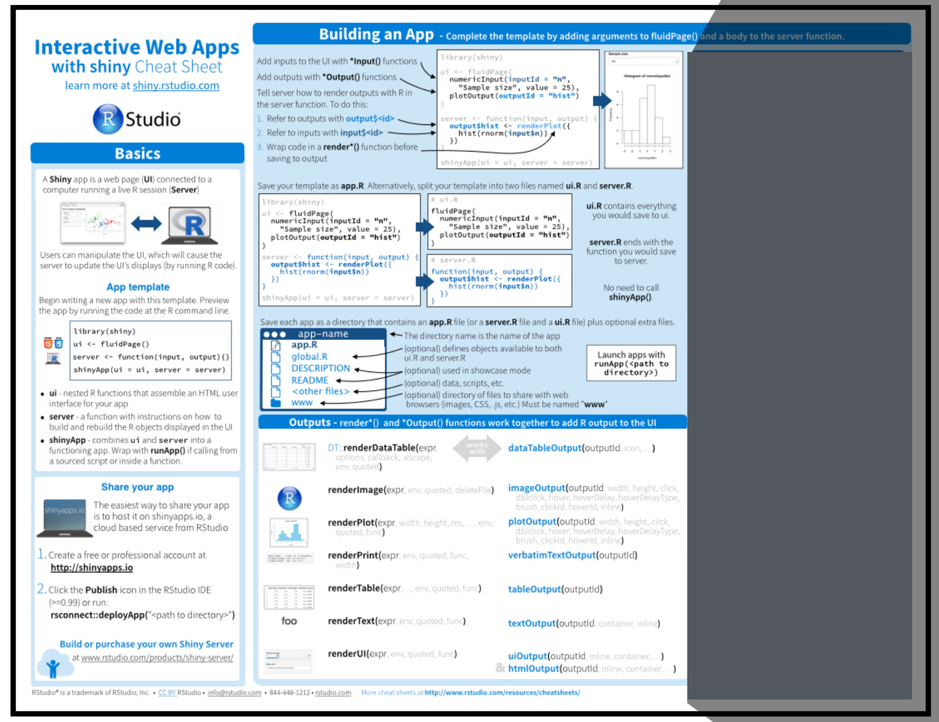
```
library(shiny)
ui <- fluidPage()
server <- function(input, output){}
shinyApp(ui = ui, server = server)
```

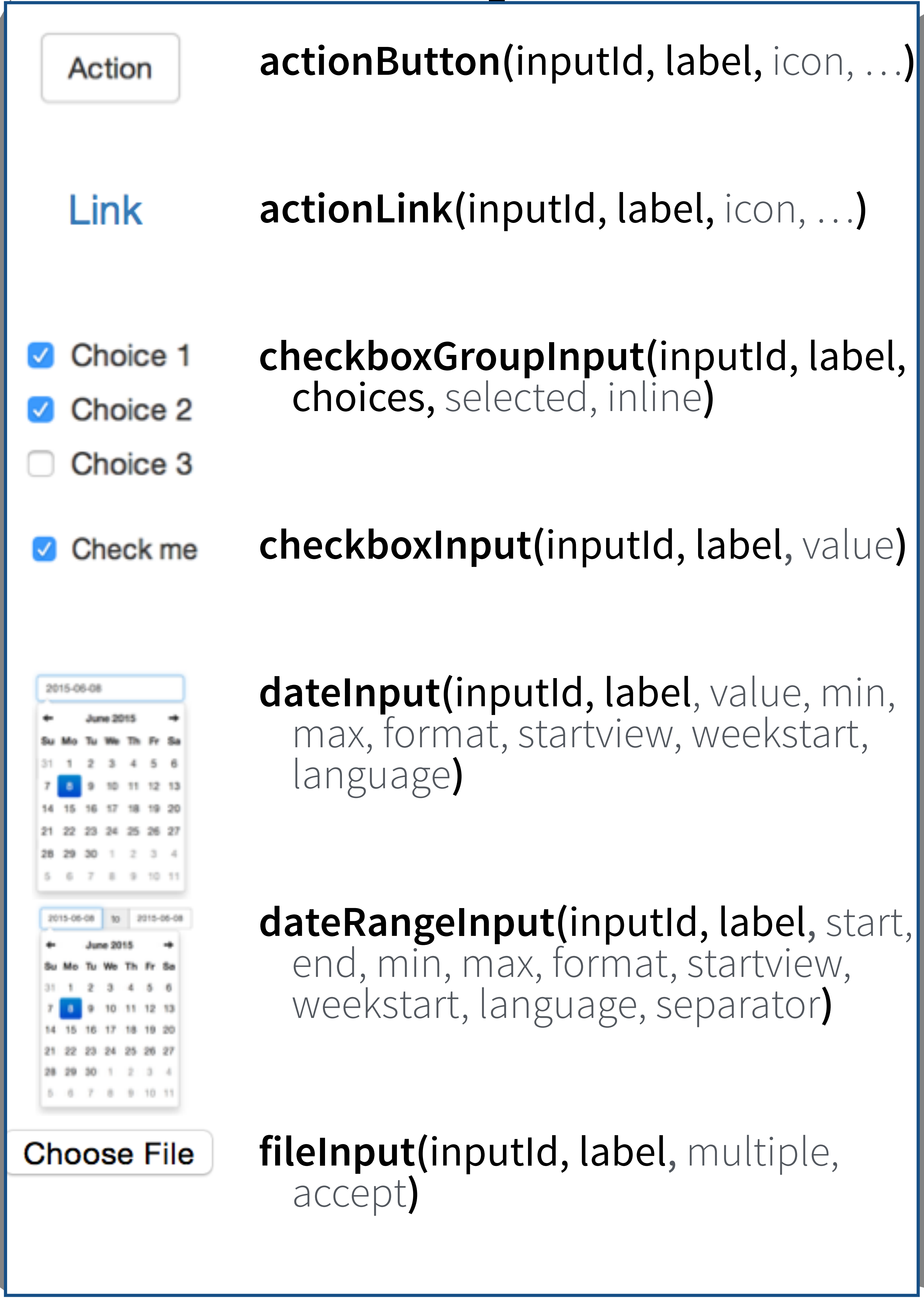


## Add elements to your app as arguments to `fluidPage()`

```
library(shiny)
ui <- fluidPage("Hello, World")

server <- function(input, output) {}

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

# Inputs





**actionButton**(**inputId**, **label**, icon, …)

**actionLink**(**inputId**, **label**, icon, …)

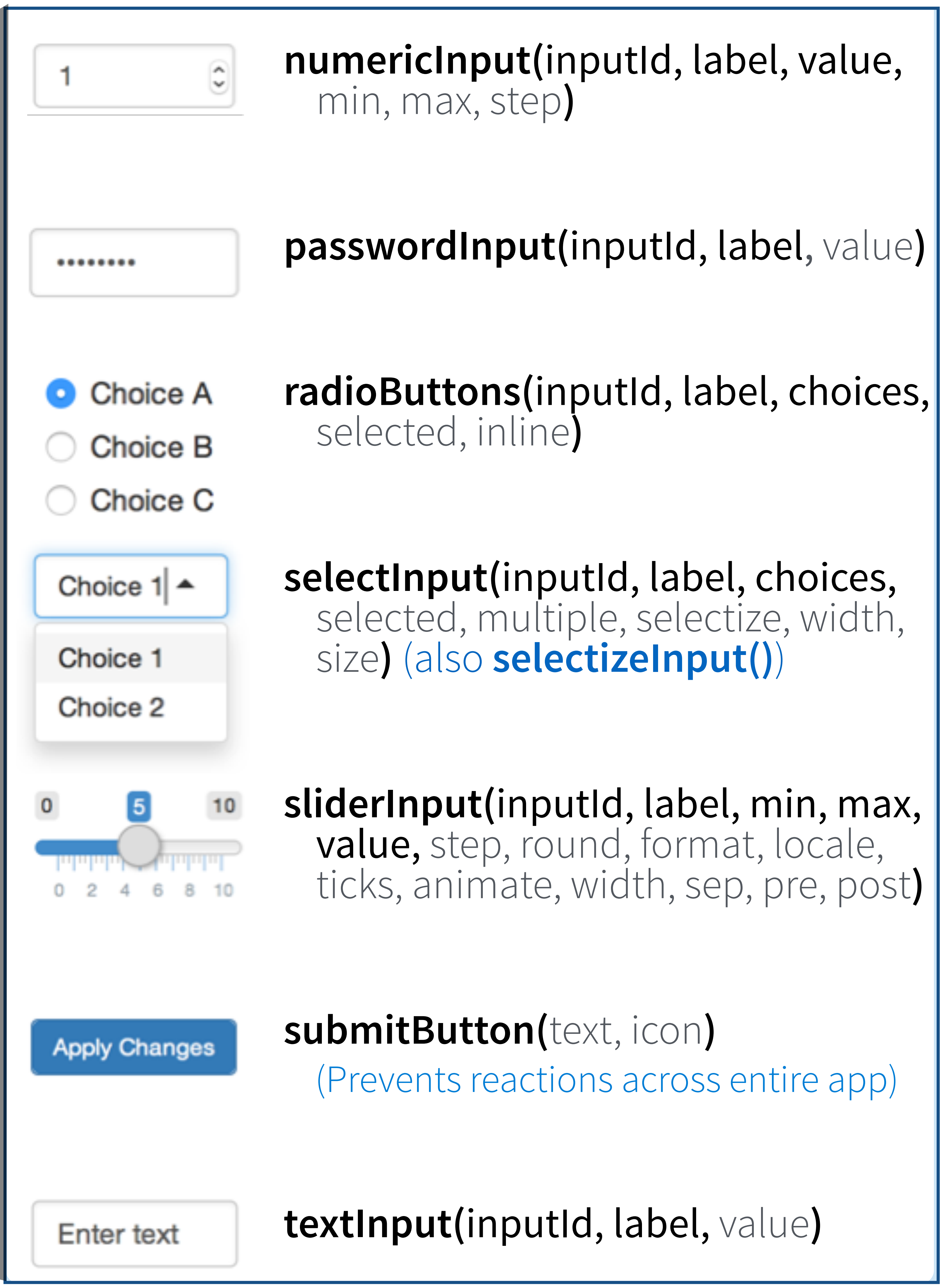
**checkboxGroupInput**(**inputId**, **label**, **choices**, selected, inline)

**checkboxInput**(**inputId**, **label**, value)

**dateInput**(**inputId**, **label**, value, min, max, format, startview, weekstart, language)

**dateRangeInput**(**inputId**, **label**, start, end, min, max, format, startview, weekstart, language, separator)

**fileInput**(**inputId**, **label**, multiple, accept)



**numericInput**(**inputId**, **label**, **value**, min, max, step)

**passwordInput**(**inputId**, **label**, value)

**radioButtons**(**inputId**, **label**, **choices**, selected, inline)

**selectInput**(**inputId**, **label**, **choices**, selected, multiple, selectize, width, size) (also **selectizeInput()**)

**sliderInput**(**inputId**, **label**, **min**, **max**, **value**, step, round, format, locale, ticks, animate, width, sep, pre, post)

**submitButton**(text, icon)
(Prevents reactions across entire app)

**textInput**(**inputId**, **label**, value)

# Inputs

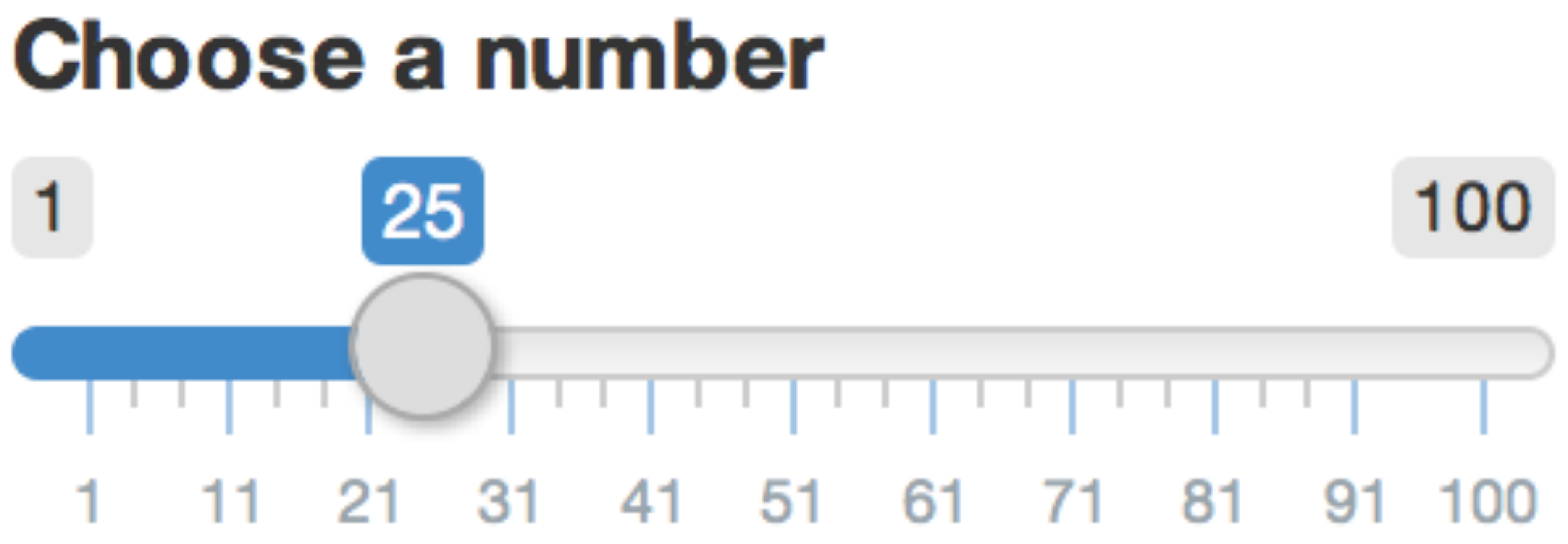
collect a value from your user.

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", “Choose a number”, 1, 100, 25)
)
server <- function(input, output) {}
shinyApp(ui = ui, server = server)
```

unique Id

displayed text

## Syntax



```
sliderInput(inputId = "num", label = “Choose a number", …)
```

Notice: Id not ID

input name (used by server)

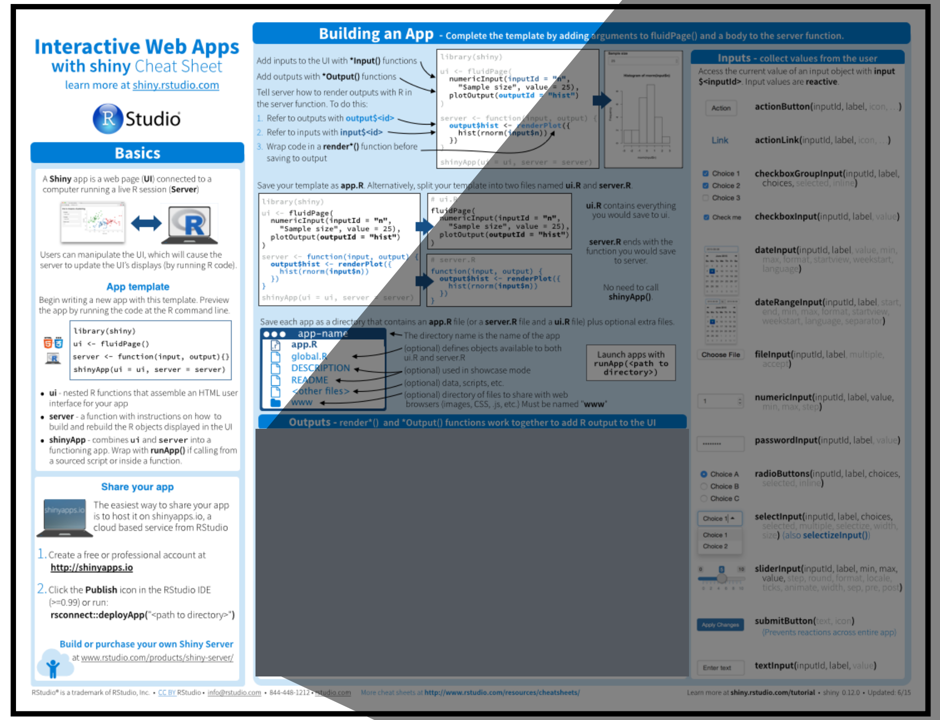
label to display

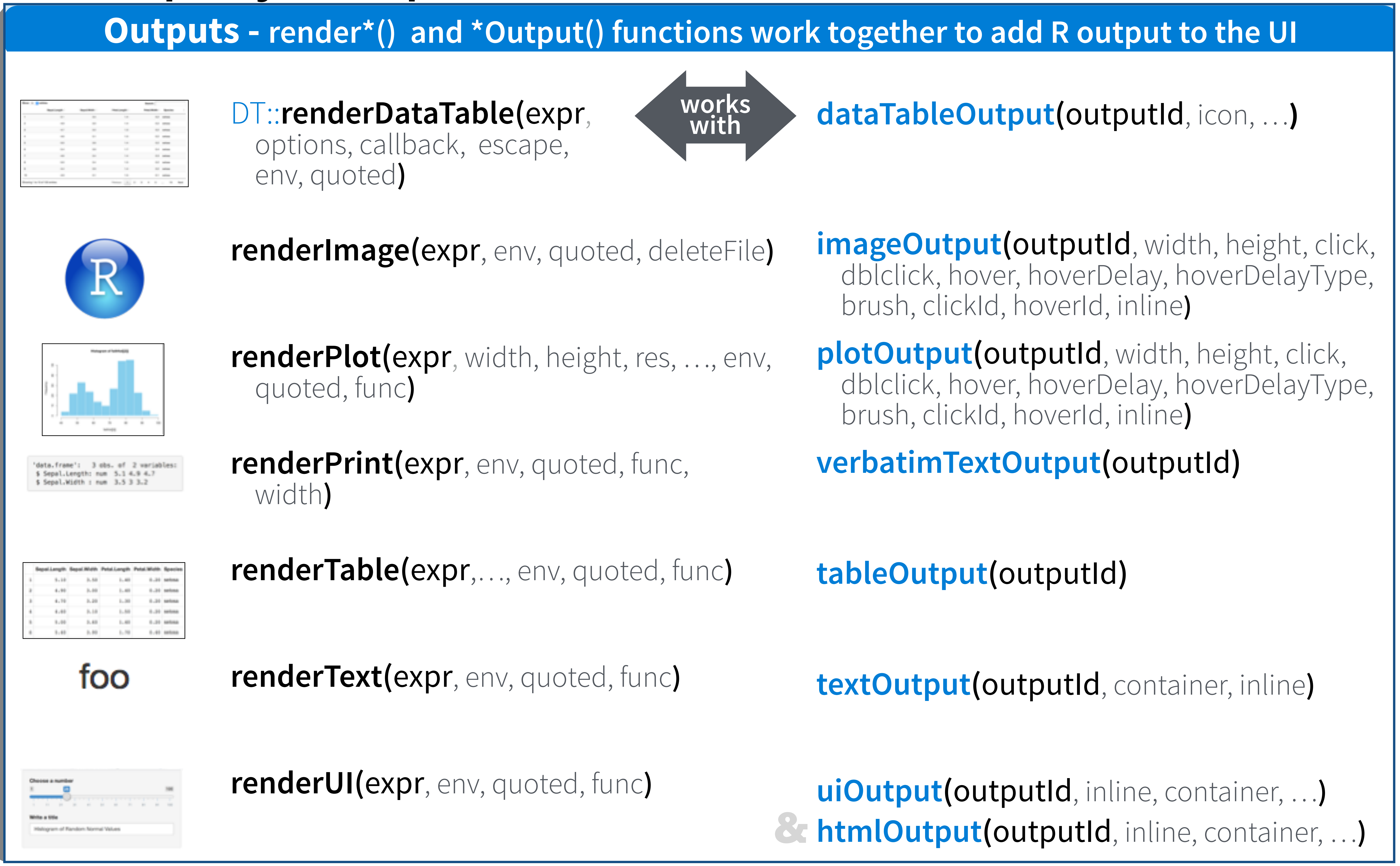
input specific arguments

`?sliderInput`

# Outputs

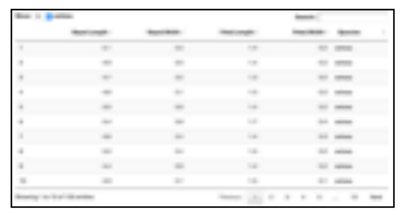
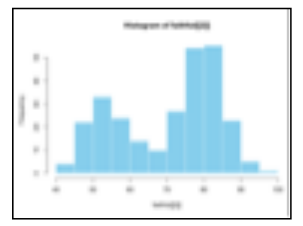
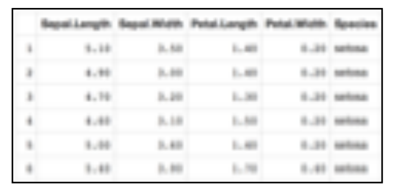
display output from R.





**Outputs - render*() and *Output() functions work together to add R output to the UI**

works with

| | | |
|---|---|---|
|  | DT::**renderDataTable**(expr, options, callback, escape, env, quoted) | **dataTableOutput**(outputId, icon, …) |
| | **renderImage**(expr, env, quoted, deleteFile) | **imageOutput**(outputId, width, height, click, dblclick, hover, hoverDelay, hoverDelayType, brush, clickId, hoverId, inline) |
|  | **renderPlot**(expr, width, height, res, …, env, quoted, func) | **plotOutput**(outputId, width, height, click, dblclick, hover, hoverDelay, hoverDelayType, brush, clickId, hoverId, inline) |
| 'data.frame': 3 obs. of 2 variables: $ Sepal.Length: num 5.1 4.9 4.7 $ Sepal.Width : num 3.5 3 3.2 | **renderPrint**(expr, env, quoted, func, width) | **verbatimTextOutput**(outputId) |
|  | **renderTable**(expr,…, env, quoted, func) | **tableOutput**(outputId) |
| foo | **renderText**(expr, env, quoted, func) | **textOutput**(outputId, container, inline) |
| | **renderUI**(expr, env, quoted, func) | **uiOutput**(outputId, inline, container, …) & **htmlOutput**(outputId, inline, container, …) |

# Outputs

display output from R.

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 10, 5),
)

server <- function(input, output) {}




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

Build outputs in 3 steps:

# Outputs

display output from R.

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("bar")
)
server <- function(input, output) {}




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

Build outputs in 3 steps:

**1.** Add a *Output() function to ui (places output)

# *Output()

To display output, add it to `fluidPage()` with an `*Output()` function

```
plotOutput(outputId = "bar")
```

the type of output to display

name to give to the output object

# Outputs

display output from R.

```r
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("bar")
)
server <- function(input, output) {
  renderPlot({
     barplot(50, ylim = c(0, 100))
  })
}
shinyApp(ui = ui, server = server)
```

Build outputs in 3 steps:

1. Add a *Output() function to ui (places output)

2. Make with render*() function in server (builds output)

# render*()

Builds reactive output to display in UI

```
renderPlot({ barplot(50, ylim = c(0, 100)) })
```

type of object to build

code block that builds the object

# Outputs

display output from R.

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("bar")
)
server <- function(input, output) {
  output$bar <- renderPlot({
    barplot(50, ylim = c(0, 100))
  })
}
shinyApp(ui = ui, server = server)
```

Build outputs in 3 steps:

1. Add a *Output() function to ui (places output)
2. Make with render*() function in server (builds output)
3. Save to output$ list (stores output)

# Outputs

display output from R.

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("bar")
)
server <- function(input, output) {
  output$bar <- renderPlot({
    barplot(50, ylim = c(0, 100))
  })
}
shinyApp(ui = ui, server = server)
```

Match names

Build outputs in 3 steps:

1. Add a *Output() function to ui (places output)
2. Make with render*() function in server (builds output)
3. Save to output$ list (stores output)

## Your Turn

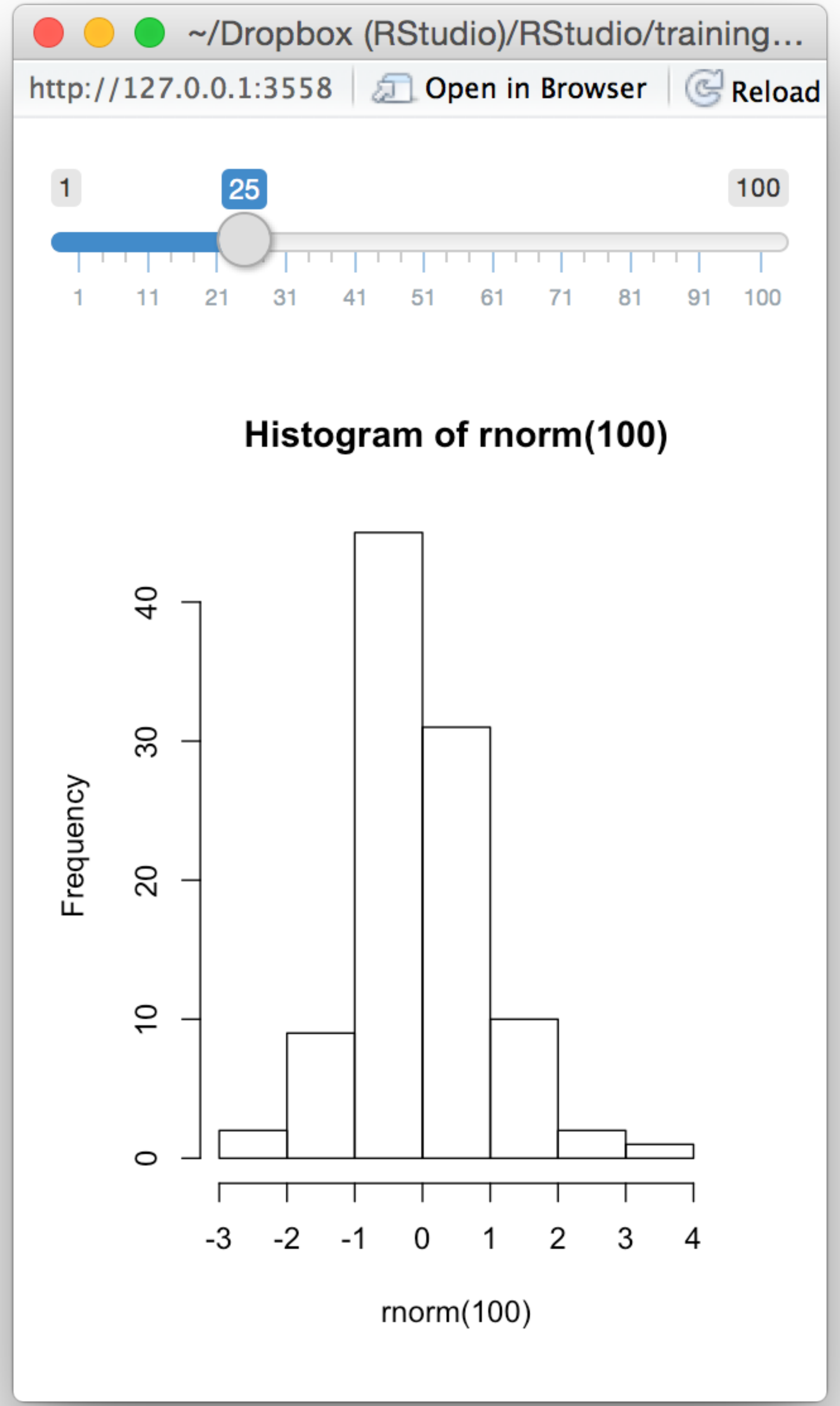
Make a new app that contains:

1. A slider that goes from 1 to 100
2. A histogram 100 random normal values

```
hist(rnorm(100))                # base
histogram( ~ rnorm(100)) # lattice
qplot(rnorm(100))            # ggplot2
```

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("hist")
)
server <- function(input, output) {
  output$hist <- renderPlot({
     hist(rnorm(100))
  })
}
shinyApp(ui = ui, server = server)
```

To do: add interaction between slider and plot



## App template

The shortest viable shiny app

```
library(shiny)

ui <- fluidPage()


server <- function(input, output) {}


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

Communication b/w UI and server

## Reactions

The **input$** list stores the current value of each input object under its name.

```
sliderInput(inputId = "num", …)

                              input$num
```

# Reactions

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("bar")
)
server <- function(input, output) {
  output$bar <- renderPlot({
   barplot(input$num, ylim=c(0, 100))
  })
}
shinyApp(ui = ui, server = server)
```

Shiny will update an output whenever an input value changes *if the output uses the input value in its render function*.

An input value

## Reactions

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("bar")
)
server <- function(input, output) {
  output$bar <- renderPlot({
    input$num
    barplot(50, ylim=c(0,100))
  })}

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

Shiny will update an output whenever an input value changes *if the output uses the input value in its render function*.

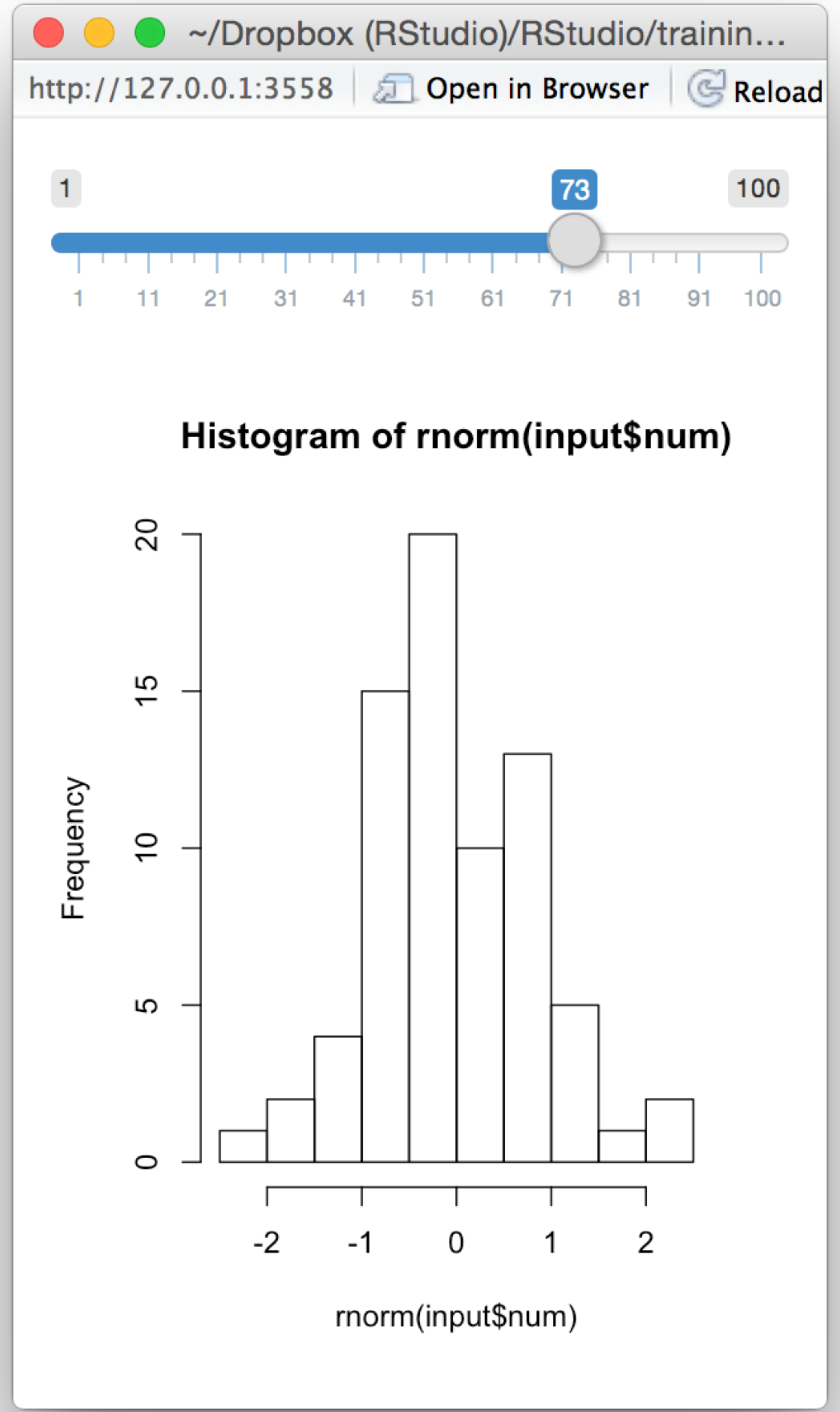
An input value

## Your Turn

Change your app to make the number of random normal values in the histogram react to the value of the slider.

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("bar")
)
server <- function(input, output) {
  output$bar <- renderPlot({
   barplot(input$num, ylim=c(0, 100))
  })
}
shinyApp(ui = ui, server = server)
```

```
library(shiny)
ui <- fluidPage(
  sliderInput("num", "", 1, 100, 25),
  plotOutput("hist")
)
server <- function(input, output) {
  output$hist <- renderPlot({
     hist(rnorm(input$num))
  })
}
shinyApp(ui = ui, server = server)
```



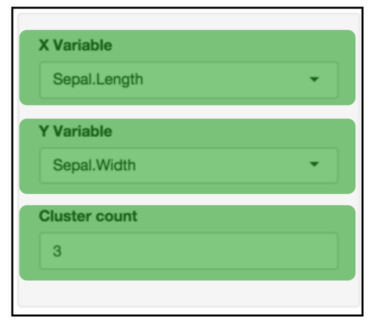
# Recap

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

Begin each app with the template

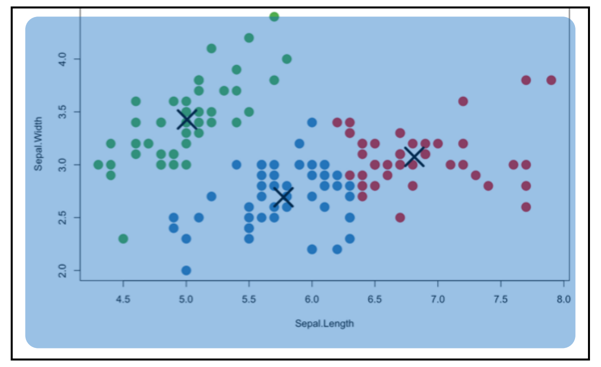
```
Hello World
```

Add elements as arguments to **fluidPage()**

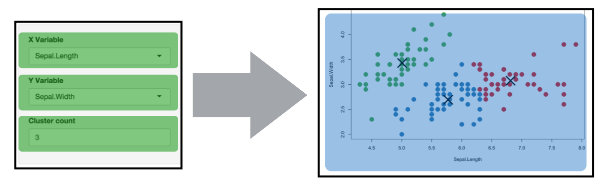


X Variable
Sepal.Length
Y Variable
Sepal.Width
Cluster count
3

Create reactive inputs with an ***Input()** function



Display R results with an ***Output()** function



Use the server function to assemble inputs into outputs

# Recap: Server

Use the server function to assemble inputs into outputs. Follow 3 rules:

`output$hist <-`

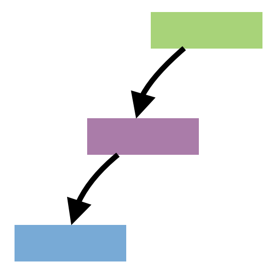
1. Save the output that you build to **output$**

```
renderPlot({
  hist(rnorm(input$num))
})
```

2. Build the output with a **render*()** function

`input$num`

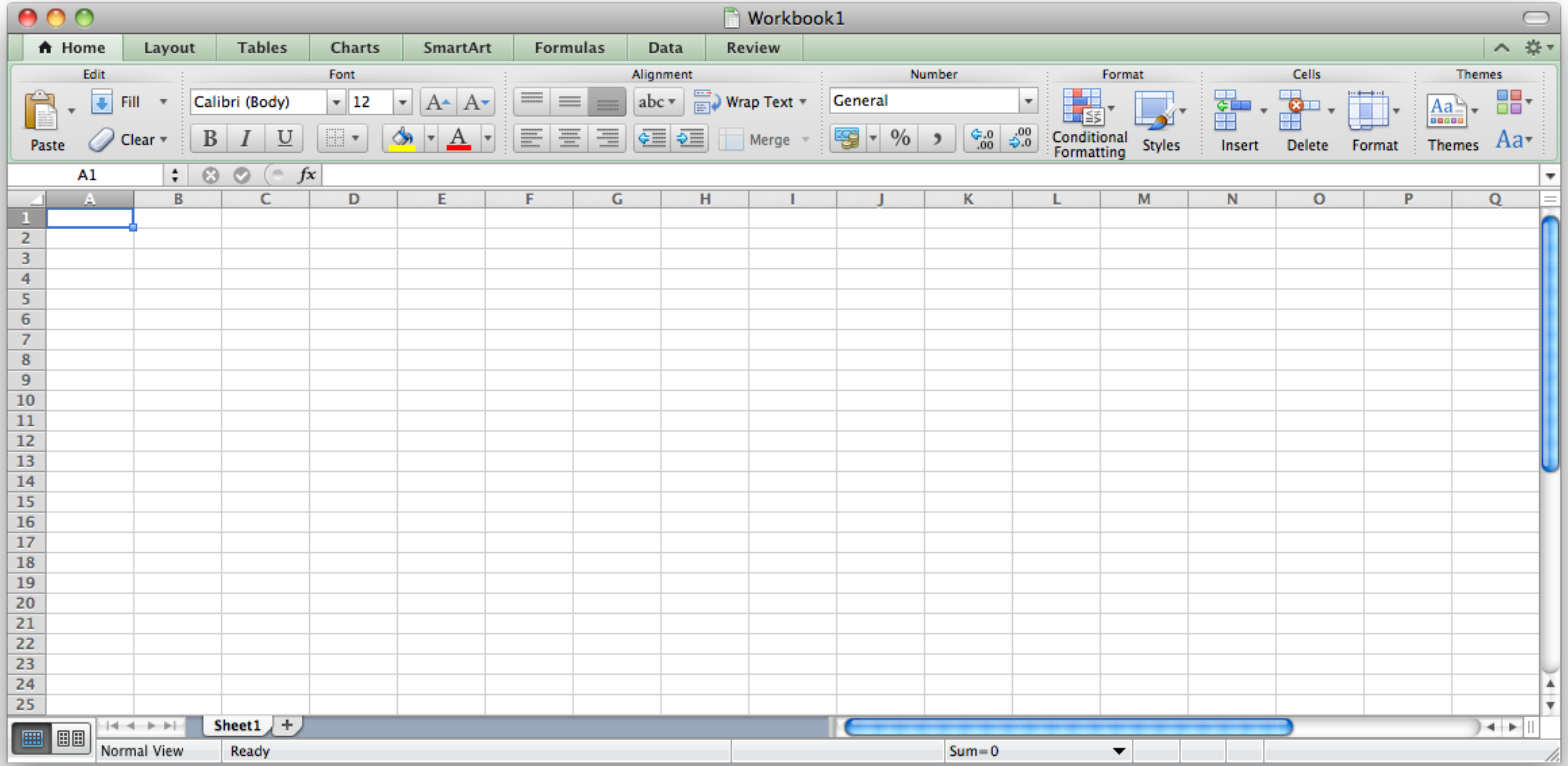
3. Access input values with **input$**



Create reactivity by using **Inputs** to build **rendered Outputs**

## Reactivity

# Think Excel.


Workbook1
Home
Layout
Tables
Charts
SmartArt
Formulas
Data
Review
Edit
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Format
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| F | G | H | I | J |
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| 50 | | | | = F4 + 1 |

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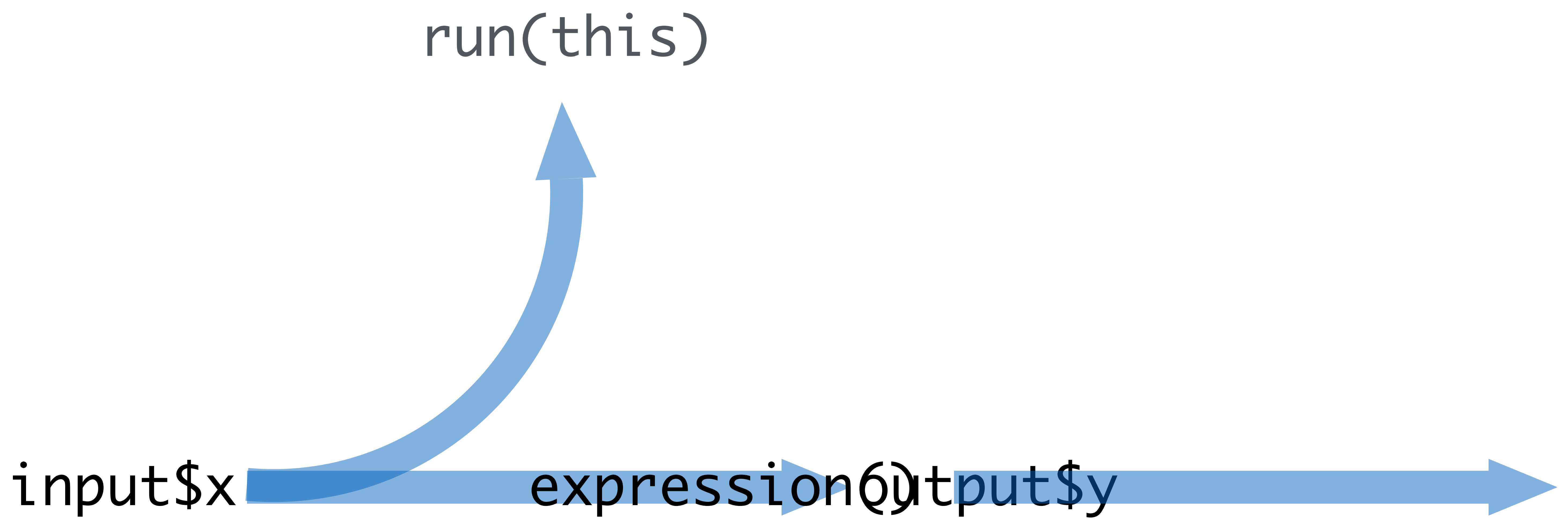
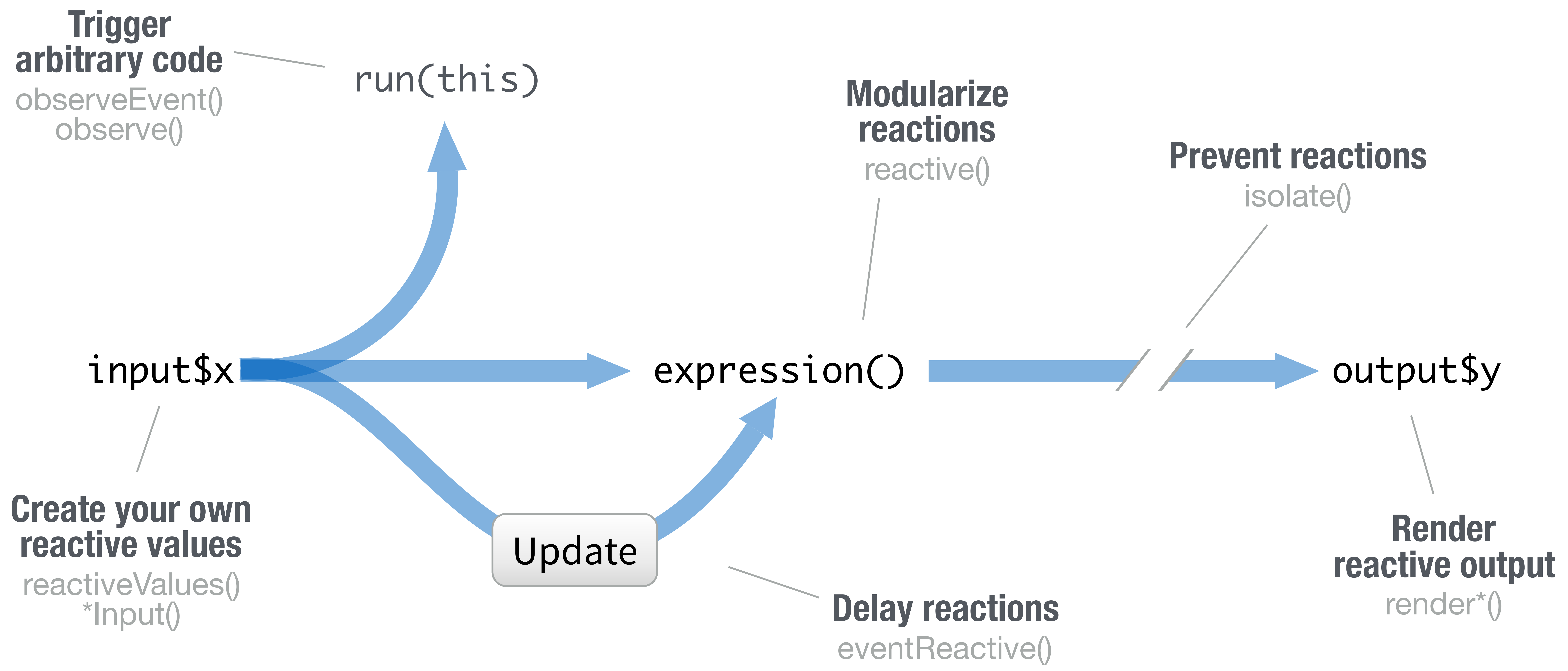
1000 → 1001

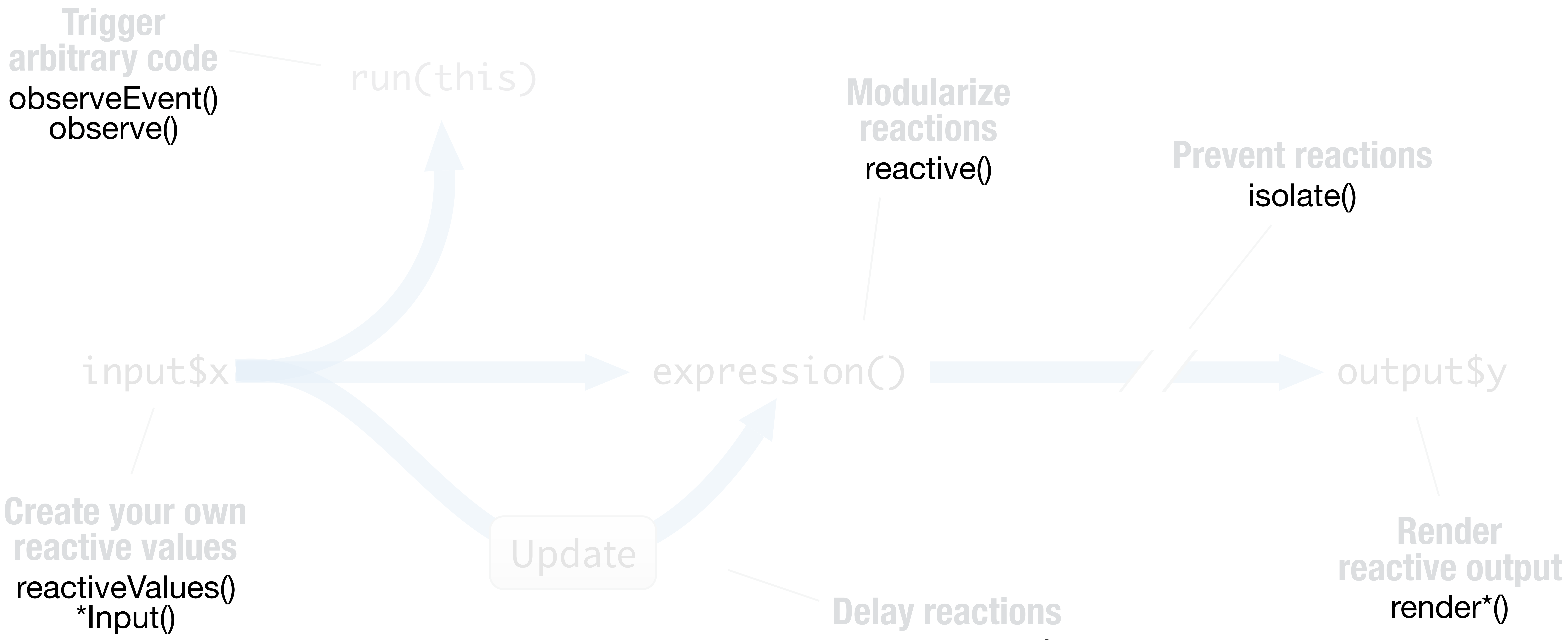
`input$x` → `output$y`

$$\begin{tikzcd}
 & \texttt{run(this)} & \\
\texttt{input\$x} \arrow[ur, bend right] \arrow[rr] & & \texttt{output\$y}
\end{tikzcd}$$


run(this)
input$x
expression()
output$y


Trigger arbitrary code
observeEvent()
observe()
run(this)
Modularize reactions
reactive()
Prevent reactions
isolate()
input$x
expression()
output$y
Create your own reactive values
reactiveValues()
*Input()
Update
Delay reactions
eventReactive()
Render reactive output
render*()

# Reactive functions



observeEvent()
observe()

reactive()

isolate()

reactiveValues()
*Input()

eventReactive()

render*()

You cannot call an **input value** (reactive value) from outside of a **reactive function**.

✓
```
renderPlot({ hist(rnorm(input$num)) })
```

⚠
```
hist(rnorm(input$num))
```

## Think of reactivity in R as a two step process

**1 Reactive values notify**
the objects that use them
when they become invalid

**2 Objects respond**
How the object responds
depends on which reactive
function created it.

`input$x` $\longrightarrow$ `output$y <- renderPlot({`

```
  hist(rnorm(input$num))
})
```

```
> hist(rnorm(input$num))
```

## render*()

```
output$p <- renderPlot({hist(rnorm(input$num))})
```

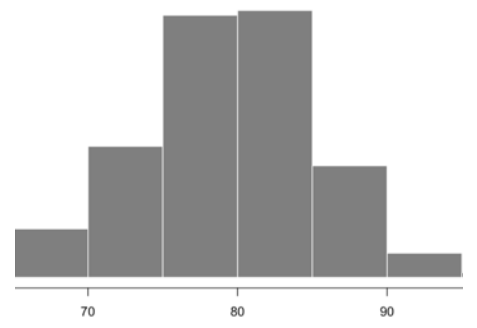
Builds an object that: Reruns code chunk (saves results to output$)

When notified by: any reactive value in the code chunk

## Each function builds a different type of output.

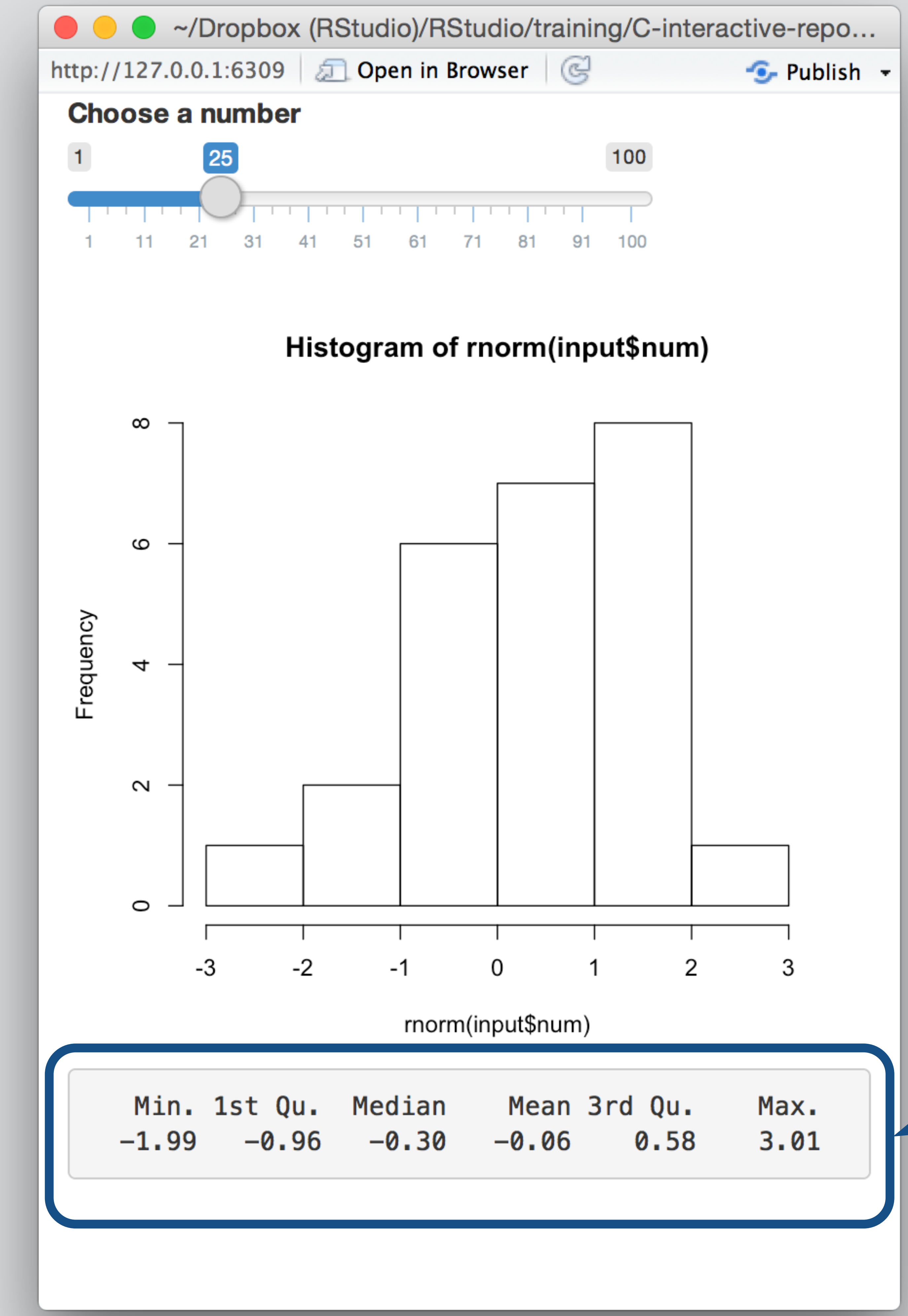
| function | creates |
|---|---|
| `renderDataTable()` | An interactive table (from a data frame, matrix, or other table-like structure) |
| `renderImage()` | An image (saved as a link to a source file) |
| `renderPlot()` | A plot |
| `renderPrint()` | A code block of printed R output |
| `renderTable()` | A table (from a data frame, matrix, or other table-like structure) |
| `renderText()` | A character string |
| `renderUI()` | a Shiny UI element |

# Use…



**render*()** to make an **object to display** in the UI.

## Your Turn

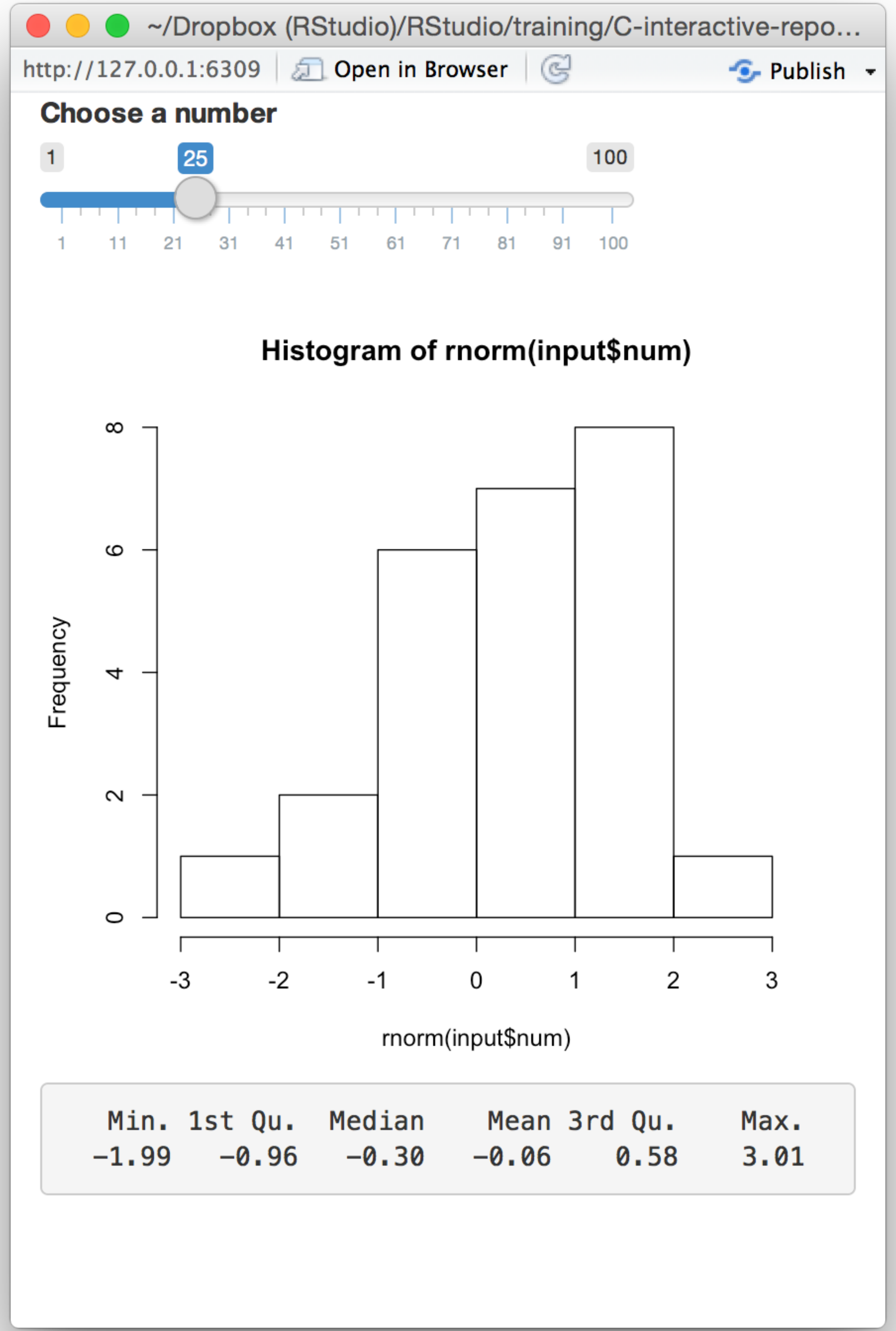


```
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 -1.99   -0.96   -0.30   -0.06    0.58    3.01
```

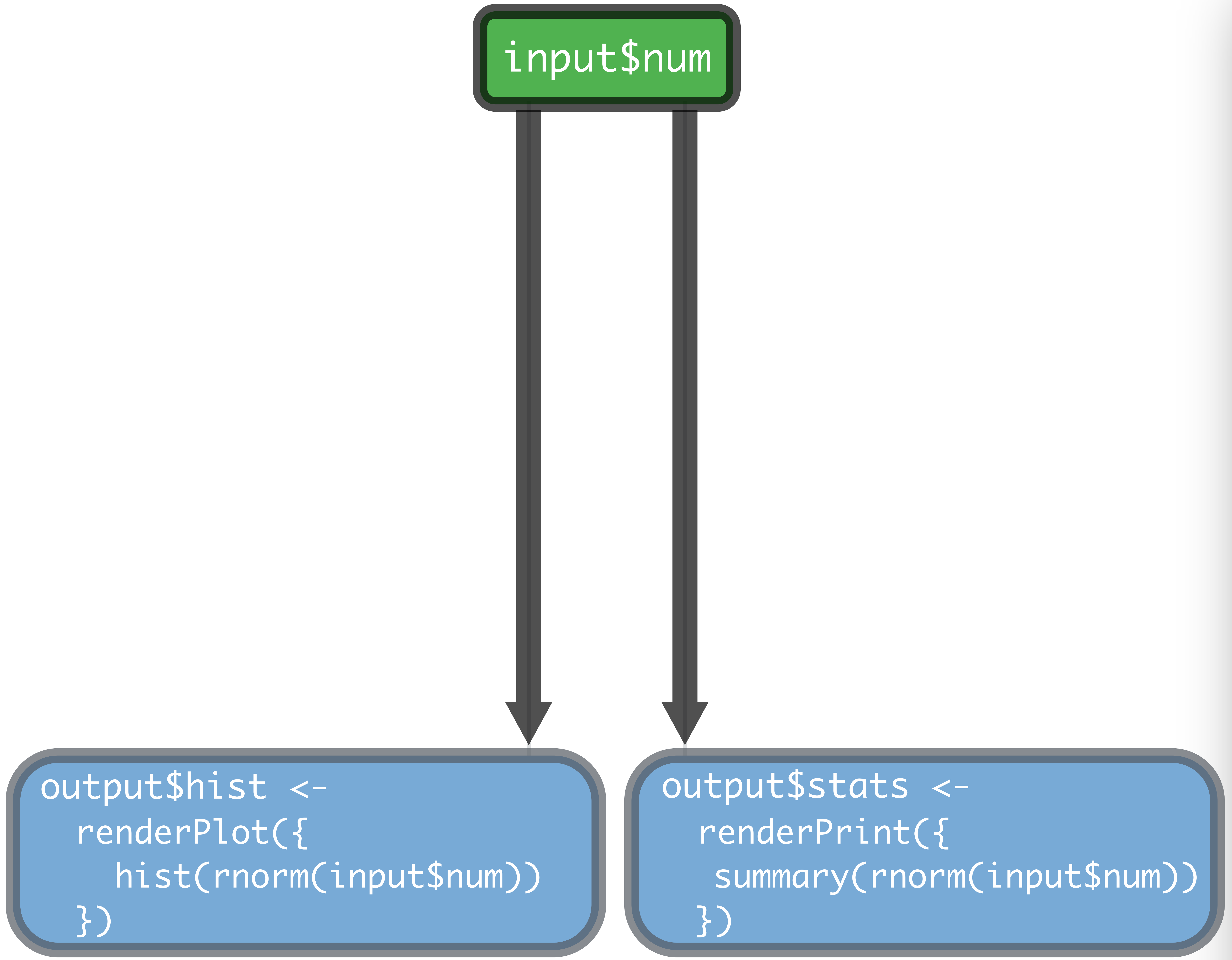
Use **renderPrint()** and **verbatimTextOutput()** to add a **summary()** of **rnorm(input$num)** to your app, e.g.

```
summary(rnorm(input$num))
```

```
ui <- fluidPage(
  sliderInput("num", “Choose a #”, 1, 100, 50),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
   output$hist <- renderPlot({
     hist(rnorm(input$num))
   })
   output$sum <- renderPrint({
     summary(rnorm(input$num))
   })
}
shinyApp(ui = ui, server = server)
```

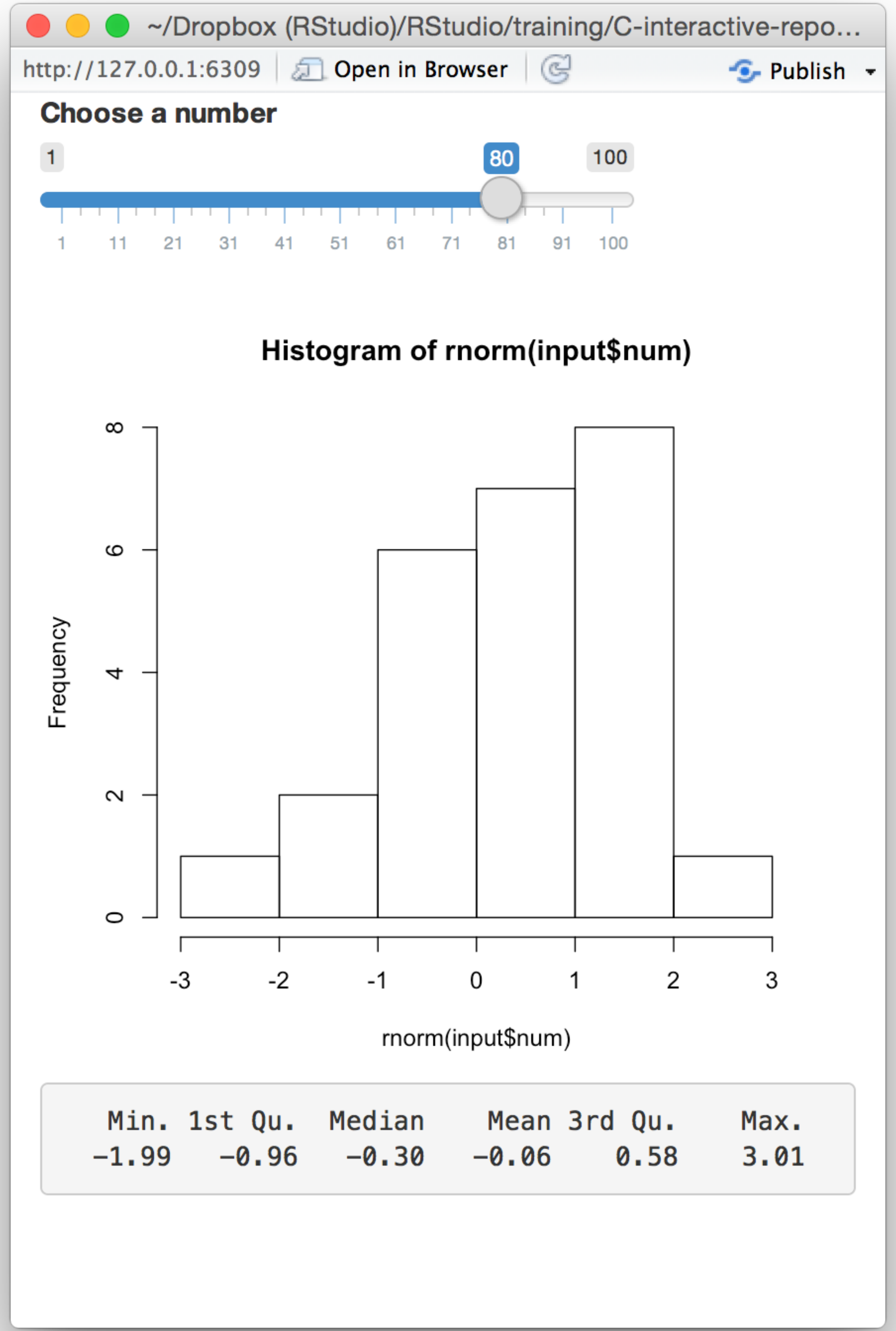


```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  -1.99   -0.96   -0.30   -0.06    0.58    3.01 
```

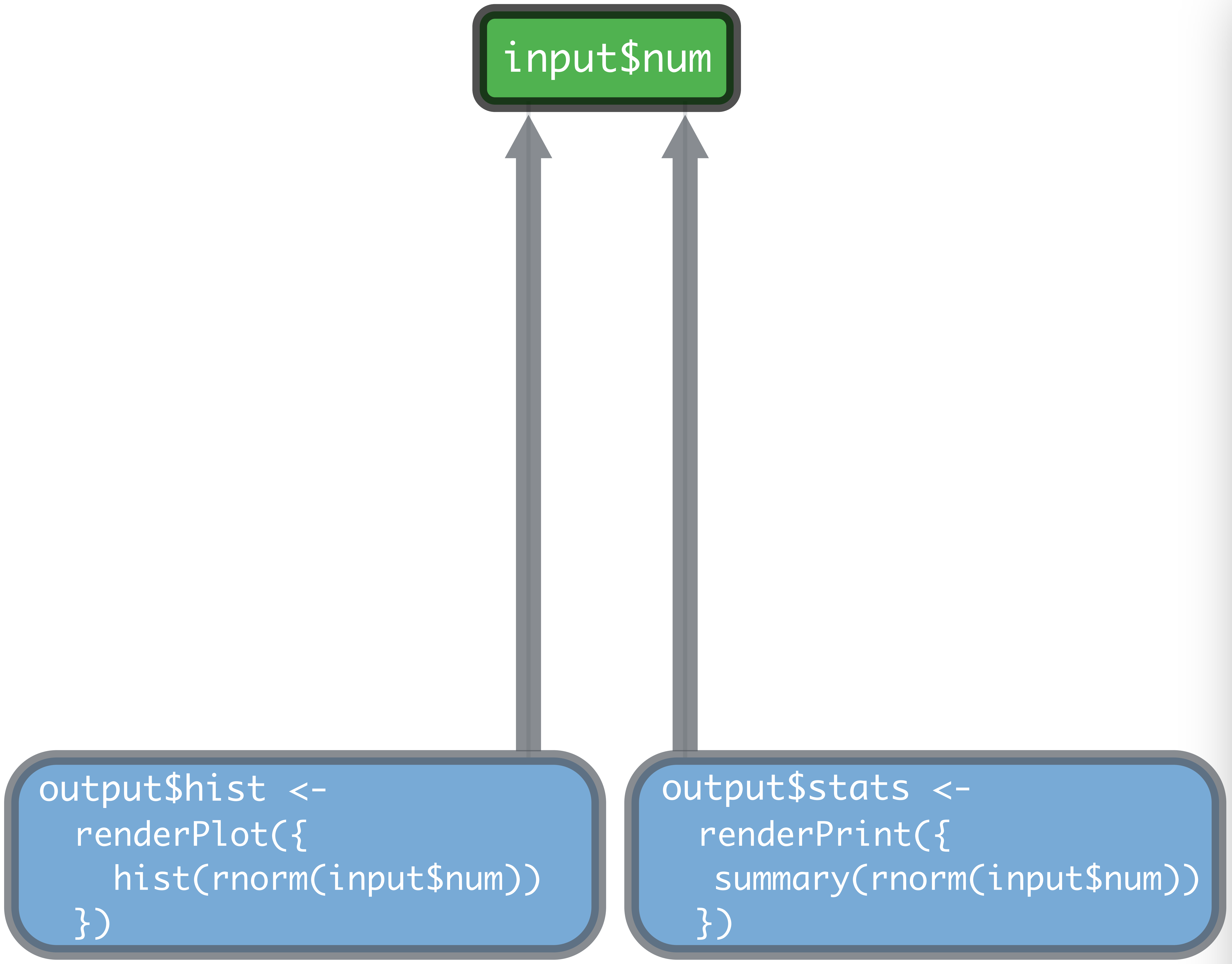


```r
output$hist <-
  renderPlot({
    hist(rnorm(input$num))
  })
```

```r
output$stats <-
  renderPrint({
   summary(rnorm(input$num))
  })
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 -1.99   -0.96   -0.30   -0.06    0.58    3.01
```

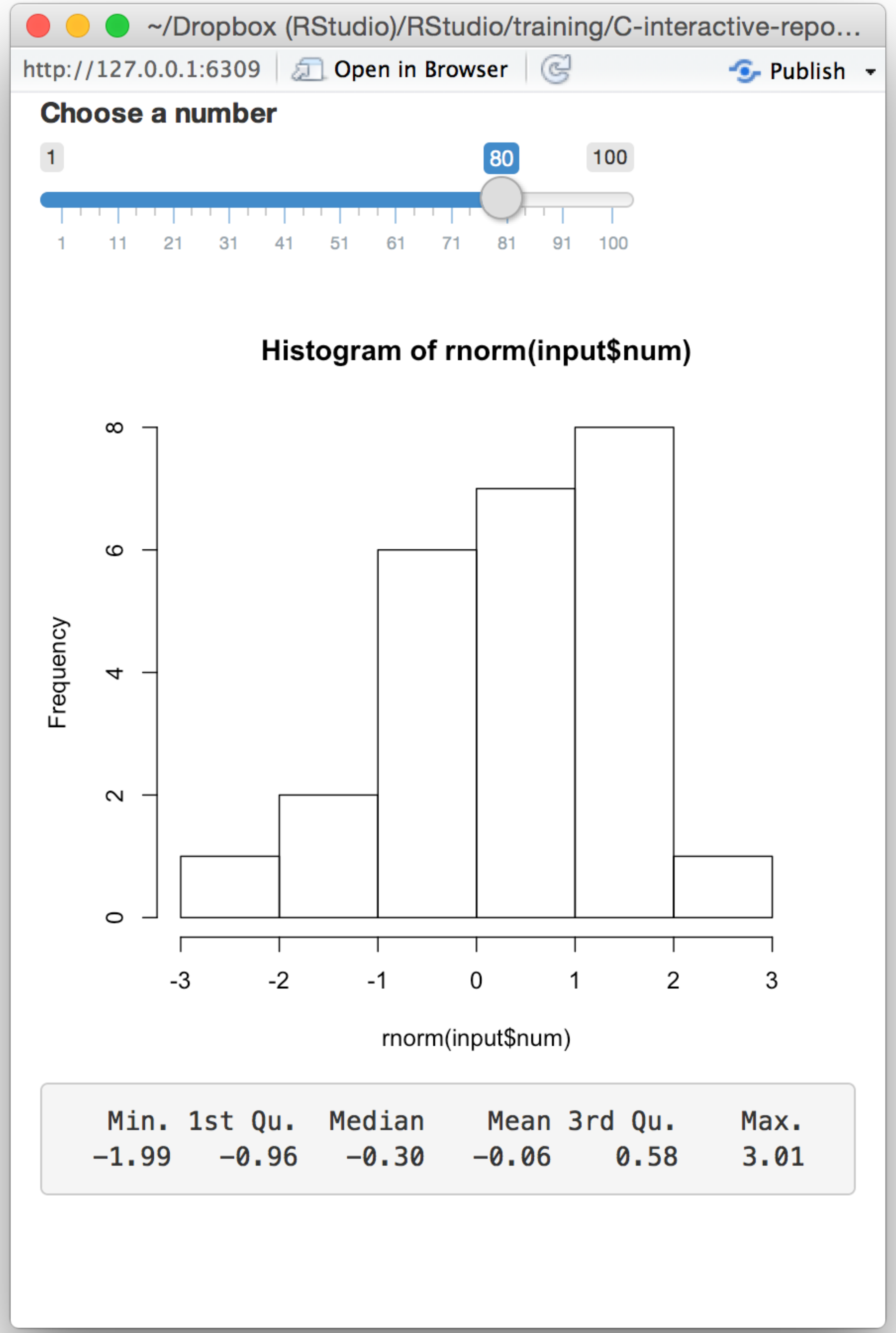


```
output$hist <-
  renderPlot({
    hist(rnorm(input$num))
  })
```

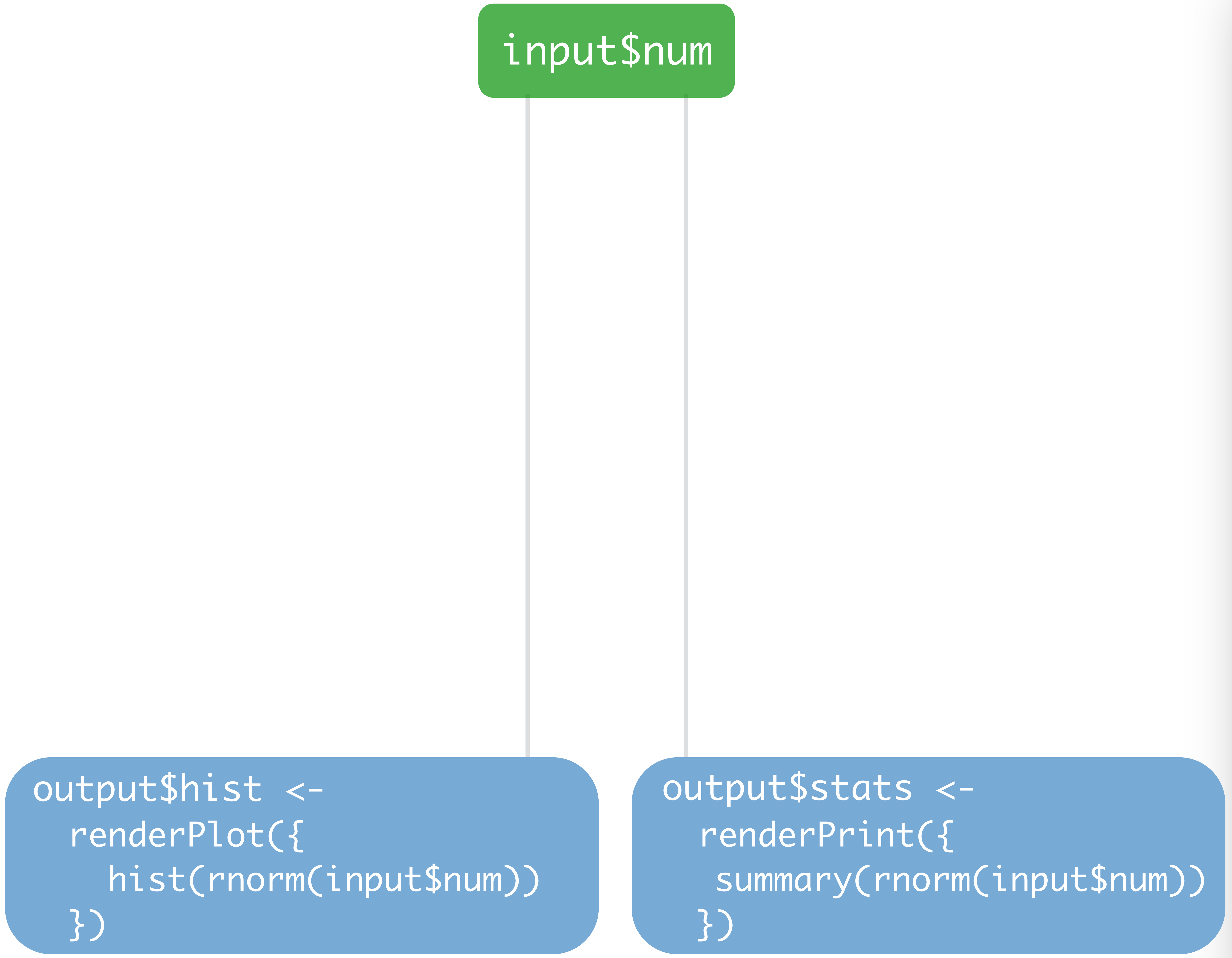
```
output$stats <-
  renderPrint({
   summary(rnorm(input$num))
  })
```

```
> hist(rnorm(input$num))
```

```
> summary(rnorm(input$num))
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  -1.99   -0.96   -0.30   -0.06    0.58    3.01 
```



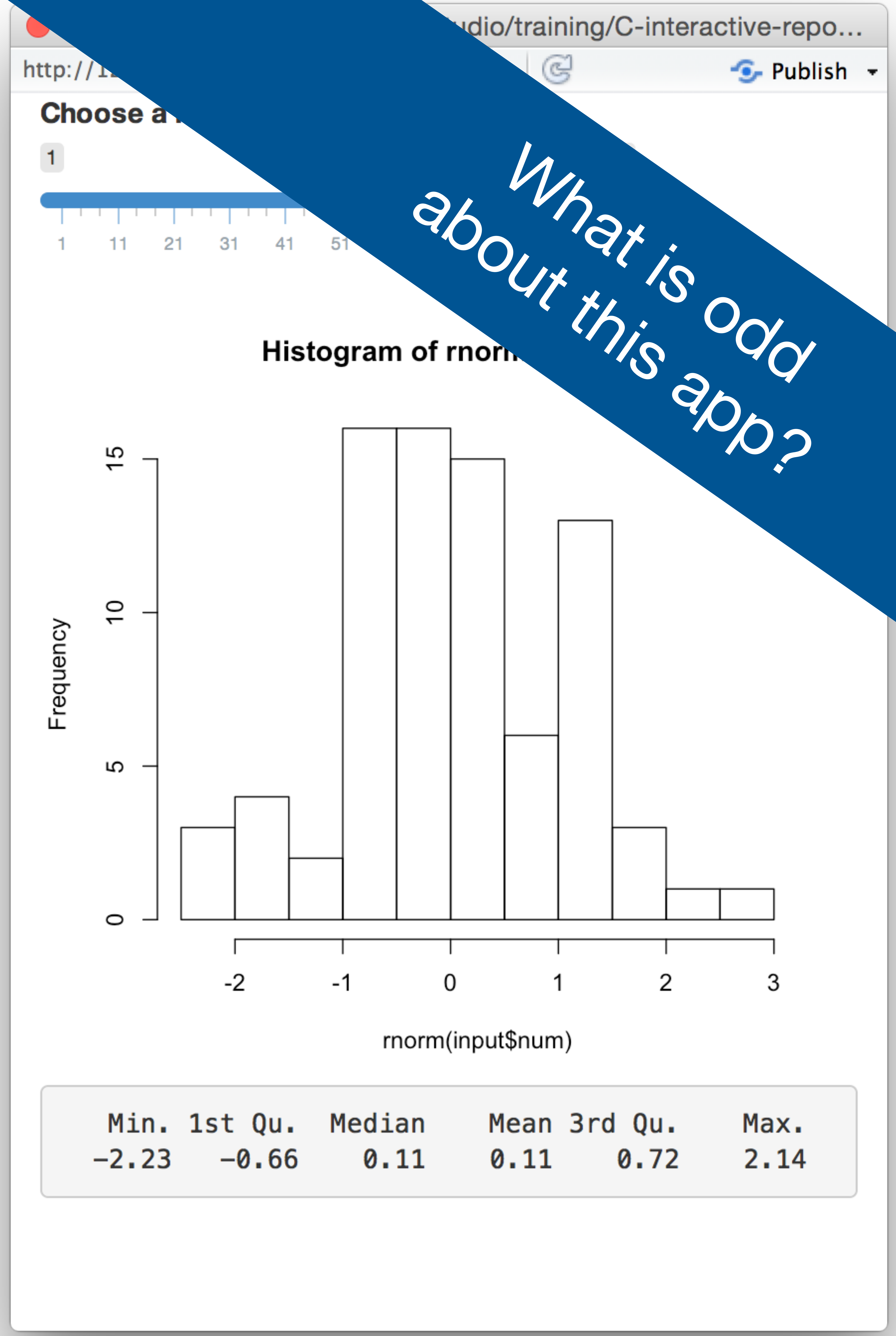
```
input$num
```

```
output$hist <-
  renderPlot({
    hist(rnorm(input$num))
  })
```

```
output$stats <-
  renderPrint({
   summary(rnorm(input$num))
  })
```

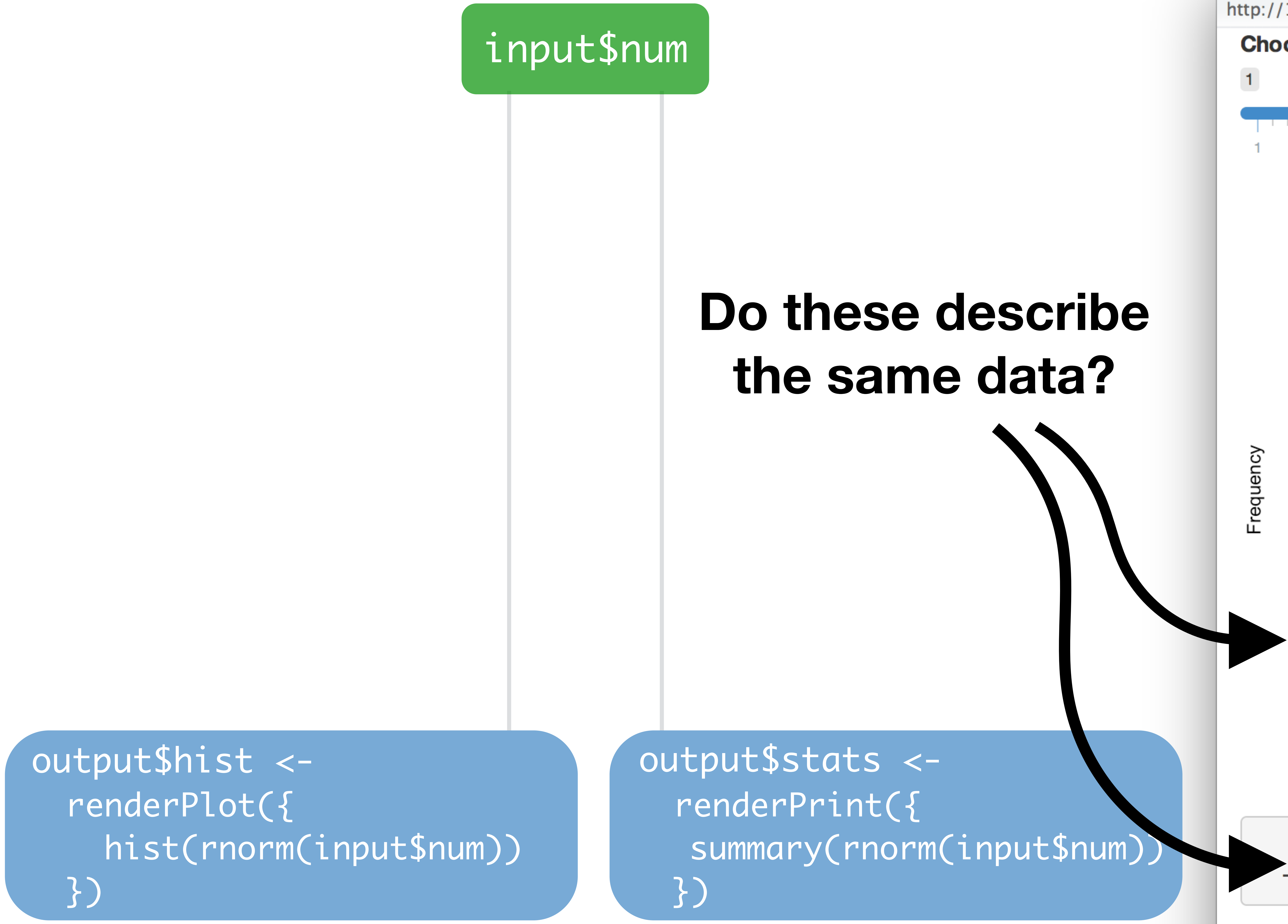
```
> hist(rnorm(input$num))
```

```
> summary(rnorm(input$num))
```



```
 Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-2.23   -0.66    0.11    0.11    0.72    2.14
```

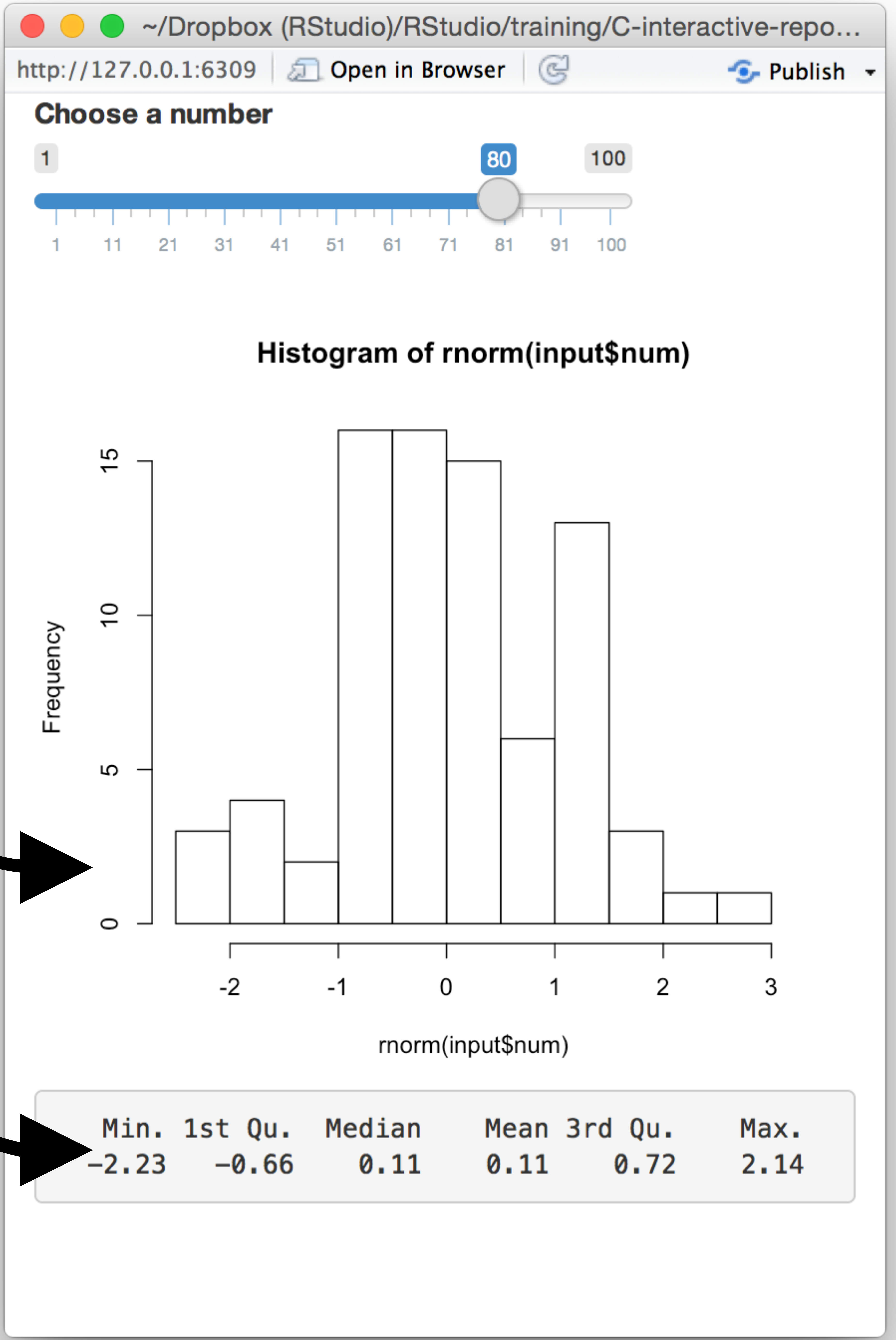
What is odd about this app?



```
output$hist <-
  renderPlot({
    hist(rnorm(input$num))
  })
```

```
output$stats <-
  renderPrint({
   summary(rnorm(input$num))
  })
```

**Do these describe the same data?**



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -2.23   -0.66    0.11    0.11    0.72    2.14
```

## reactive()

Makes a reactive object that you can use in downstream code.

```
data <- reactive(   { rnorm(input$num) })
```

Builds an object that: notifies objects that use it that they are invalid

When notified by: any reactive value in the code chunk

## A reactive expression is special in two ways

```
data()
```

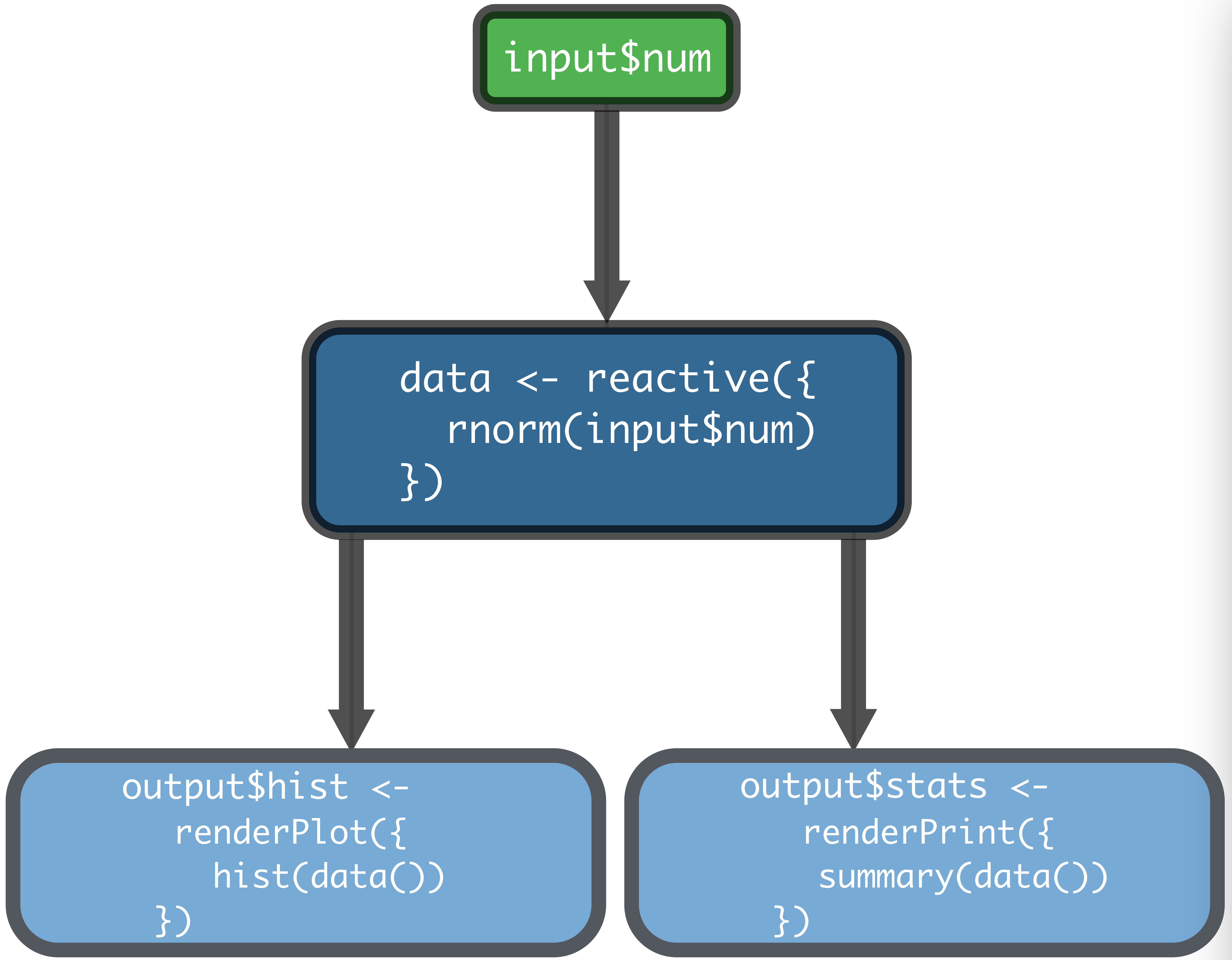
**1** You call a reactive expression like a function

## A reactive expression is special in two ways

```
data()
```

**1** You call a reactive expression like a function

**2** Reactive expressions **cache** their values
(the expression will return its most recent value, unless it has become invalidated)

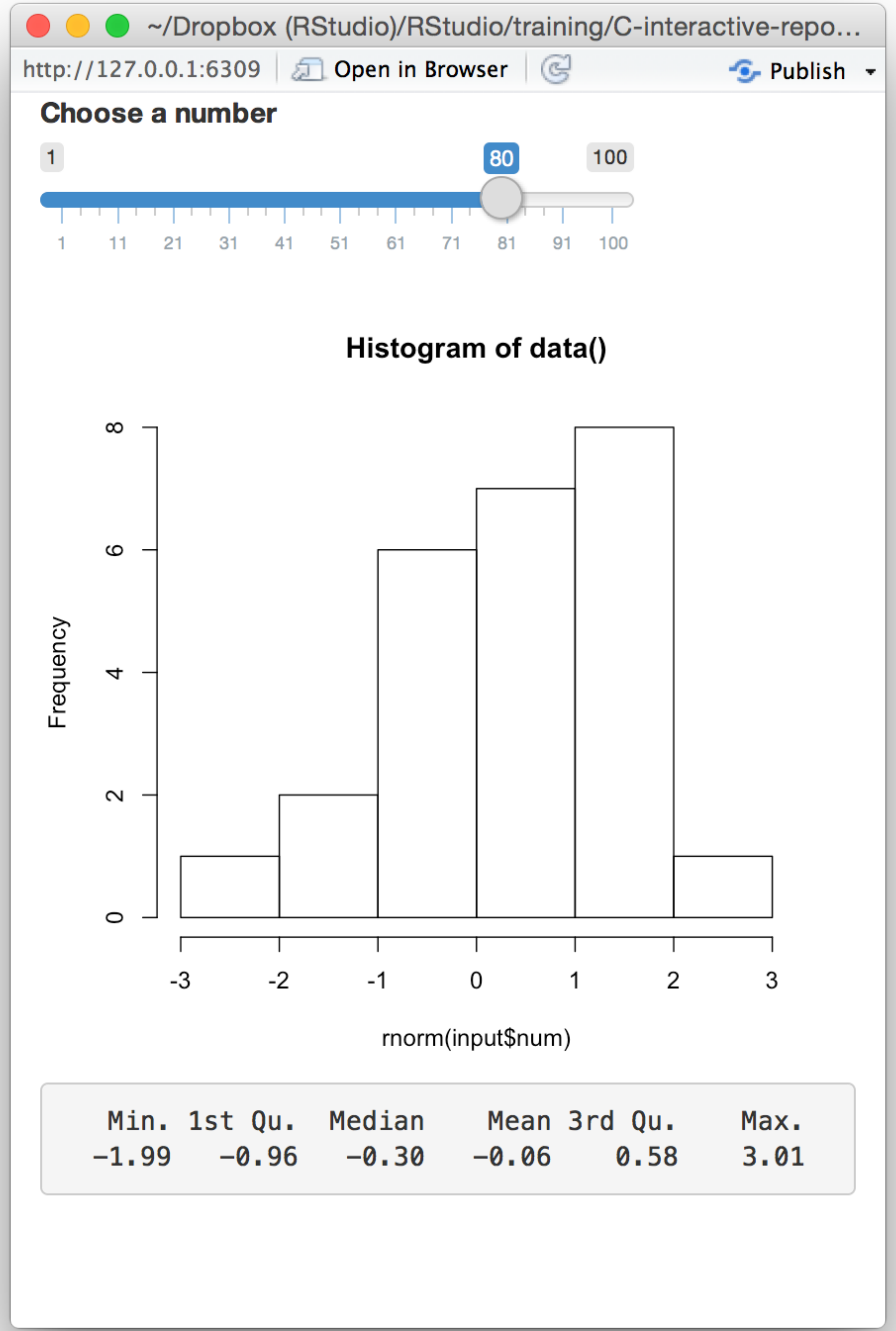


```
input$num
```

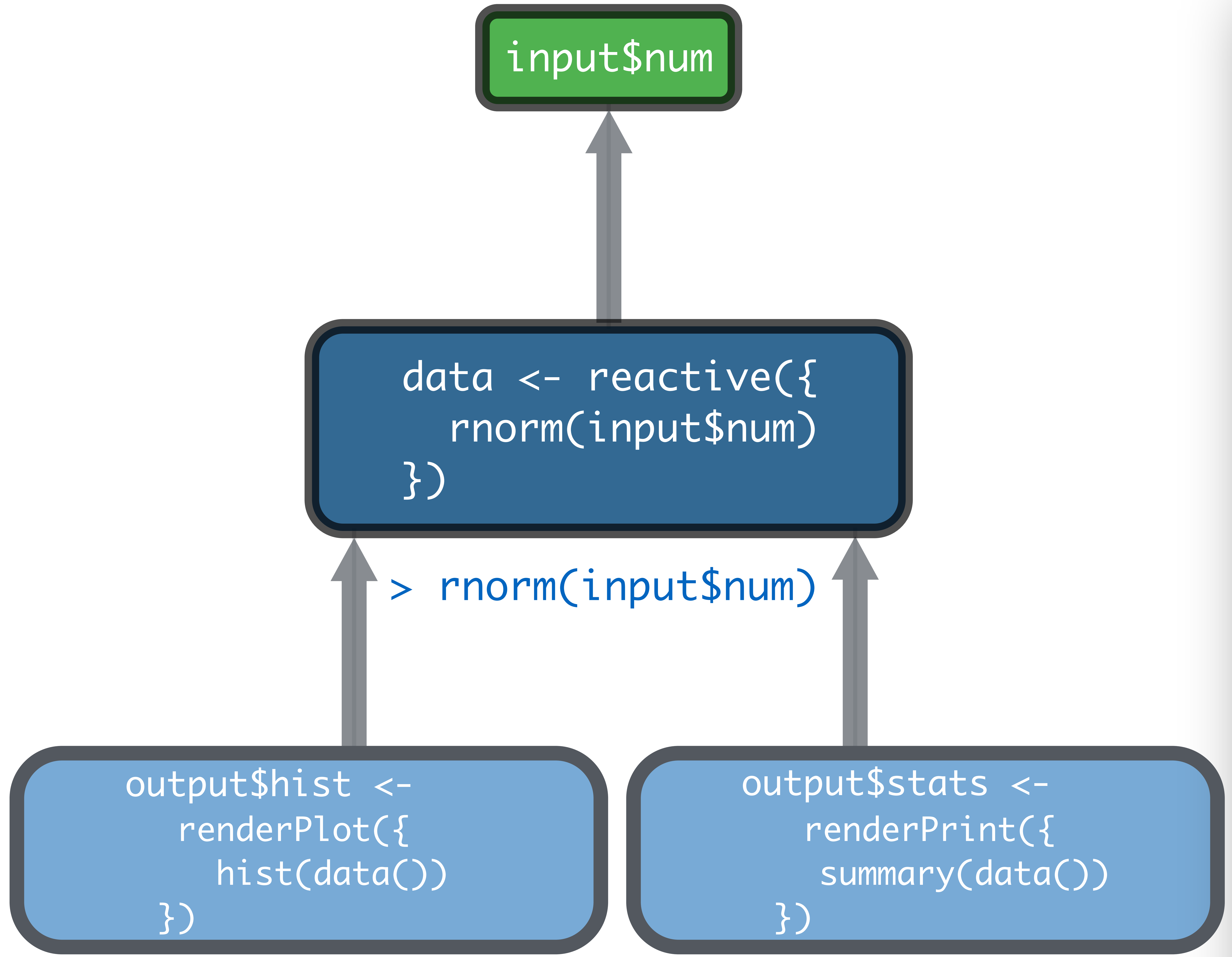
```
data <- reactive({
  rnorm(input$num)
})
```

```
output$hist <-
  renderPlot({
    hist(data())
})
```

```
output$stats <-
  renderPrint({
    summary(data())
})
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  -1.99   -0.96   -0.30   -0.06    0.58    3.01 
```



```
input$num
```

```
data <- reactive({
  rnorm(input$num)
})
```

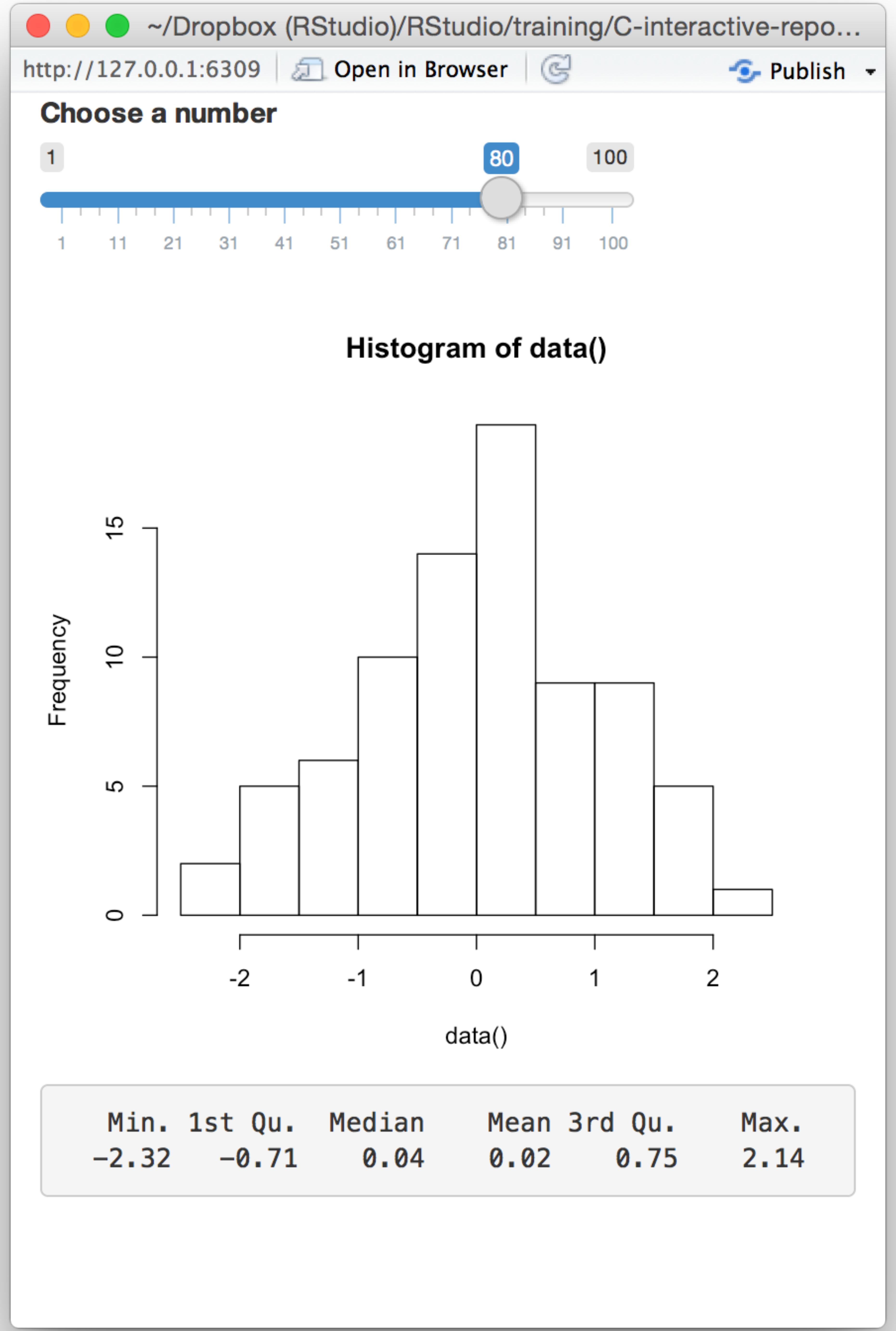
```
> rnorm(input$num)
```

```
output$hist <-
  renderPlot({
    hist(data())
})
```

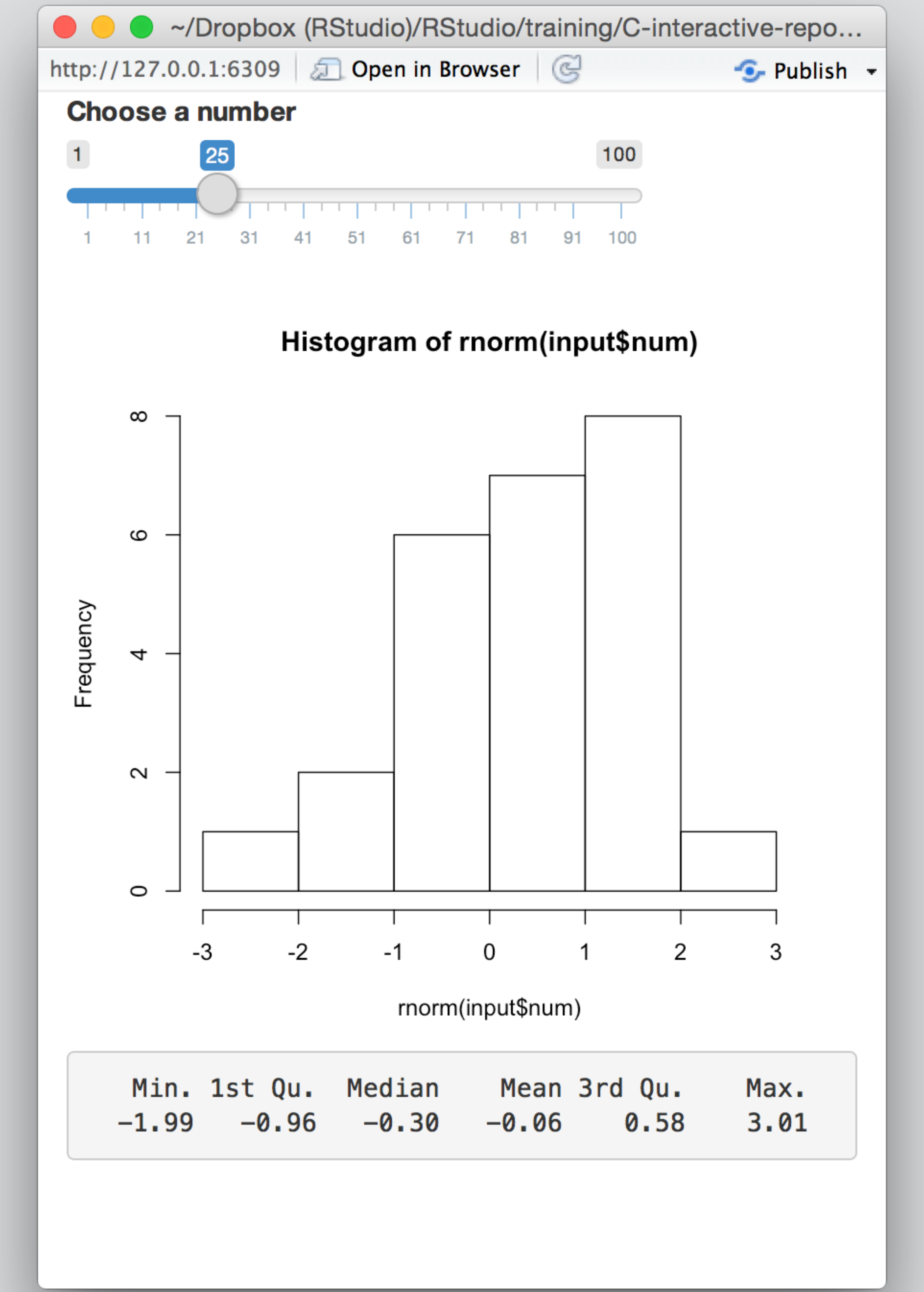
```
output$stats <-
  renderPrint({
    summary(data())
})
```

```
> hist(data())
```

```
> summary(data())
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -2.32   -0.71    0.04    0.02    0.75    2.14
```



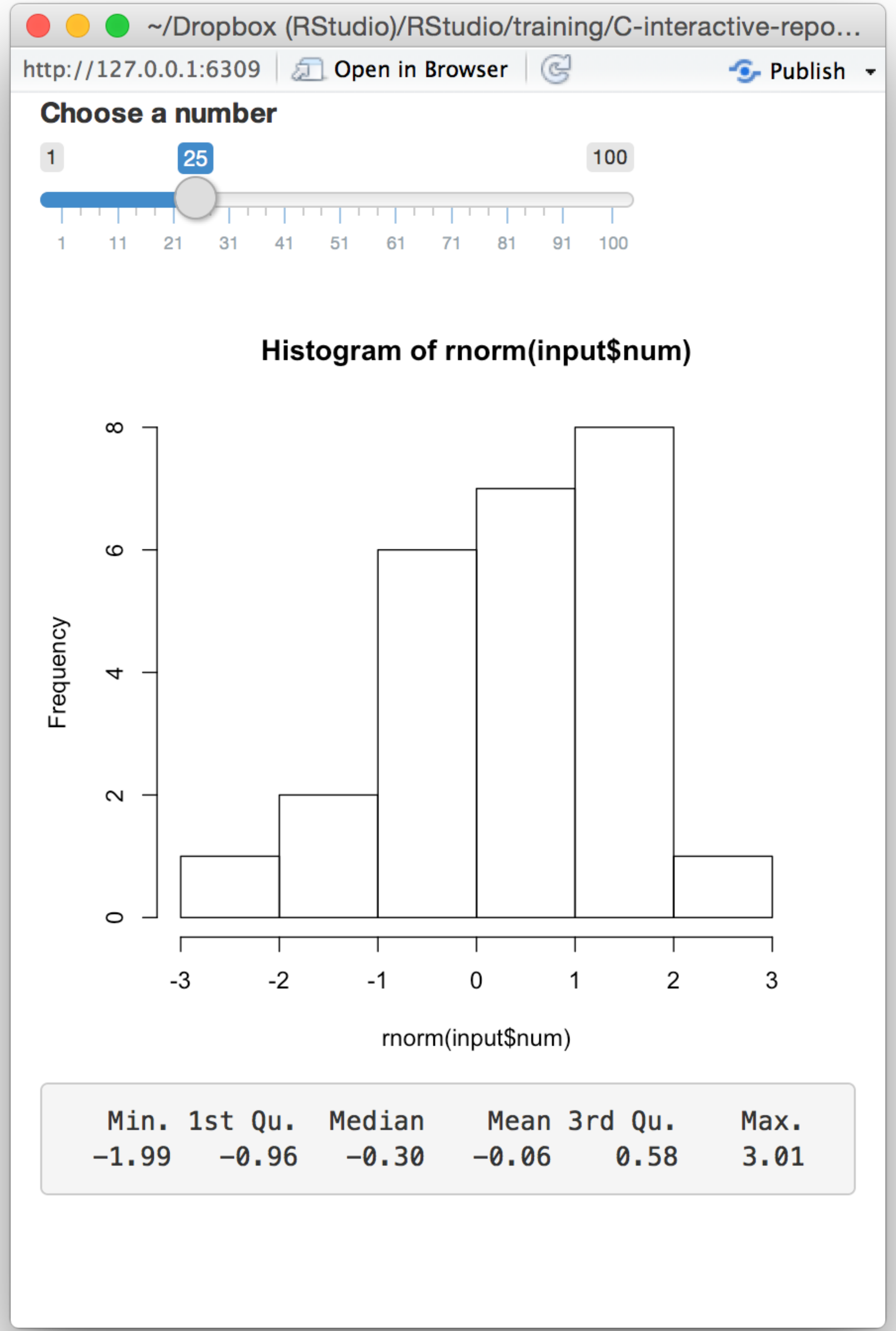
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -1.99   -0.96   -0.30   -0.06    0.58    3.01
```

## Your Turn

Use **reactive()** to pass the same data to the histogram and the summary.

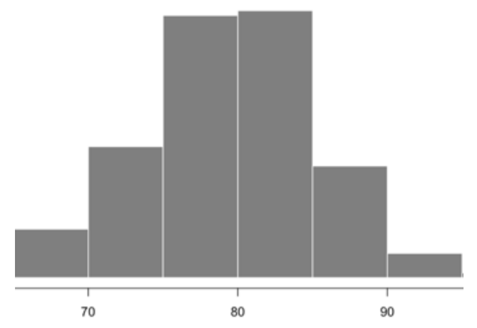
Ensure that you can predict how the app will work.

```r
ui <- fluidPage(
  sliderInput("num", “Choose a #”, 1, 100, 50),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
   data <- reactive({ rnorm(input$num) })
   output$hist <- renderPlot({
     hist(data())
   })
   output$sum <- renderPrint({
     summary(data())
   })
}
shinyApp(ui = ui, server = server)
```

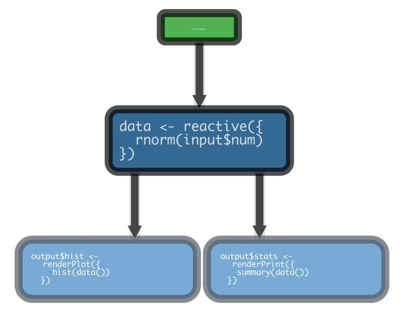


```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -1.99   -0.96   -0.30   -0.06    0.58    3.01
```

## Use…



**render()** to make an **object to display** in the UI.



```
data <- reactive({
  rnorm(input$num)
})
```

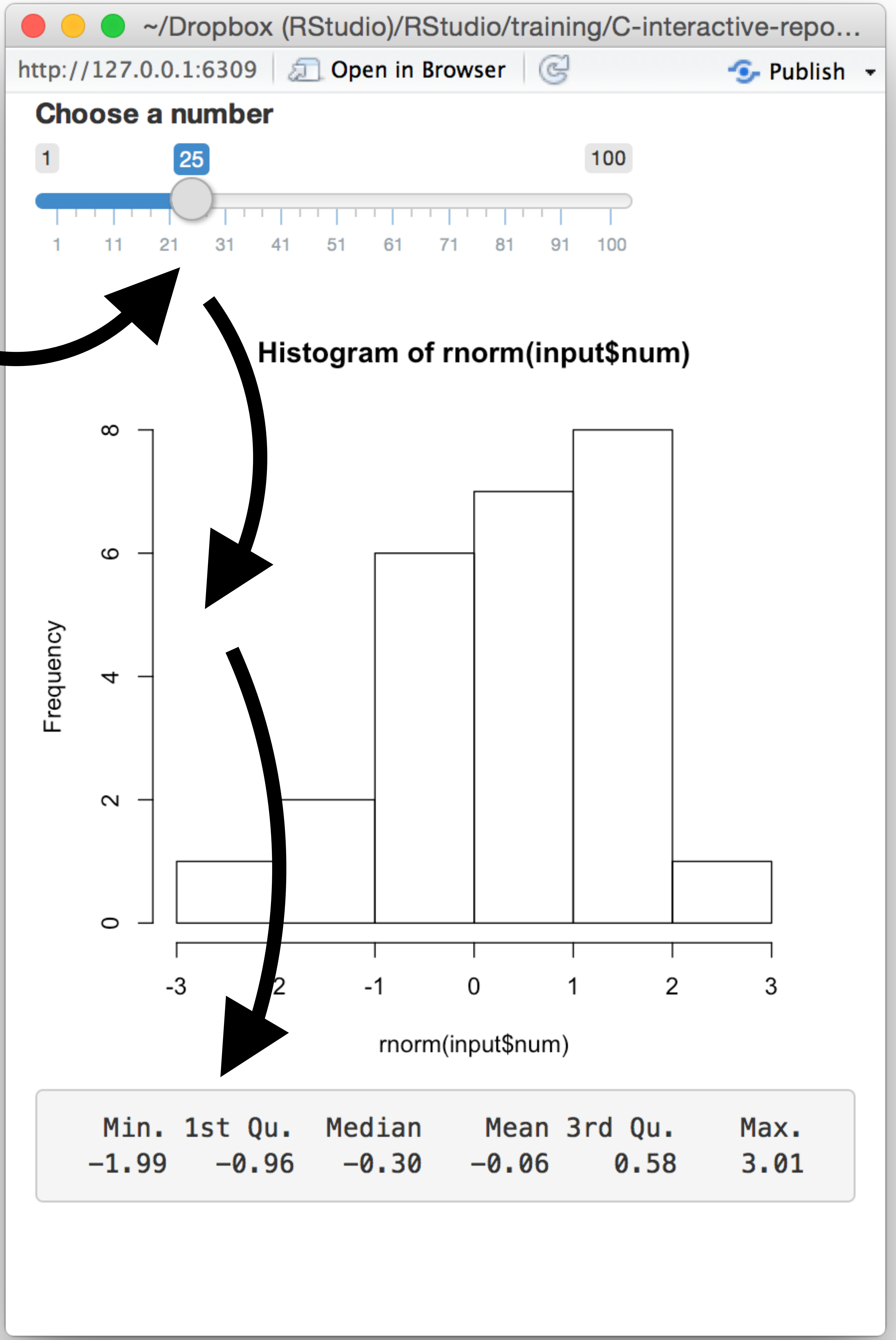
```
output$hist <-
  renderPlot({
    hist(data())
  })
```

```
output$stats <-
  renderPrint({
    summary(data())
  })
```

**reactive()** to make an **object to use** in downstream code.

```
ui <- fluidPage(
  sliderInput("num", “Choose a #”, 1, 100, 50),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
   data <- reactive({ rnorm(input$num) })
   output$hist <- renderPlot({
     hist(data())
   })
   output$sum <- renderPrint({
     summary(data())
   })
}
shinyApp(ui = ui, server = server)
```

**Can we delay the reactions?**



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -1.99   -0.96   -0.30   -0.06    0.58    3.01
```

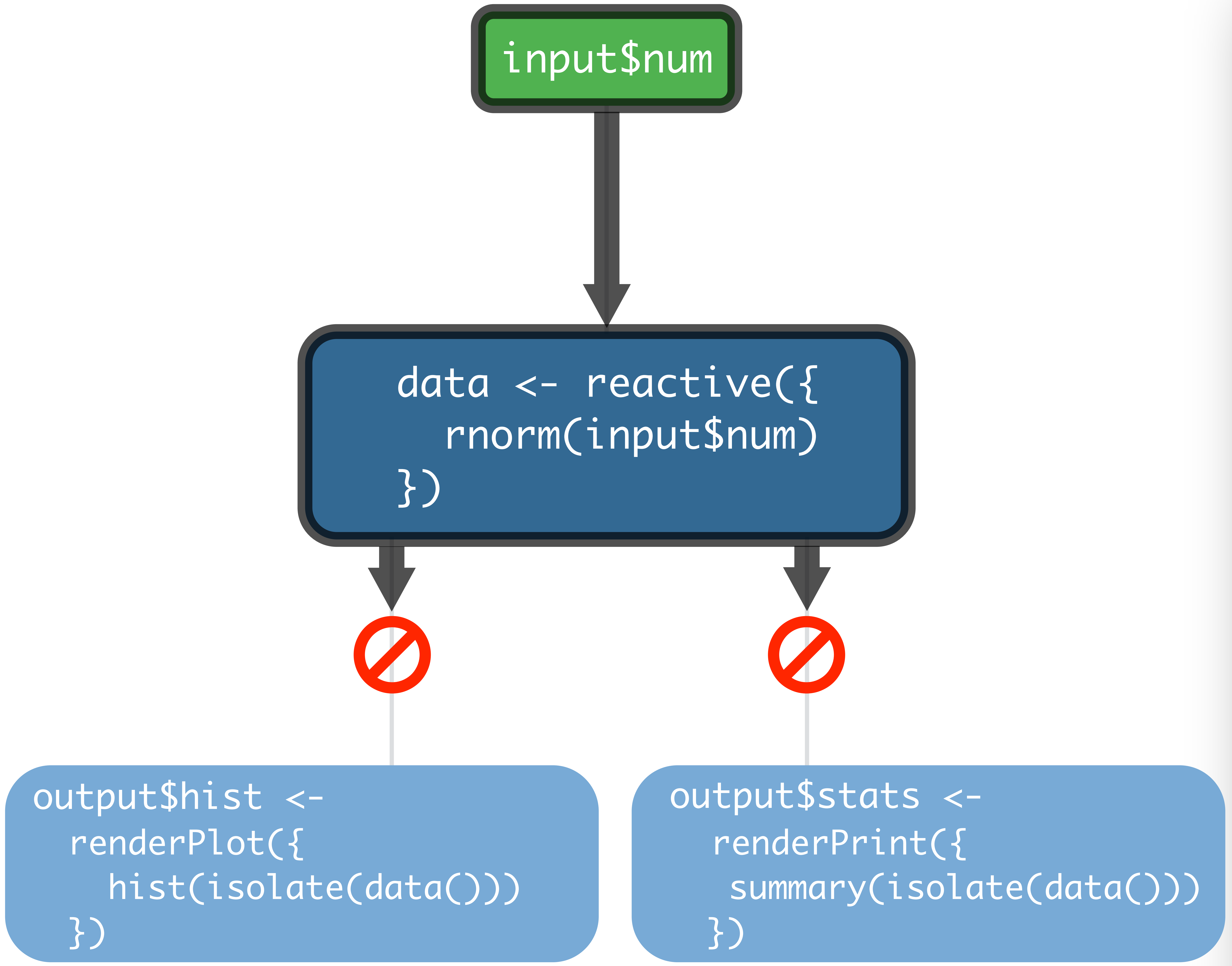
# isolate()

Makes a reactive object non-reactive.

```
renderPlot({ hist(rnorm(isolate(input$num))) })
```

Builds an object that: does nothing

When notified by: any reactive value wrapped by isolate

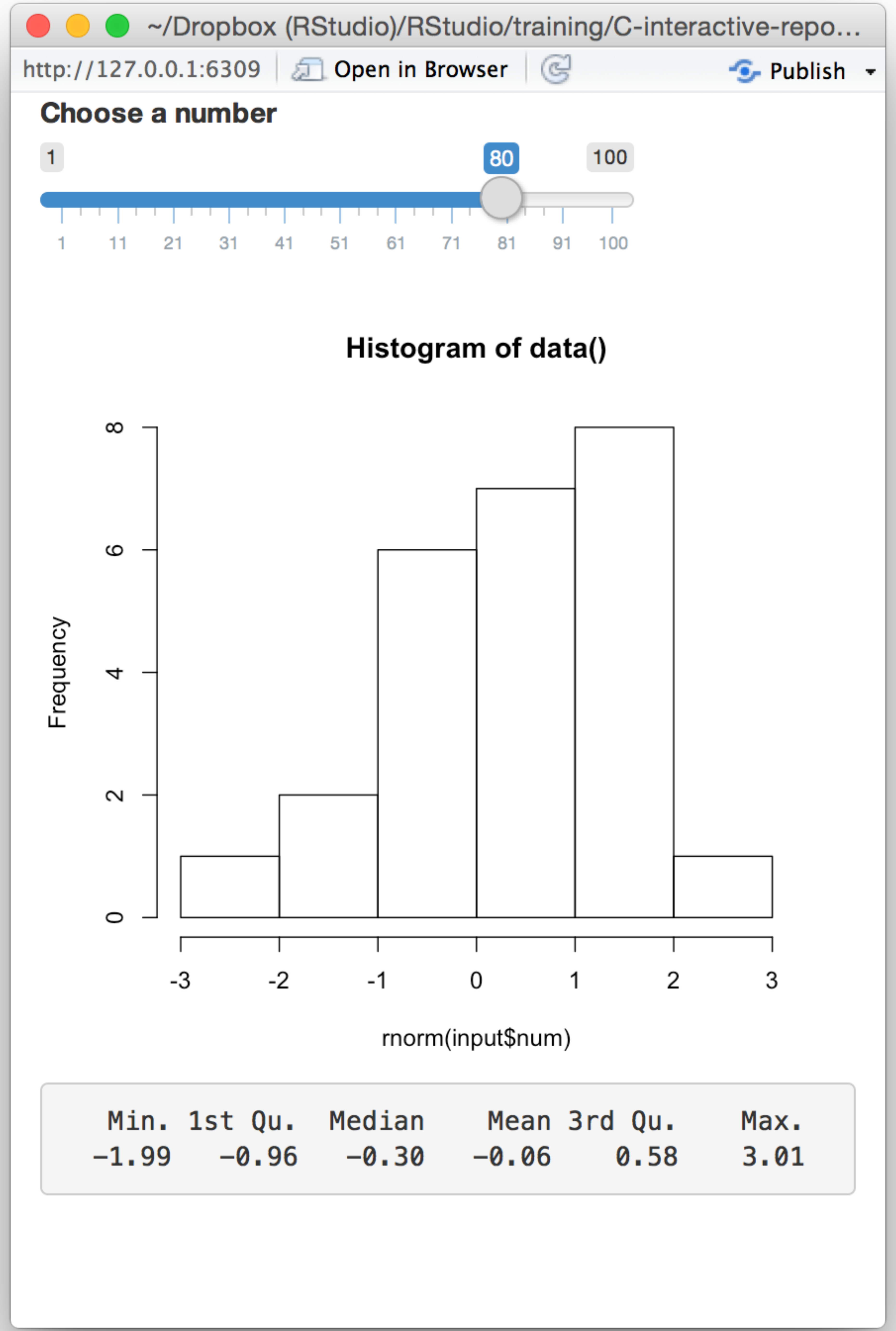


```
input$num
```

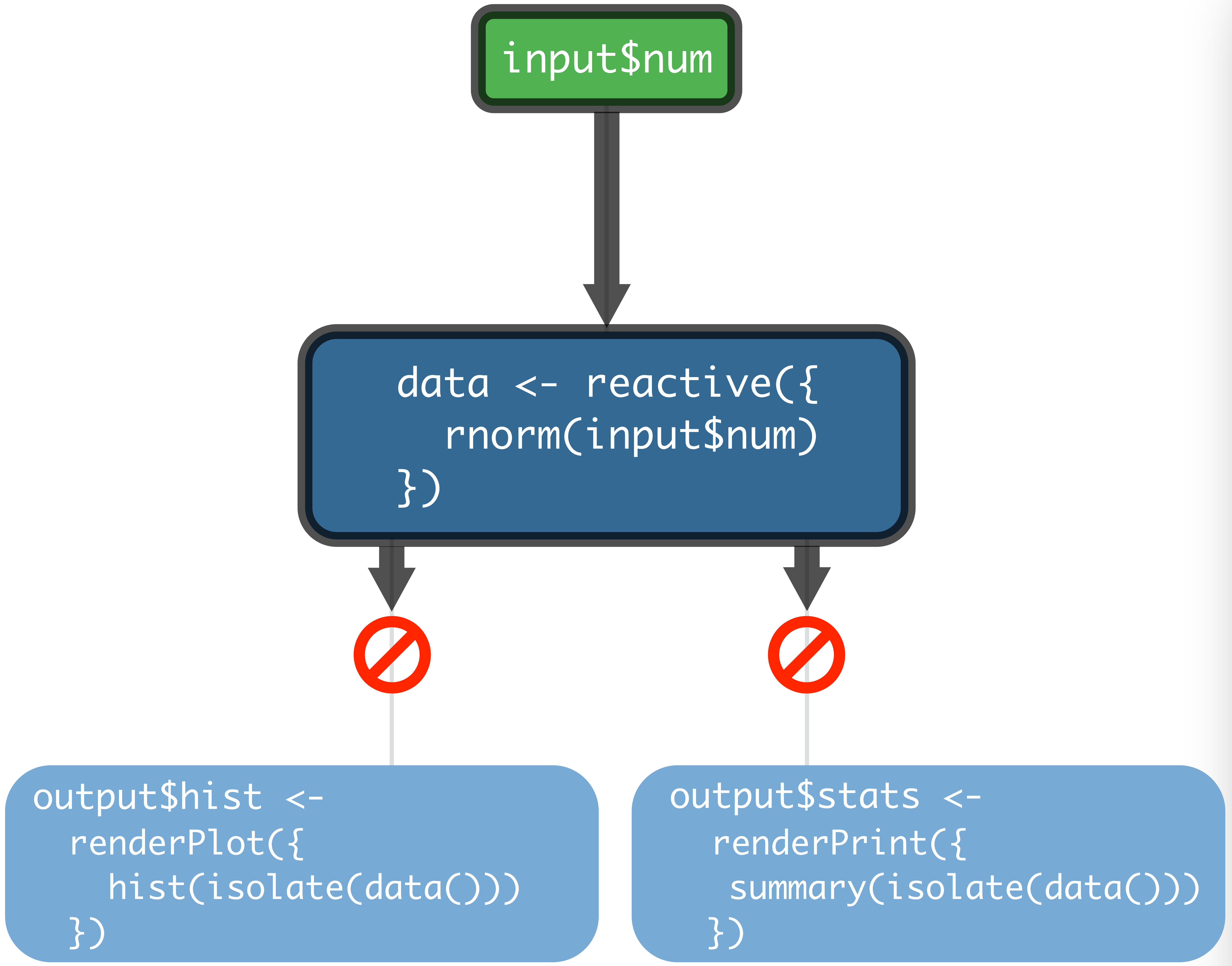
```
data <- reactive({
  rnorm(input$num)
})
```

```
output$hist <-
  renderPlot({
    hist(isolate(data()))
  })
```

```
output$stats <-
  renderPrint({
   summary(isolate(data()))
  })
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -1.99   -0.96   -0.30   -0.06    0.58    3.01
```

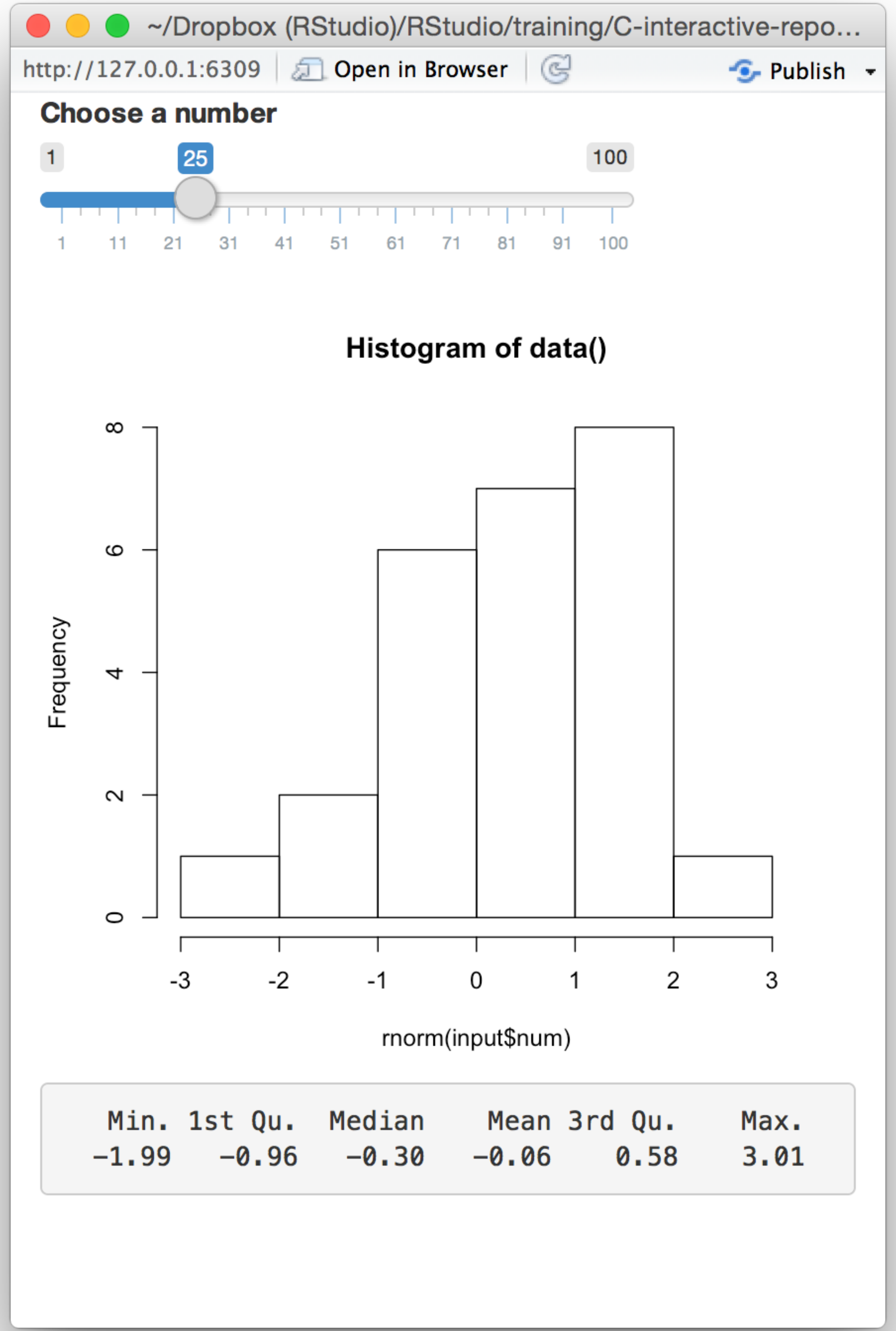


```r
input$num
```

```r
data <- reactive({
  rnorm(input$num)
})
```

```r
output$hist <-
  renderPlot({
    hist(isolate(data()))
  })
```

```r
output$stats <-
  renderPrint({
   summary(isolate(data()))
  })
```

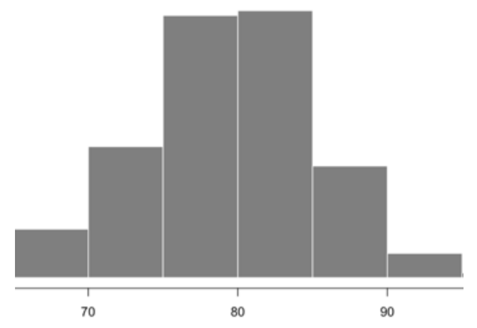


Choose a number

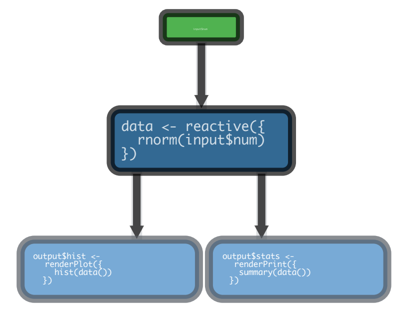
1 25 100

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  -1.99   -0.96   -0.30   -0.06    0.58    3.01 
```

## Use…



**render()** to make an **object to display** in the UI.



```
data <- reactive({
  rnorm(input$num)
})
```

```
output$hist <-
  renderPlot({
    hist(data())
  })
```

```
output$stats <-
  renderPrint({
    summary(data())
  })
```

**reactive()** to make an **object to use** in downstream code.

**isolate()** to return a **non-reactive object**.

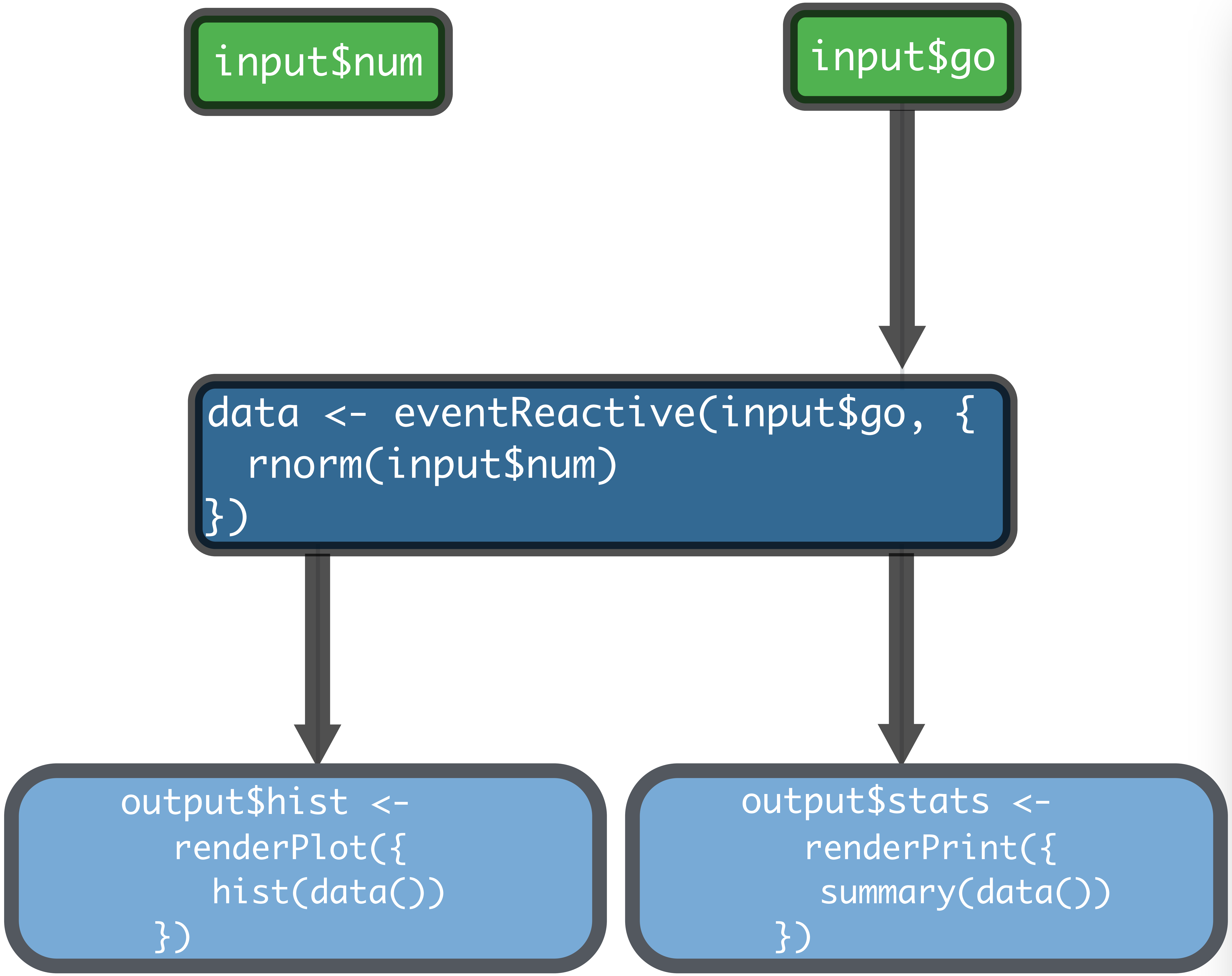
## eventReactive()

Let’s you control when an expression is invalidated

```
data <- eventReactive(input$go, { rnorm(input$num) })
```

Builds an object that: notifies objects that use it that they are invalid

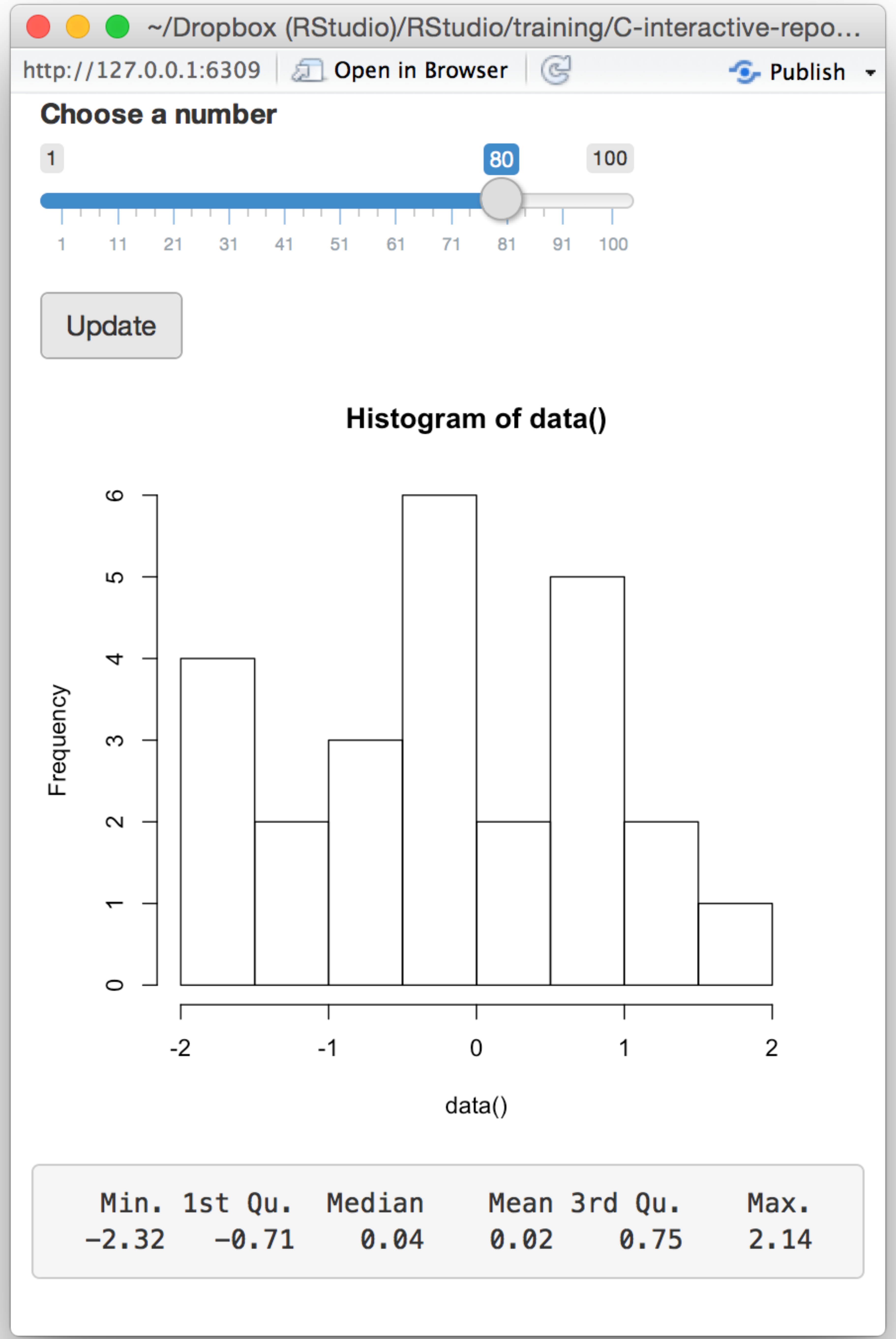
When notified by: this or these reactive value(s) **and no others**



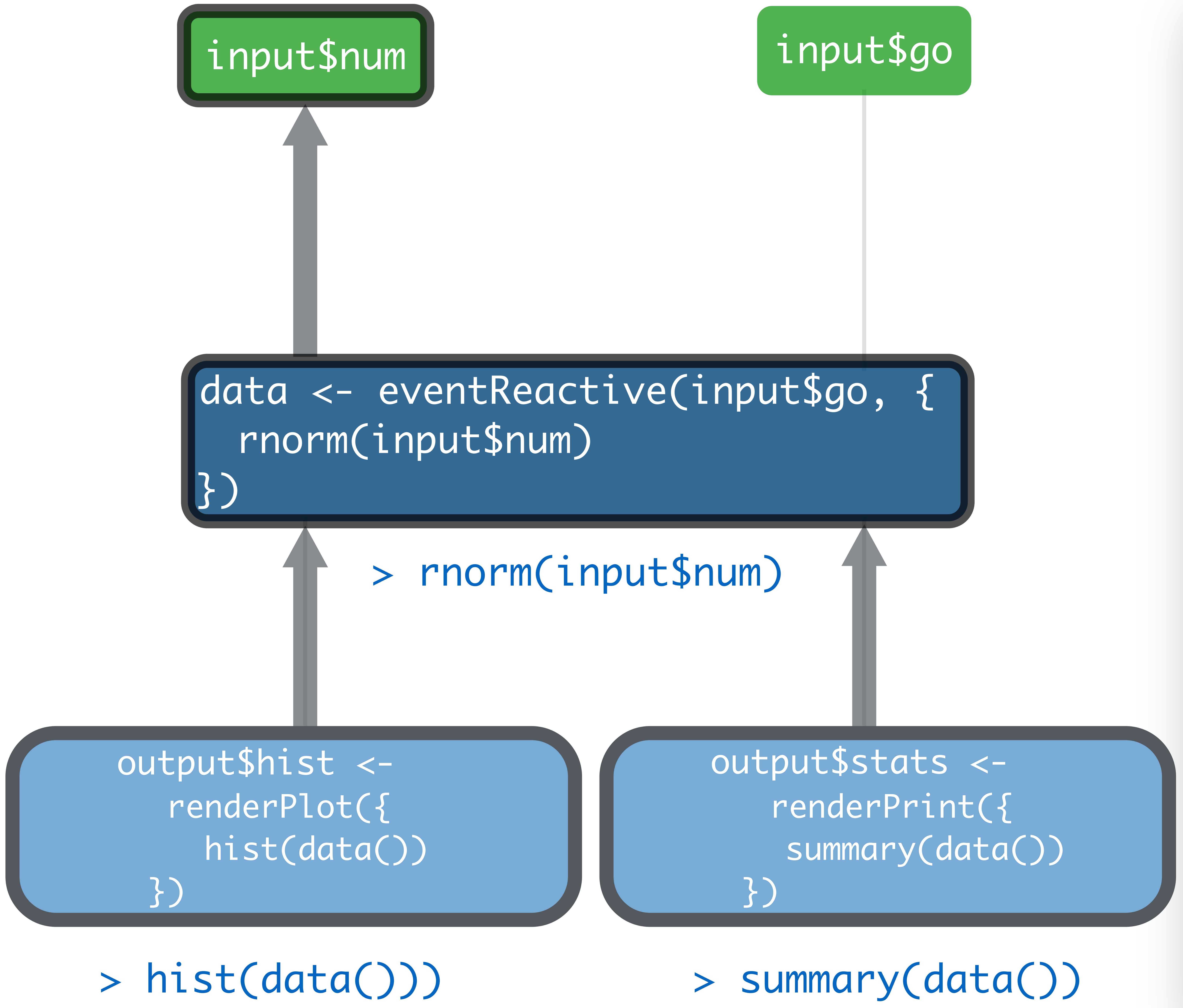
```
data <- eventReactive(input$go, {
  rnorm(input$num)
})
```

```
output$hist <-
  renderPlot({
    hist(data())
  })
```

```
output$stats <-
  renderPrint({
    summary(data())
  })
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  -2.32   -0.71    0.04    0.02    0.75    2.14 
```



```
data <- eventReactive(input$go, {
  rnorm(input$num)
})
```

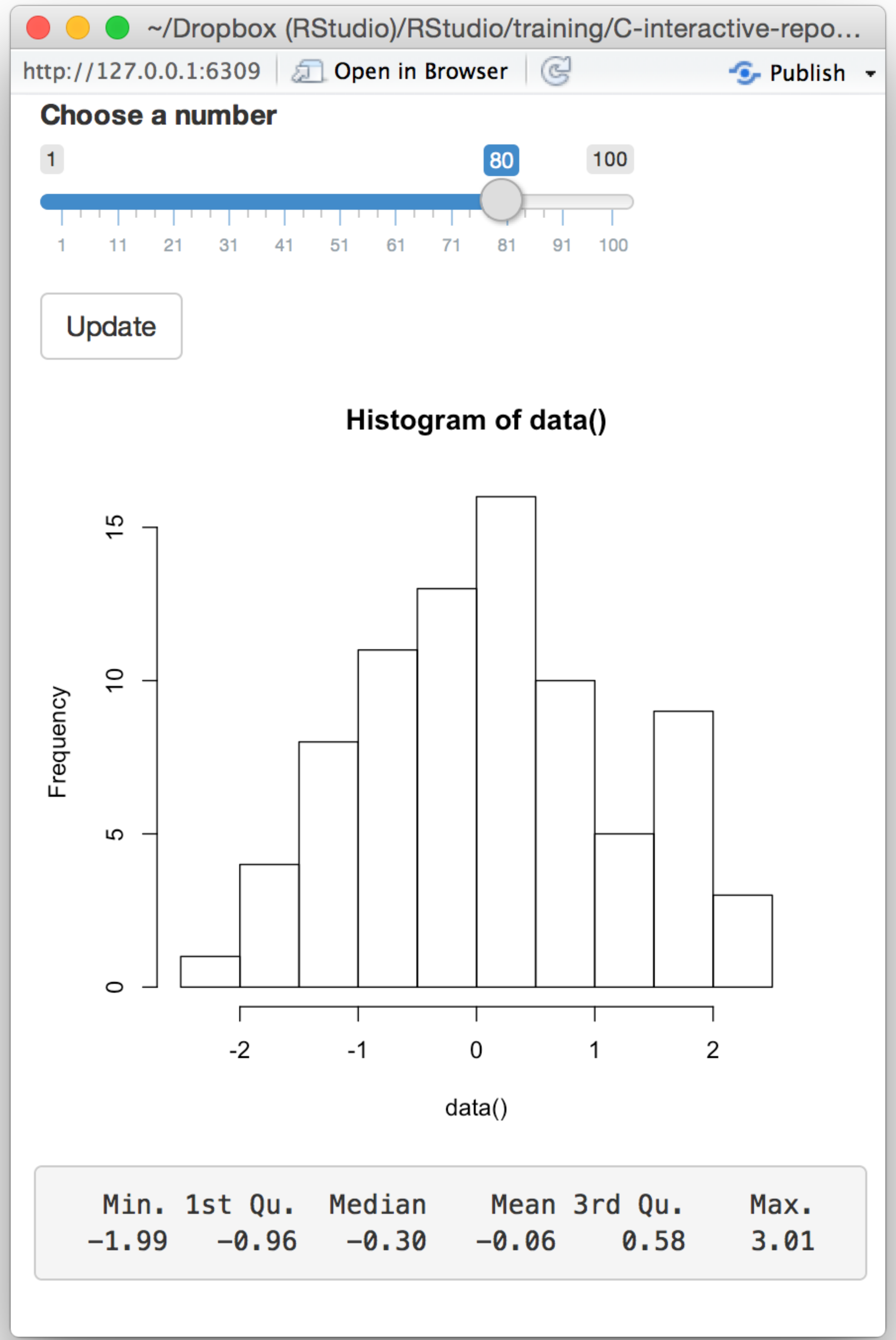
```
> rnorm(input$num)
```

```
output$hist <-
  renderPlot({
    hist(data())
  })
```

```
output$stats <-
  renderPrint({
    summary(data())
  })
```

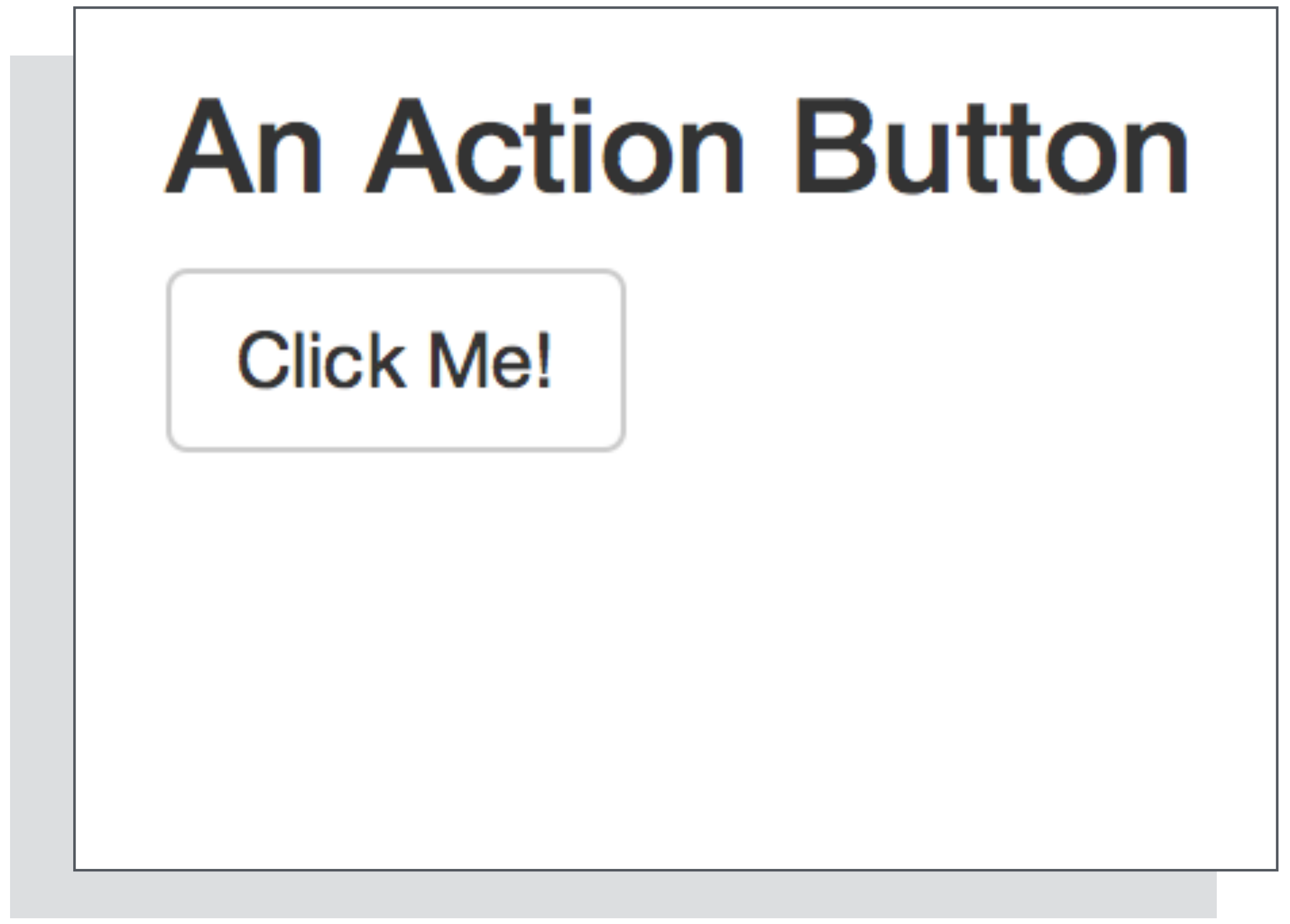
```
> hist(data())
```

```
> summary(data())
```



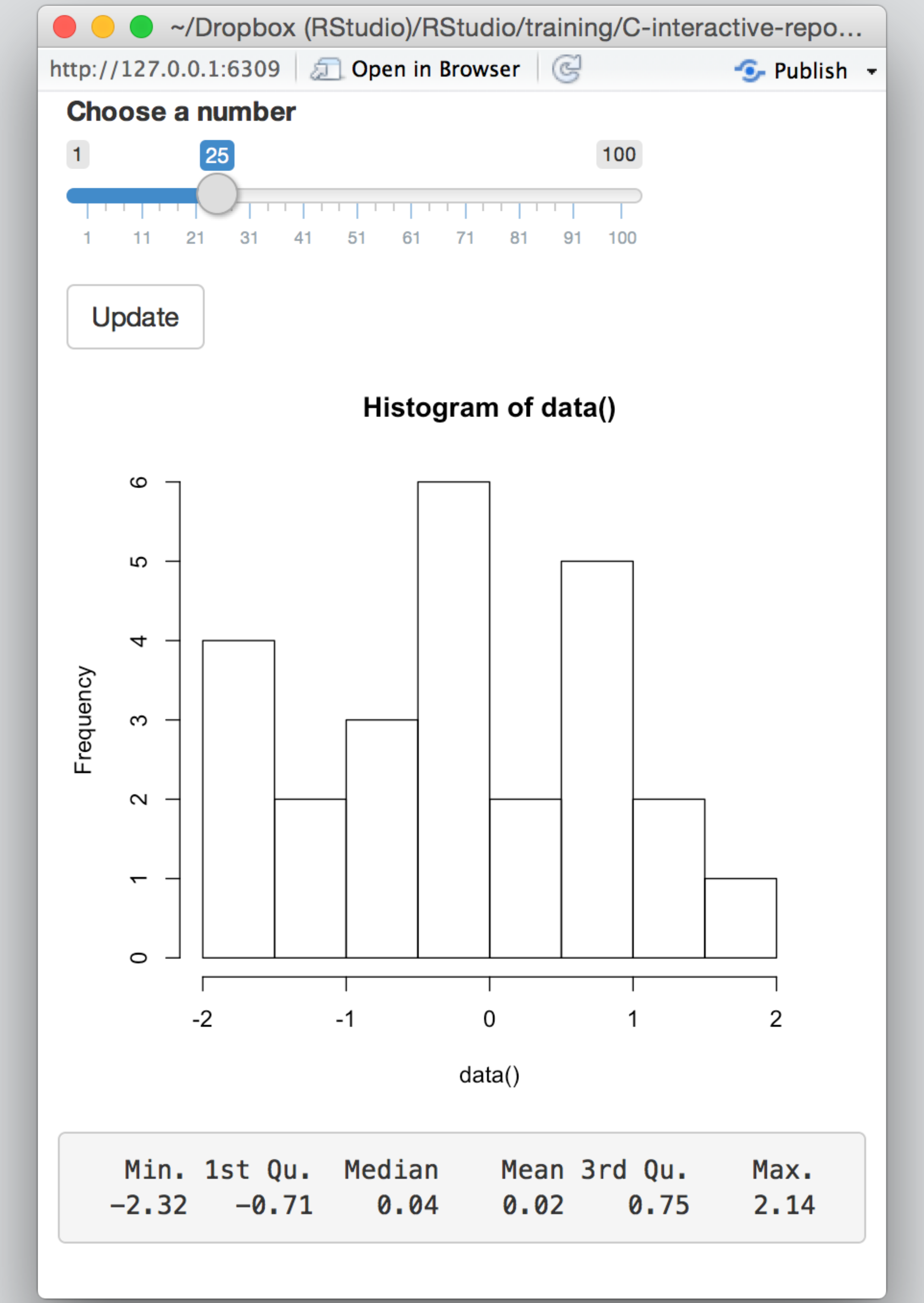
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -1.99   -0.96   -0.30   -0.06    0.58    3.01
```

# Action buttons



```
actionButton(inputId = "go", label = "Click Me!")
```

The value of an action button increases by one each time it is pressed.



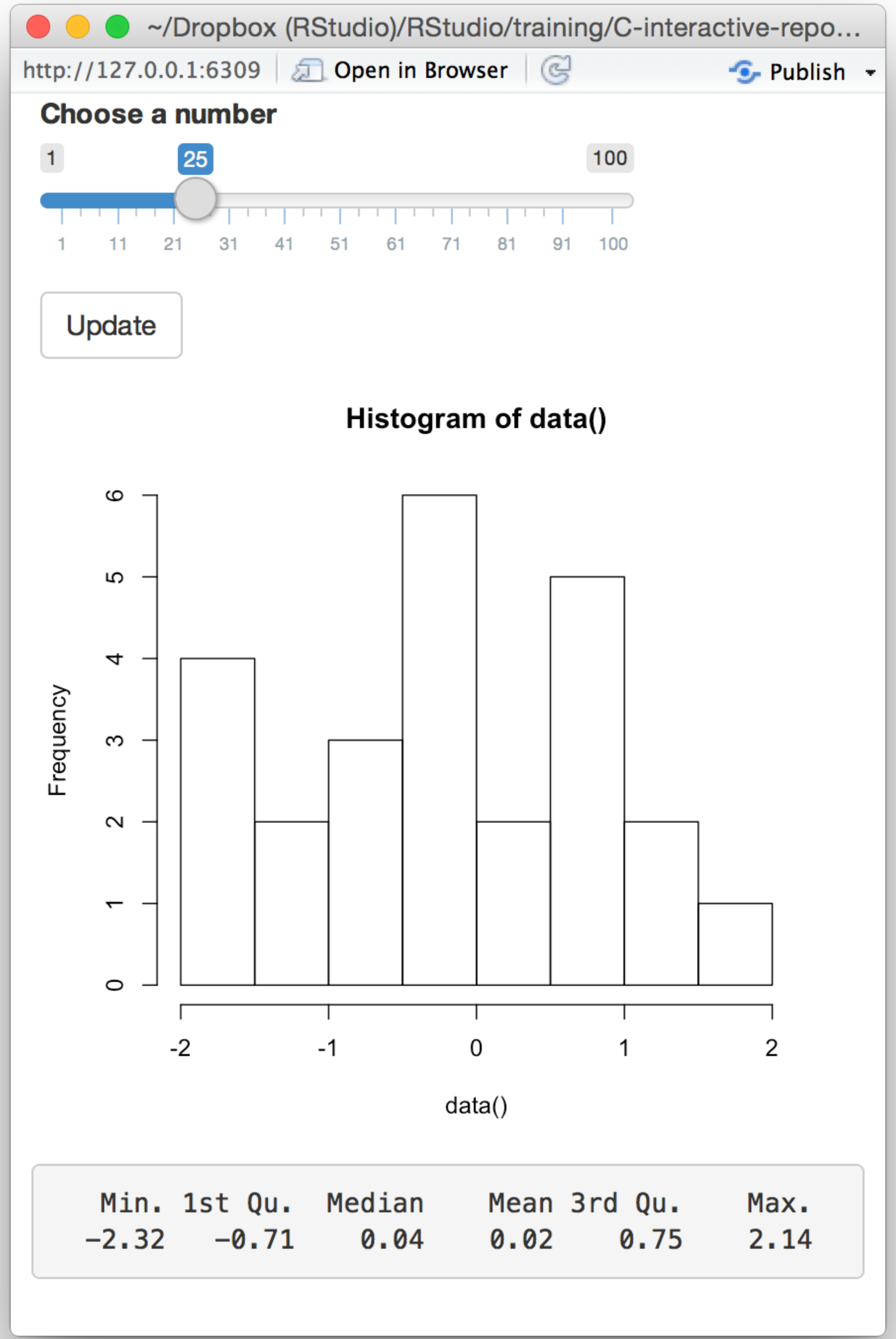
```
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 -2.32   -0.71    0.04    0.02    0.75    2.14
```

## Your Turn

Add an **actionButton()** to the app. Then replace **reactive()** with **eventReactive()** so that the app only responds when the button is clicked.

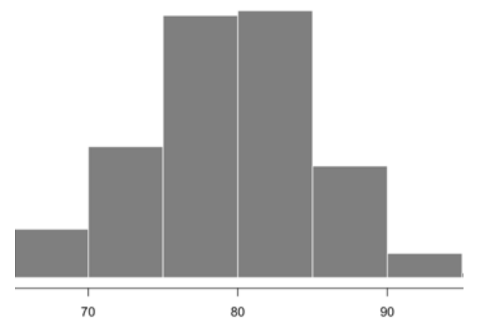
Ensure that you can predict how the app will work.

```
ui <- fluidPage(
  sliderInput("num", “Choose a number", 1, 100, 50),
  actionButton("go", "Update"),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
   data <- eventReactive(input$go, {rnorm(input$num)})
   output$hist <- renderPlot({
     hist(data())
   })
   output$sum <- renderPrint({
     summary(data())
   })
}
shinyApp(ui = ui, server = server)
```

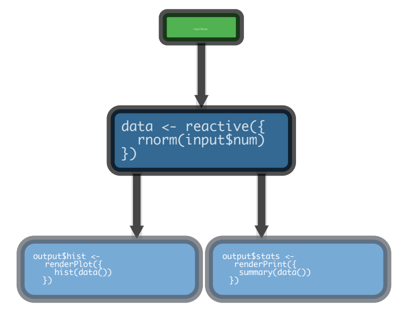


```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -2.32   -0.71    0.04    0.02    0.75    2.14
```

## Use…



**render()** to make an **object to display** in the UI.



```
data <- reactive({
  rnorm(input$num)
})
```

```
output$hist <-
  renderPlot({
    hist(data())
  })
```

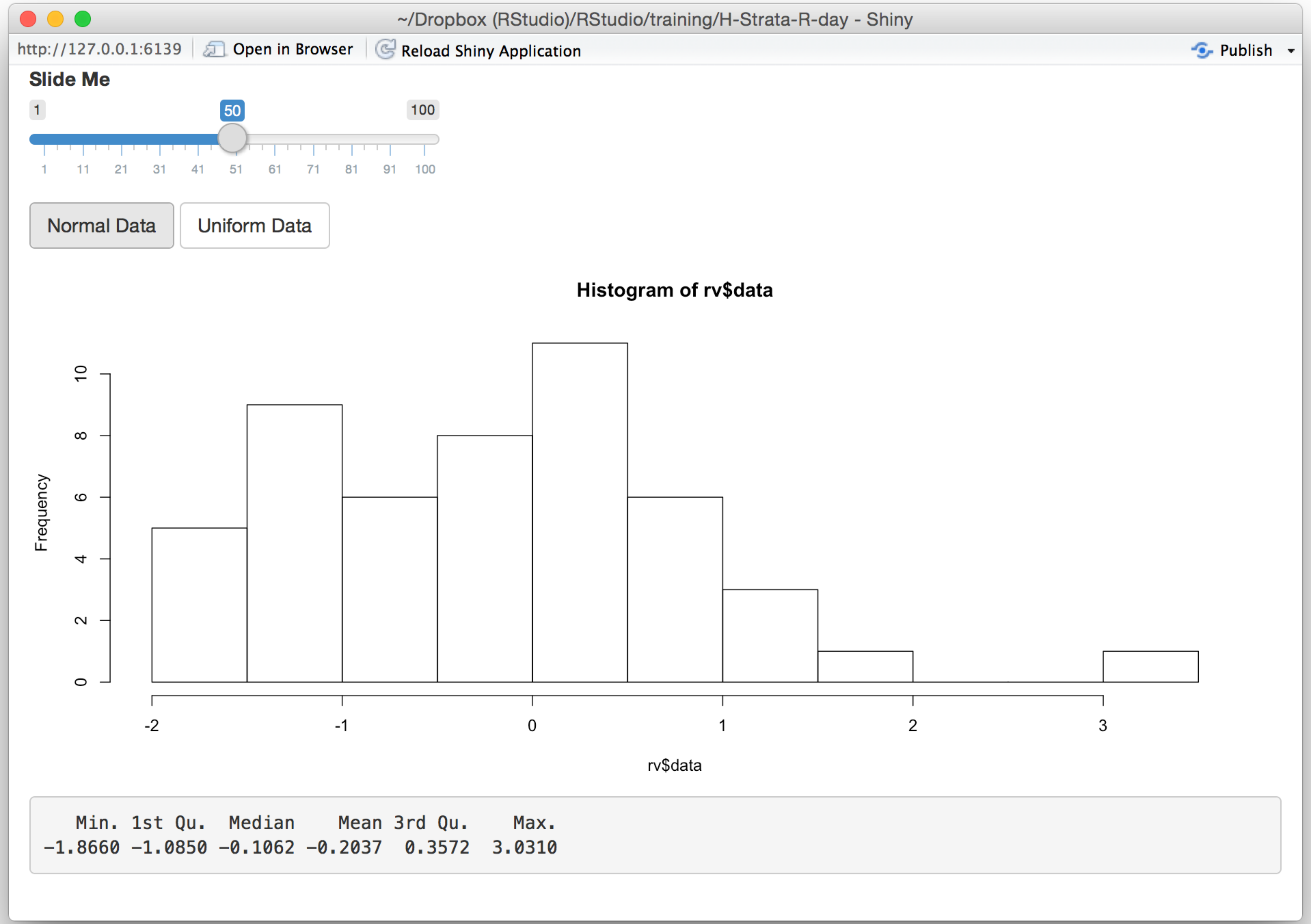
```
output$stats <-
  renderPrint({
    summary(data())
  })
```

**reactive()** to make an **object to use** in downstream code.

**isolate()** to return a **non-reactive object**.

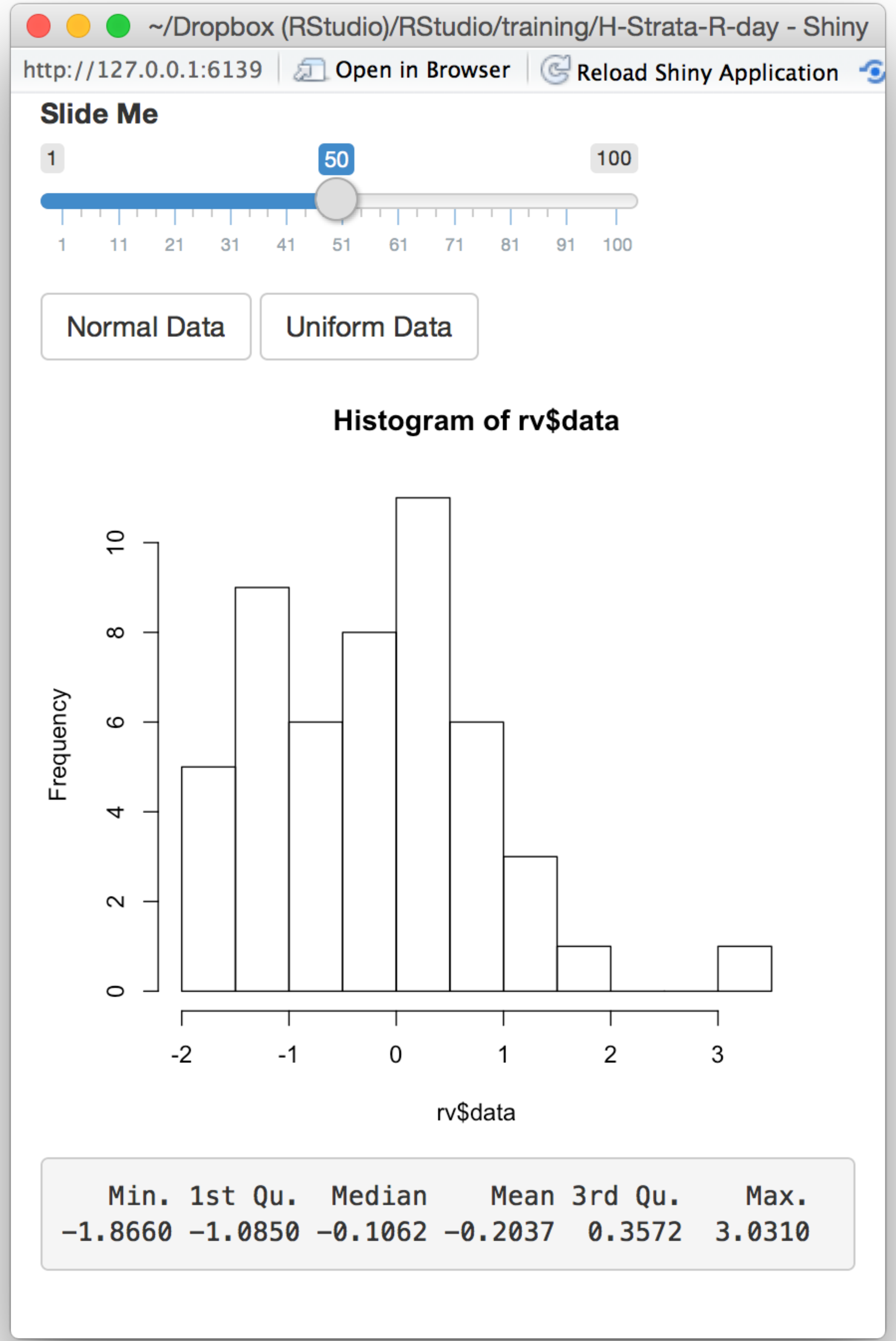
**eventReactive()** to **delay a reaction**.

# demo



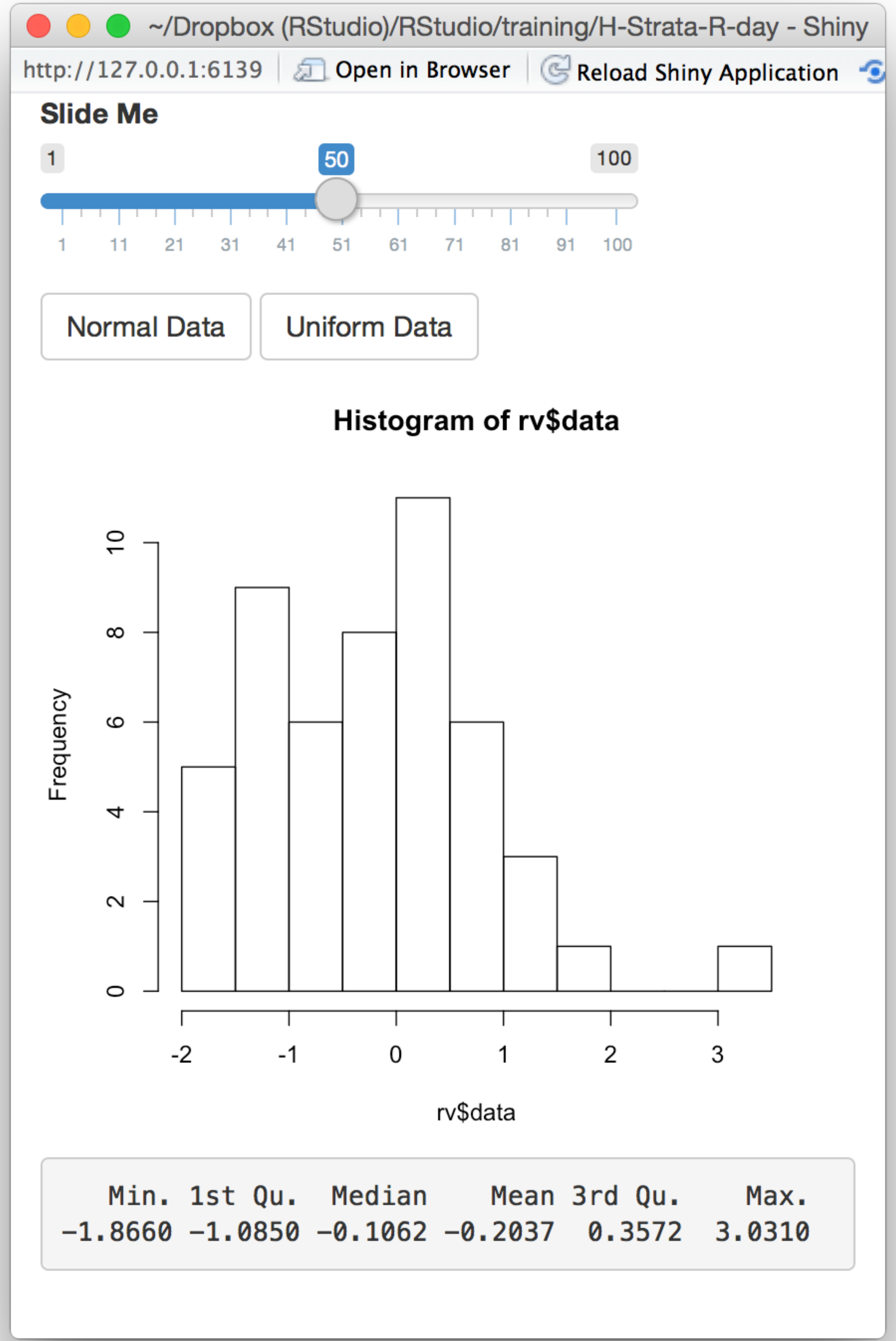
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310 
```

```r
ui <- fluidPage(
  sliderInput("num", "Slide Me", 1, 100, 50),
  actionButton("norm", "Normal Data"),
  actionButton("unif", "Uniform Data"),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
  rv <- reactiveValues(data = rnorm(50))

  observeEvent(input$norm, {rv$data <- rnorm(input$num)})
  observeEvent(input$unif, {rv$data <- runif(input$num)})

  output$hist <- renderPlot({hist(rv$data)})
  output$sum <- renderPrint({summary(rv$data)})
}
shinyApp(ui = ui, server = server)
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310
```

```
ui <- fluidPage(
  sliderInput("num", "Slide Me", 1, 100, 50),
  actionButton("norm", "Normal Data"),
  actionButton("unif", "Uniform Data"),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
  rv <- reactiveValues(data = rnorm(50))

  observeEvent(input$norm, {rv$data <- rnorm(input$num)})
  observeEvent(input$unif, {rv$data <- runif(input$num)})

  output$hist <- renderPlot({hist(rv$data)})
  output$sum <- renderPrint({summary(rv$data)})
}
shinyApp(ui = ui, server = server)
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310
```

## observeEvent()

Triggers code to run.

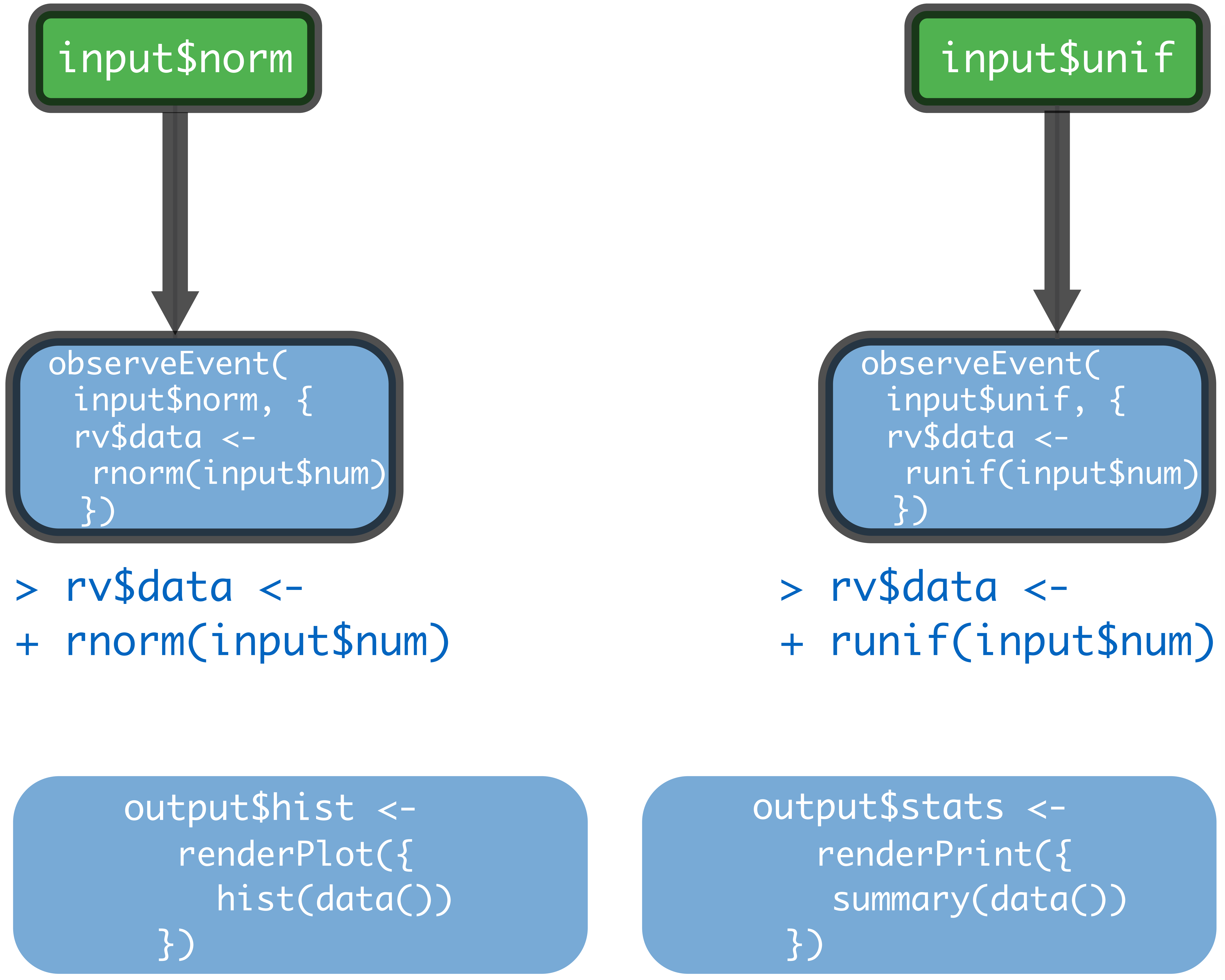
```
observeEvent(input$norm, {rv$data <- rnorm(input$num)})
```

Builds an object that:

runs the code block
(on the server side)

When notified by:

this or these reactive value(s)
**and no others**



```
input$norm
```

```
observeEvent(
  input$norm, {
  rv$data <-
   rnorm(input$num)
 })
```

```
> rv$data <-
+ rnorm(input$num)
```

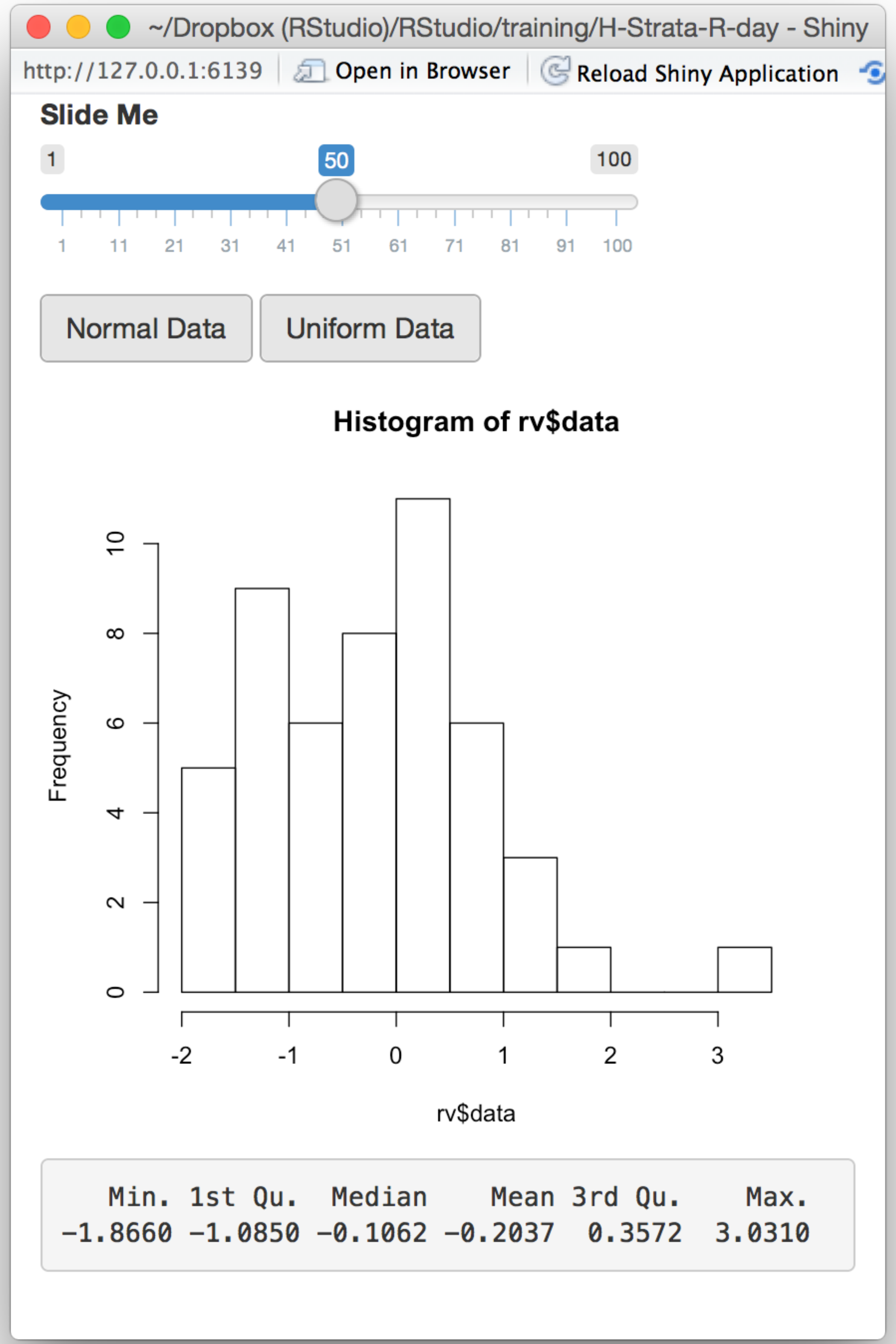
```
input$unif
```

```
observeEvent(
  input$unif, {
  rv$data <-
   runif(input$num)
 })
```

```
> rv$data <-
+ runif(input$num)
```

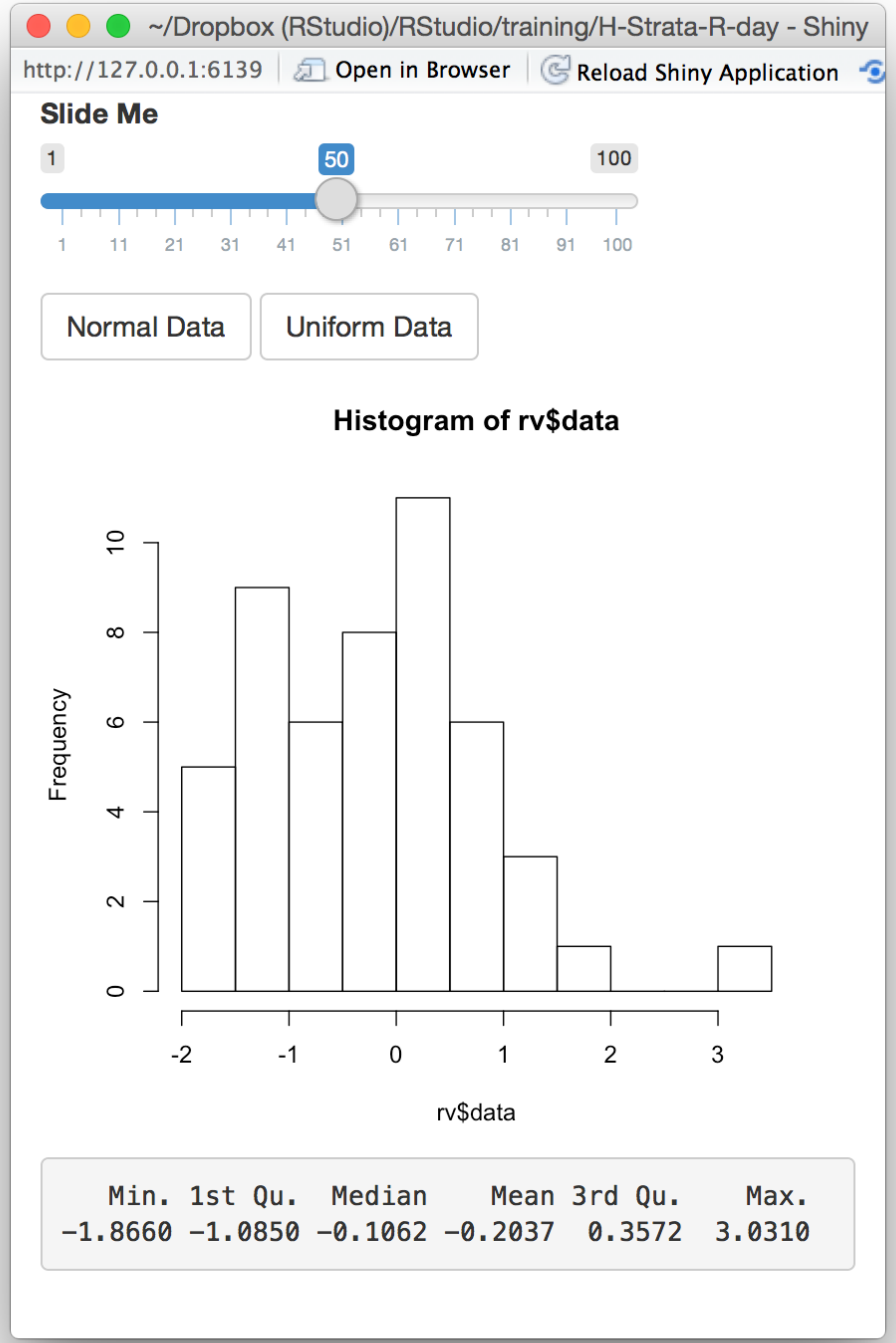
```
output$hist <-
  renderPlot({
    hist(data())
 })
```

```
output$stats <-
  renderPrint({
   summary(data())
 })
```



```
   Min.  1st Qu.  Median    Mean 3rd Qu.    Max.
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310
```

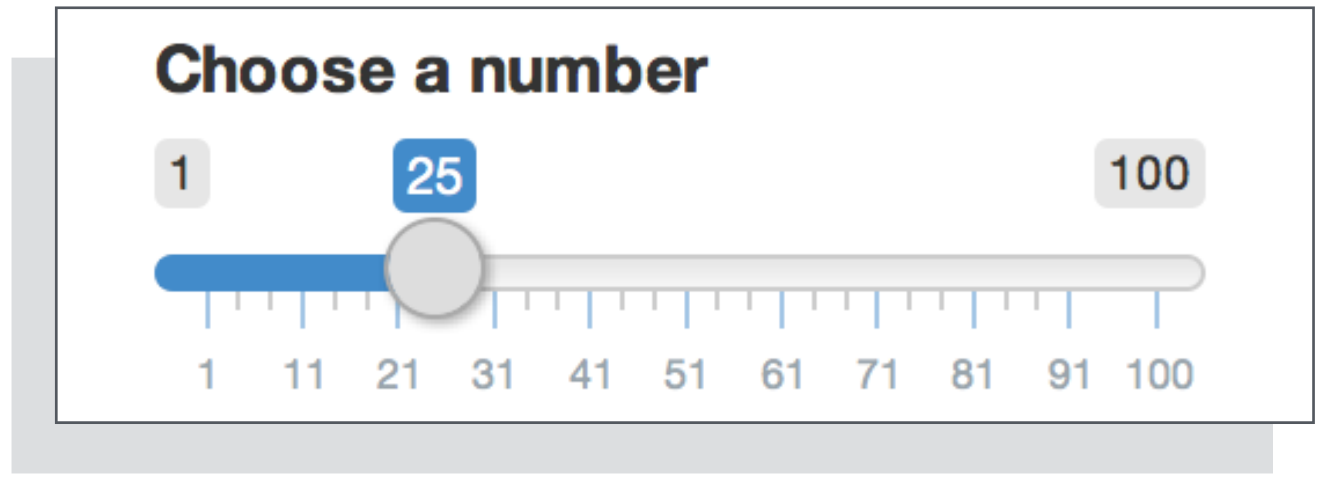
```
ui <- fluidPage(
  sliderInput("num", "Slide Me", 1, 100, 50),
  actionButton("norm", "Normal Data"),
  actionButton("unif", "Uniform Data"),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
   rv <- reactiveValues(data = rnorm(50))

   observeEvent(input$norm, {rv$data <- rnorm(input$num)})
   observeEvent(input$unif, {rv$data <- runif(input$num)})

   output$hist <- renderPlot({hist(rv$data)})
   output$sum <- renderPrint({summary(rv$data)})
}
shinyApp(ui = ui, server = server)
```



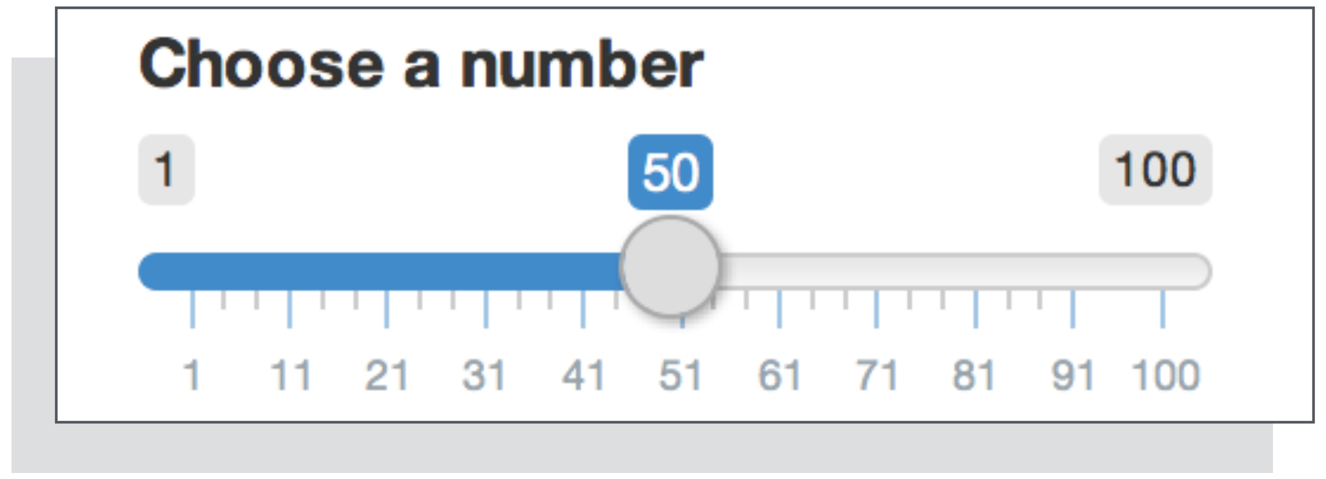
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310
```

# Reactive values

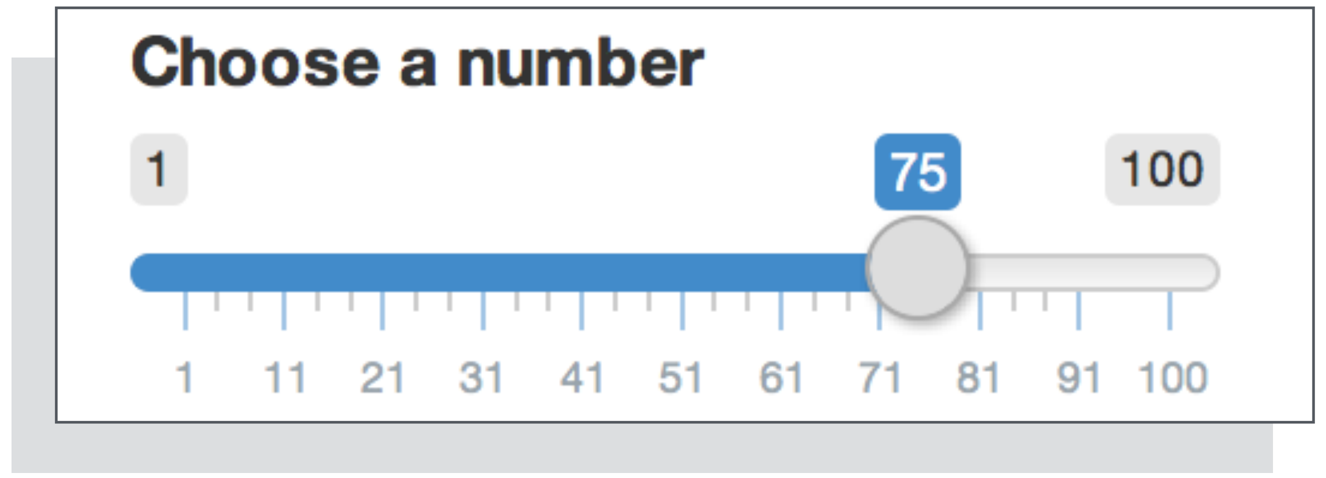
The input list contains values that change whenever a user changes an input.



```
input$num = 25
```



```
input$num = 50
```



```
input$num = 75
```

You **cannot** set these values in your code

# reactiveValues()

Creates a list of reactive values that you can manipulate

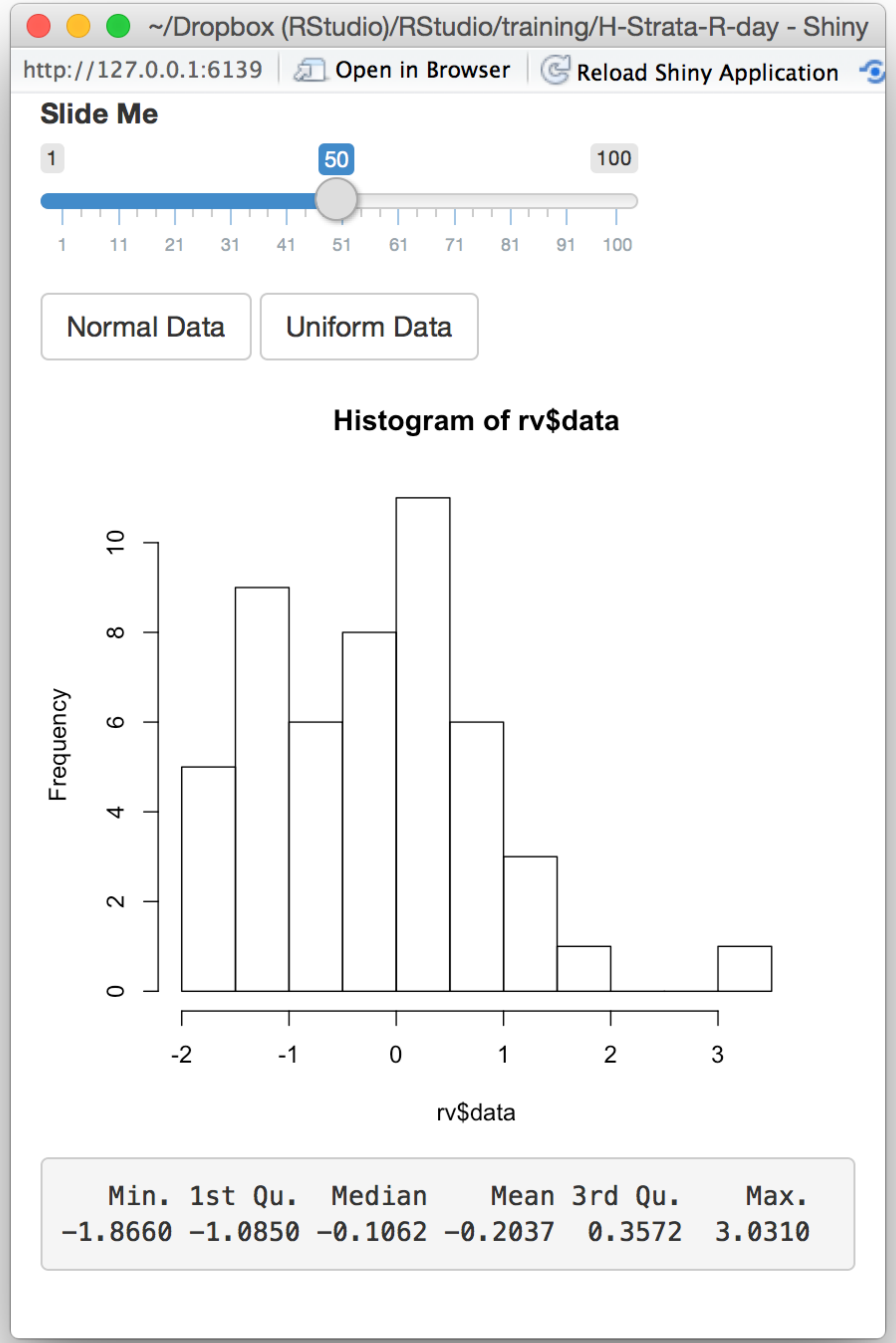
```
rv <- reactiveValues(data = rnorm(100))
```

(optional) elements to add to the list

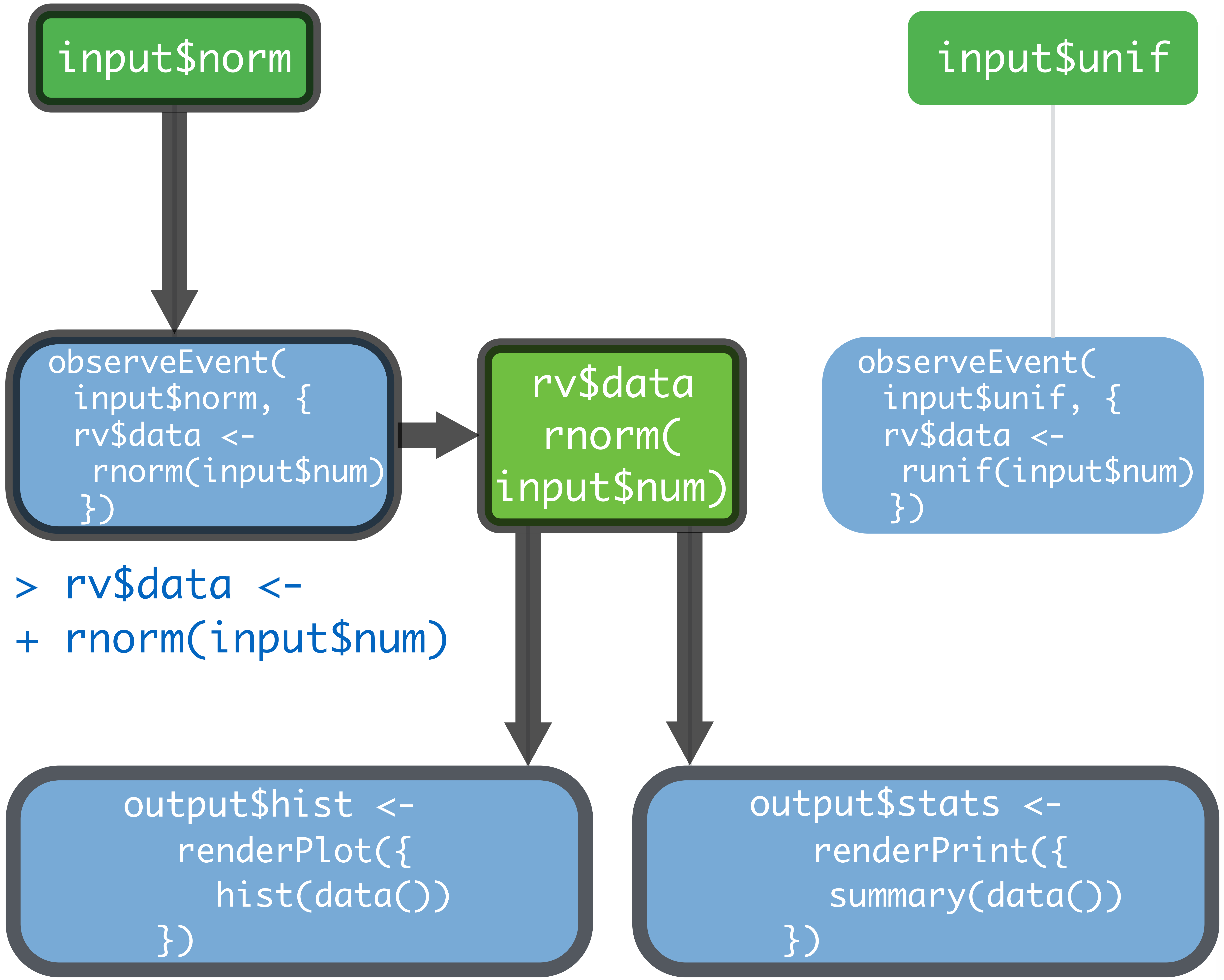
Builds a list of objects that: notify objects that use them that the objects are invalid

When: When their own value changes

```
ui <- fluidPage(
  sliderInput("num", "Slide Me", 1, 100, 50),
  actionButton("norm", "Normal Data"),
  actionButton("unif", "Uniform Data"),
  plotOutput("hist"),
  verbatimTextOutput("sum")
)
server <- function(input, output) {
   rv <- reactiveValues(data = rnorm(50))

   observeEvent(input$norm, {rv$data <- rnorm(input$num)})
   observeEvent(input$unif, {rv$data <- runif(input$num)})

   output$hist <- renderPlot({hist(rv$data)})
   output$sum <- renderPrint({summary(rv$data)})
}
shinyApp(ui = ui, server = server)
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310 
```



```
observeEvent(
 input$norm, {
 rv$data <-
  rnorm(input$num)
 })
```

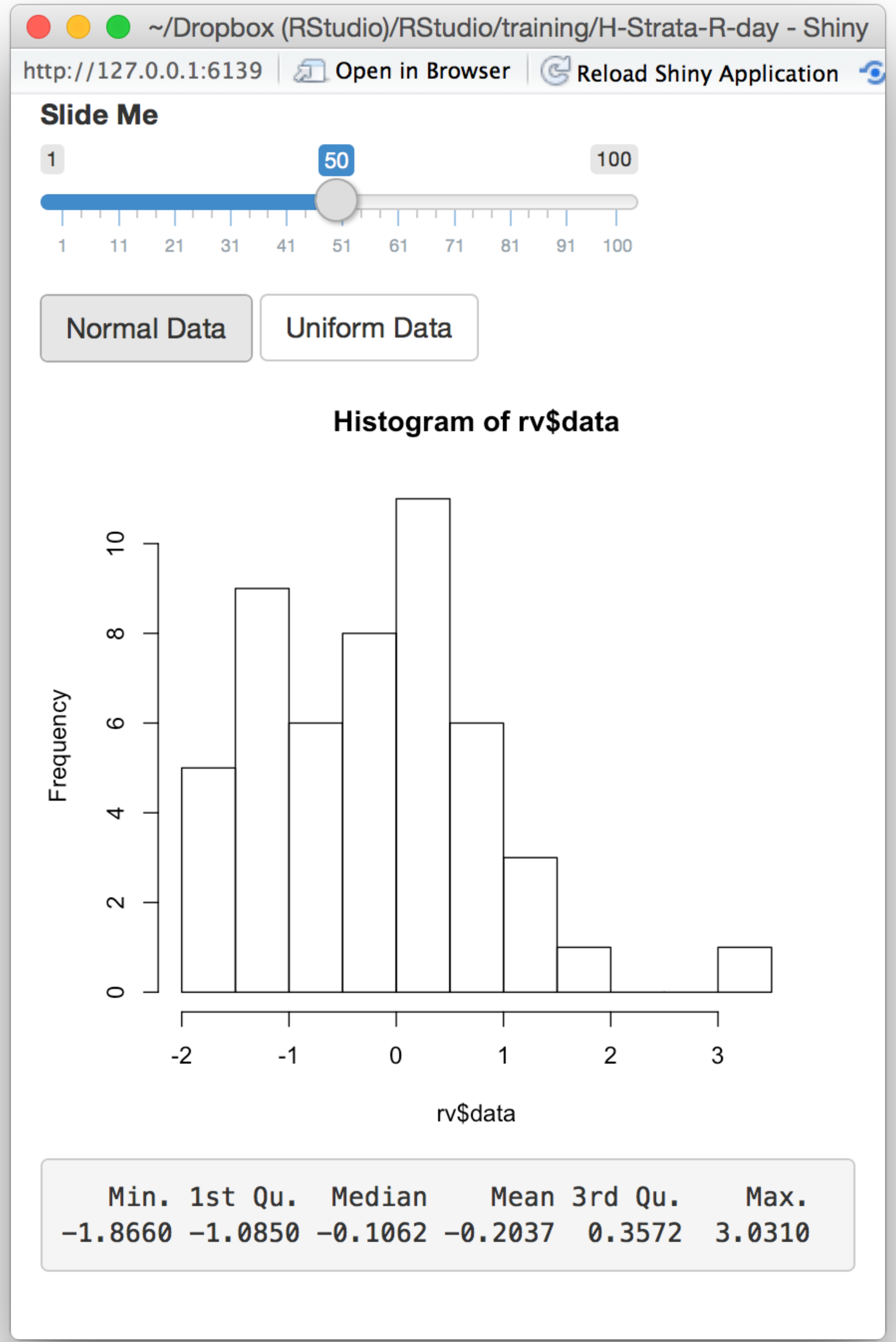
```
rv$data
rnorm(
input$num)
```

```
observeEvent(
 input$unif, {
 rv$data <-
  runif(input$num)
 })
```

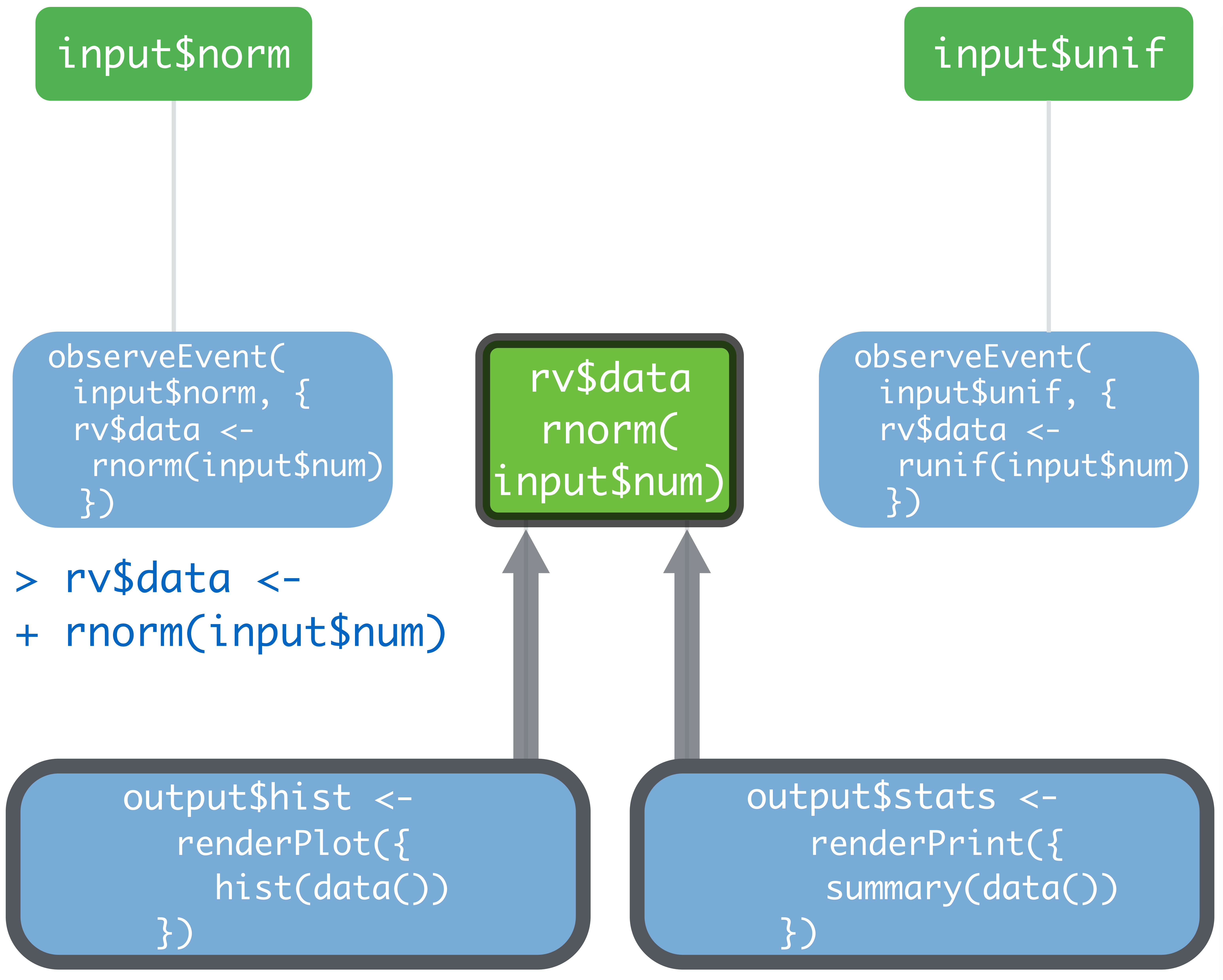
```
> rv$data <-
+ rnorm(input$num)
```

```
output$hist <-
  renderPlot({
    hist(data())
  })
```

```
output$stats <-
  renderPrint({
    summary(data())
  })
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310 
```



```
observeEvent(
 input$norm, {
 rv$data <-
  rnorm(input$num)
 })
```

```
rv$data
rnorm(
input$num)
```

```
observeEvent(
 input$unif, {
 rv$data <-
  runif(input$num)
 })
```

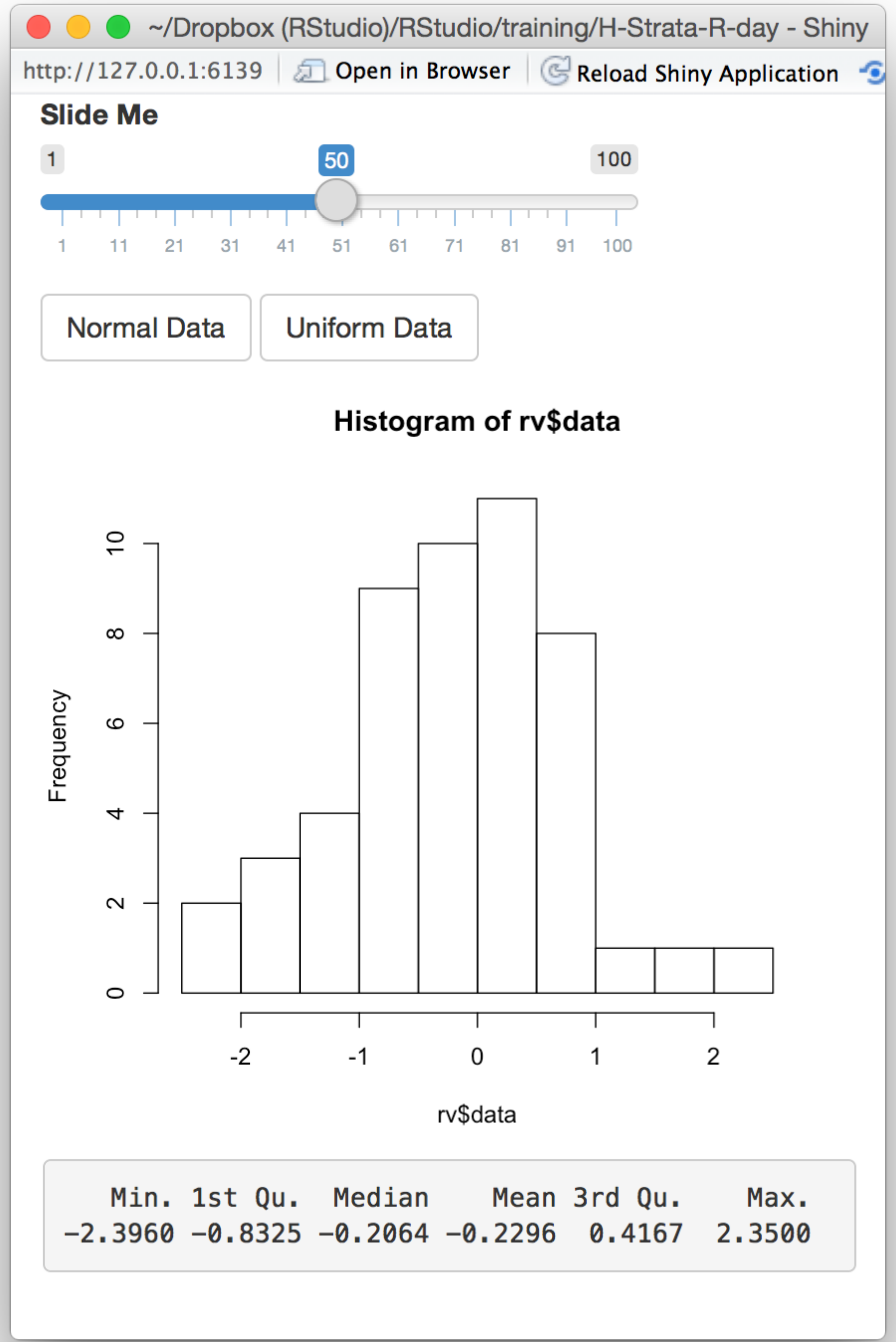
```
> rv$data <-
+ rnorm(input$num)
```

```
output$hist <-
  renderPlot({
    hist(data())
 })
```

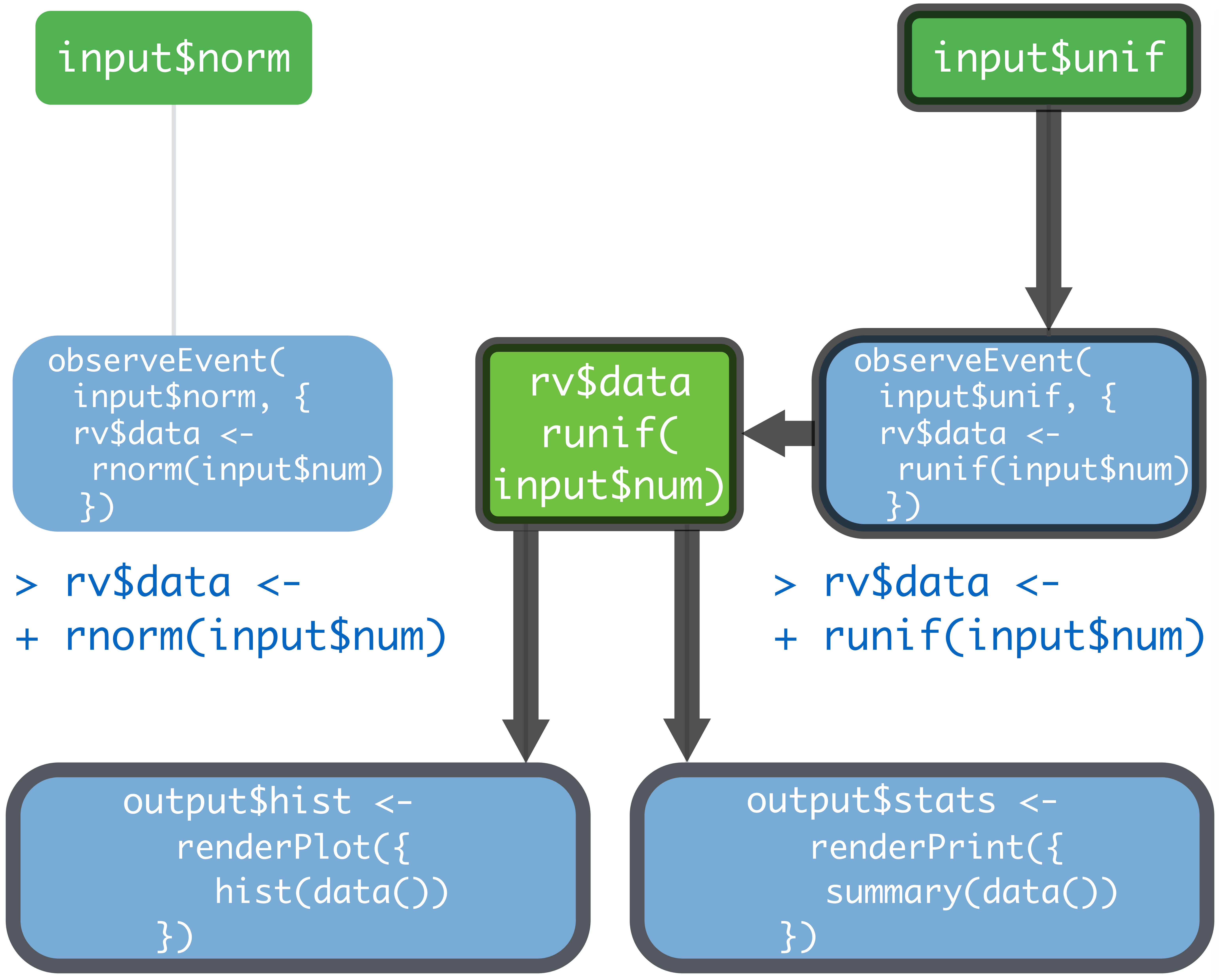
```
output$stats <-
  renderPrint({
   summary(data())
 })
```

```
> hist(data())
```

```
> summary(data())
```



```
   Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-2.3960  -0.8325  -0.2064  -0.2296   0.4167   2.3500
```



```
observeEvent(
 input$norm, {
 rv$data <-
  rnorm(input$num)
 })
```

```
rv$data
runif(
input$num)
```

```
observeEvent(
 input$unif, {
 rv$data <-
  runif(input$num)
 })
```

```
> rv$data <-
+ rnorm(input$num)
```

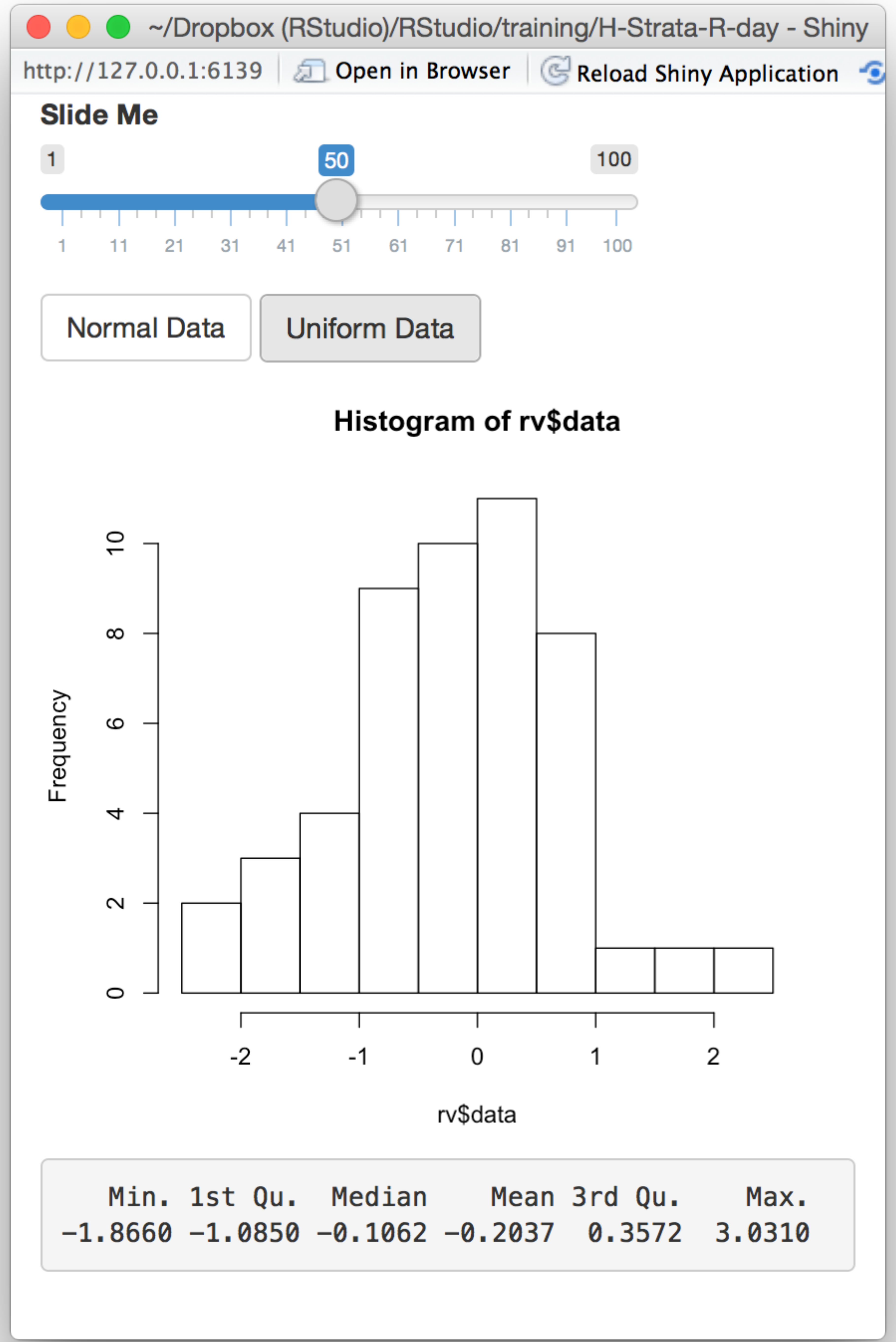
```
> rv$data <-
+ runif(input$num)
```

```
output$hist <-
  renderPlot({
    hist(data())
 })
```

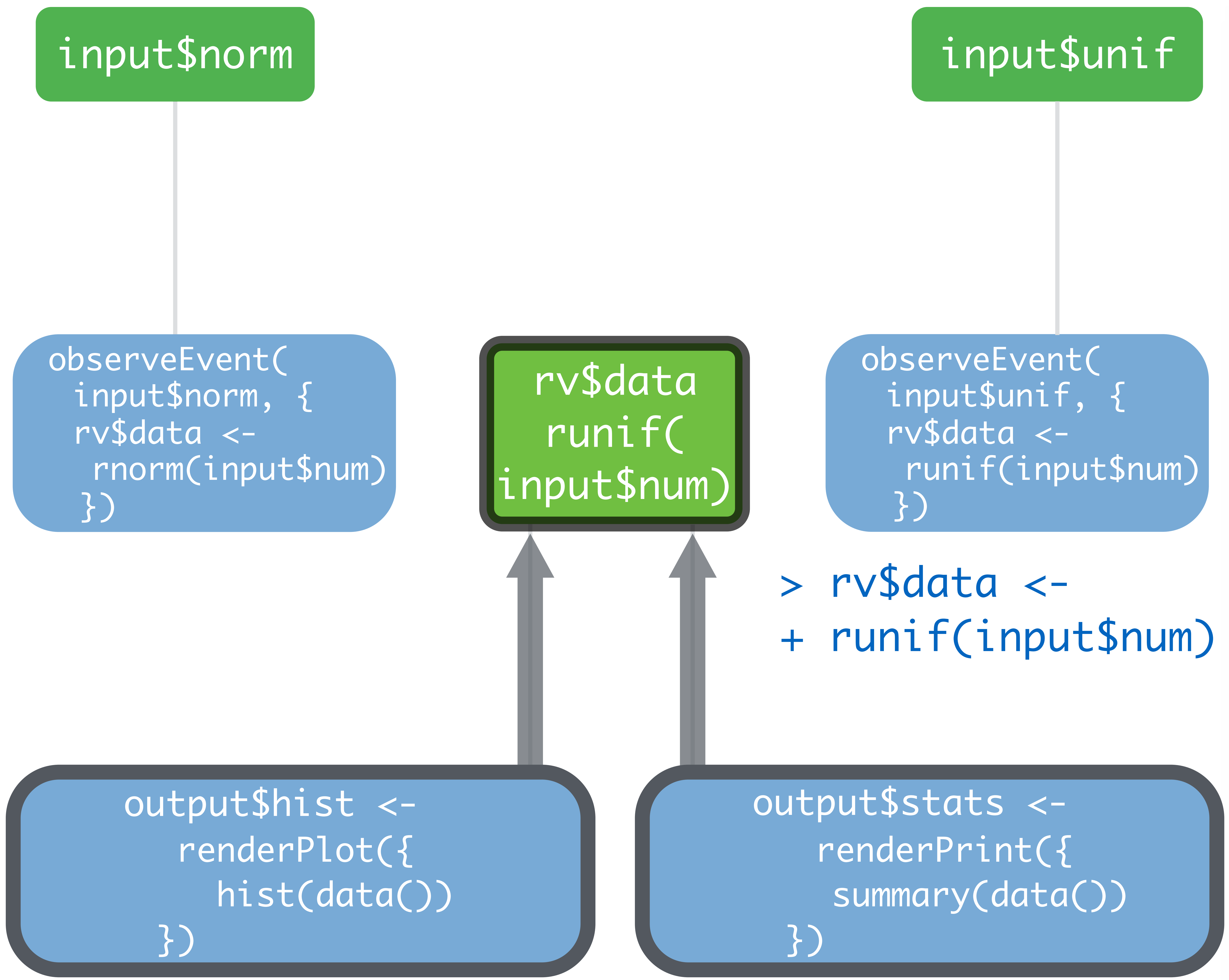
```
output$stats <-
  renderPrint({
   summary(data())
 })
```

```
> hist(data()))
```

```
> summary(data())
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-1.8660 -1.0850 -0.1062 -0.2037  0.3572  3.0310
```



```
input$norm
```

```
input$unif
```

```
observeEvent(
 input$norm, {
 rv$data <-
  rnorm(input$num)
 })
```

```
rv$data
runif(
input$num)
```

```
observeEvent(
 input$unif, {
 rv$data <-
  runif(input$num)
 })
```

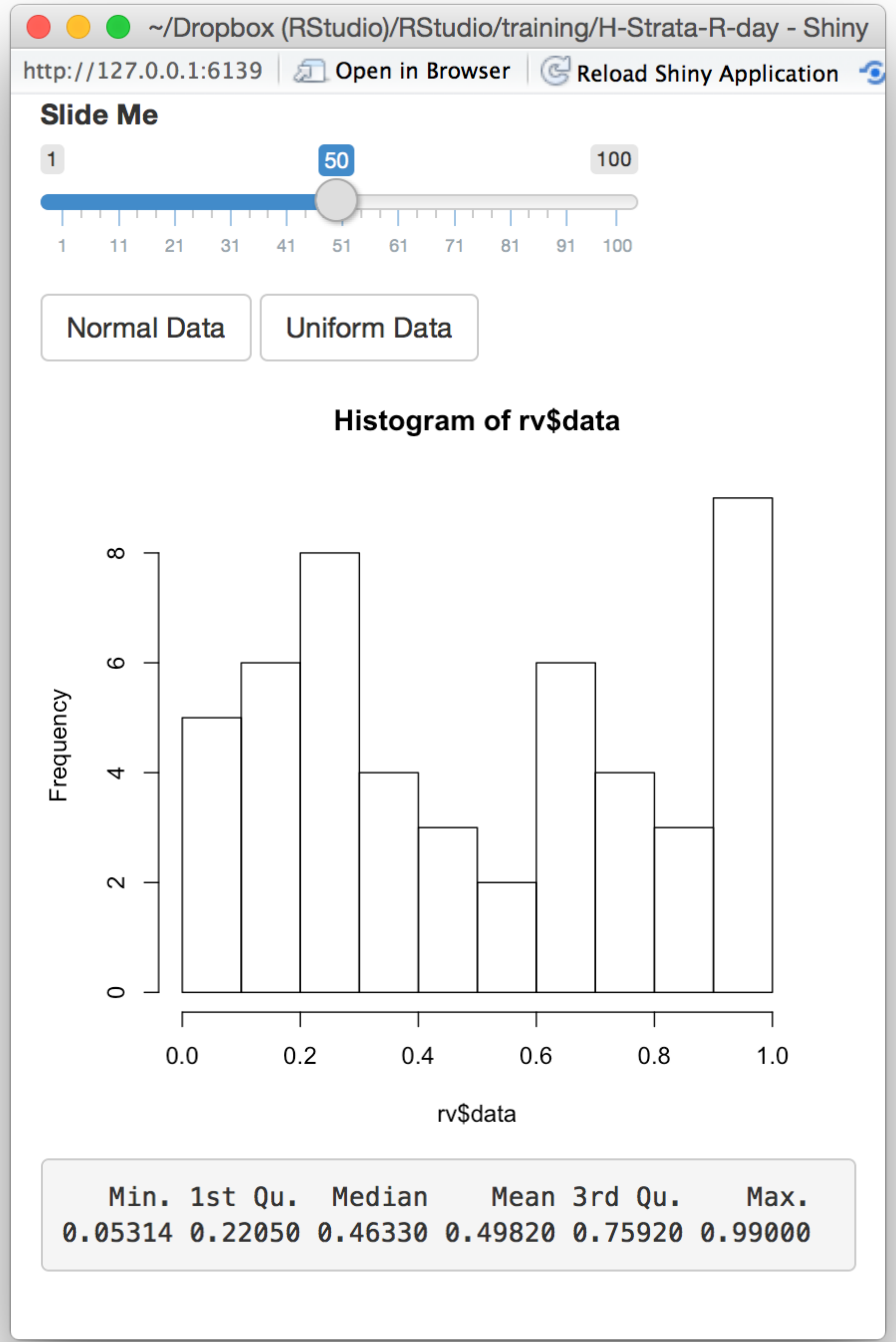
```
> rv$data <-
+ runif(input$num)
```

```
output$hist <-
  renderPlot({
    hist(data())
 })
```

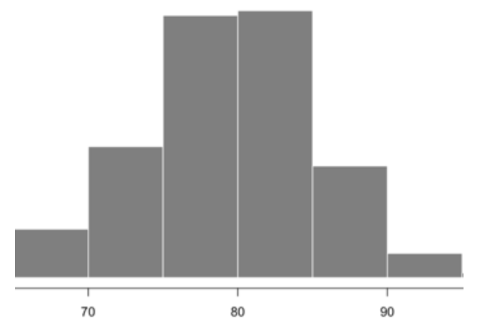
```
output$stats <-
  renderPrint({
    summary(data())
 })
```

```
> hist(data())
```

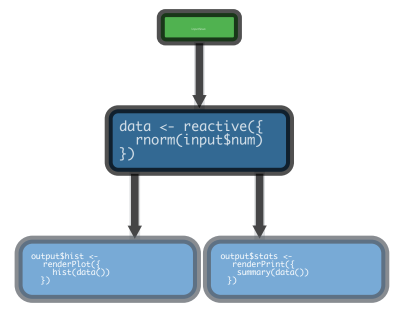
```
> summary(data())
```



```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
0.05314 0.22050 0.46330 0.49820 0.75920 0.99000 
```



**render()** to make an **object to display** in the UI.

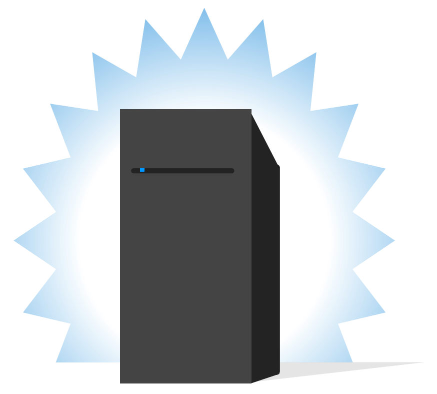

```
data <- reactive({
  rnorm(input$num)
})
```

**reactive()** to make an **object to use** in downstream code.

**isolate()** to return a **non-reactive object**.

Update

**eventReactive()** to **delay a reaction**.



**observeEvent()** to **trigger code**.

`rv$data <-`

**reactiveValues()** to **make your own** reactive values.

# observe()

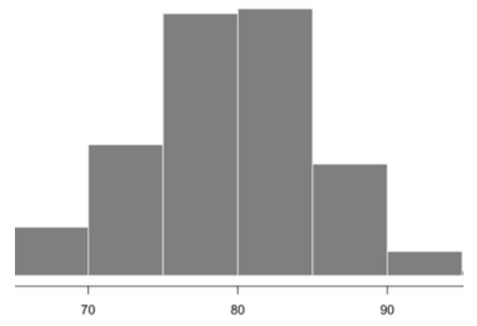
Also triggers code to run on server.
Uses same syntax as render*(), reactive(), and isolate()

```
observe({rv$data <- rnorm(input$num)})
```

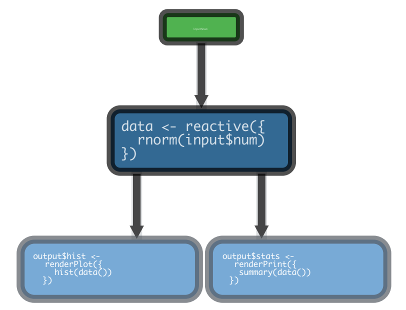
Builds an object that: runs the code block (on the server side)

When notified by: any reactive value in the code block

# Use…



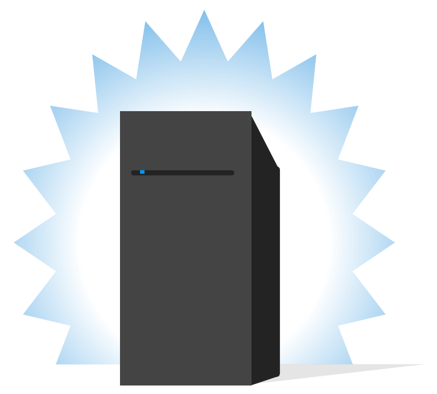
**render()** to make an **object to display** in the UI.



**reactive()** to make an **object to use** in downstream code.

**isolate()** to return a **non-reactive object**.

**eventReactive()** to **delay a reaction**.

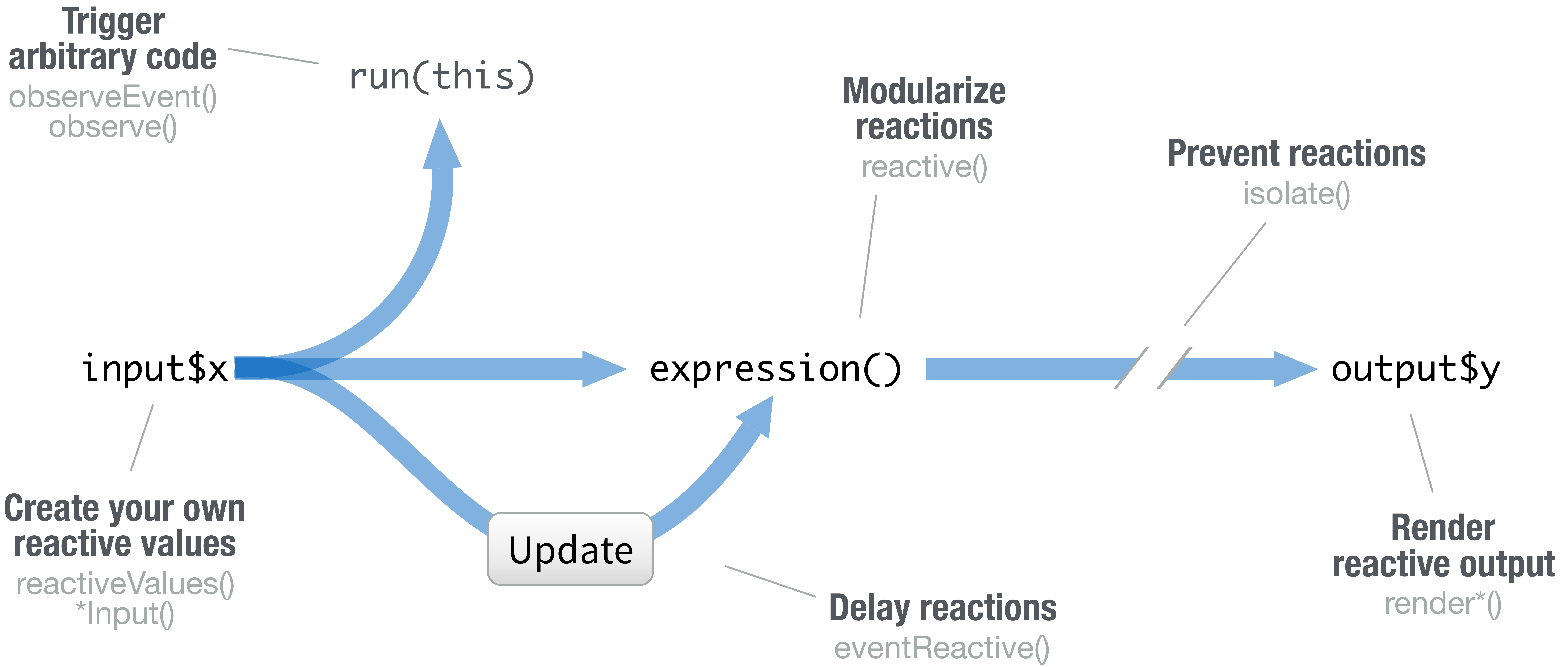


**observeEvent()** or **observe()** to **trigger code**.

rv$data <-

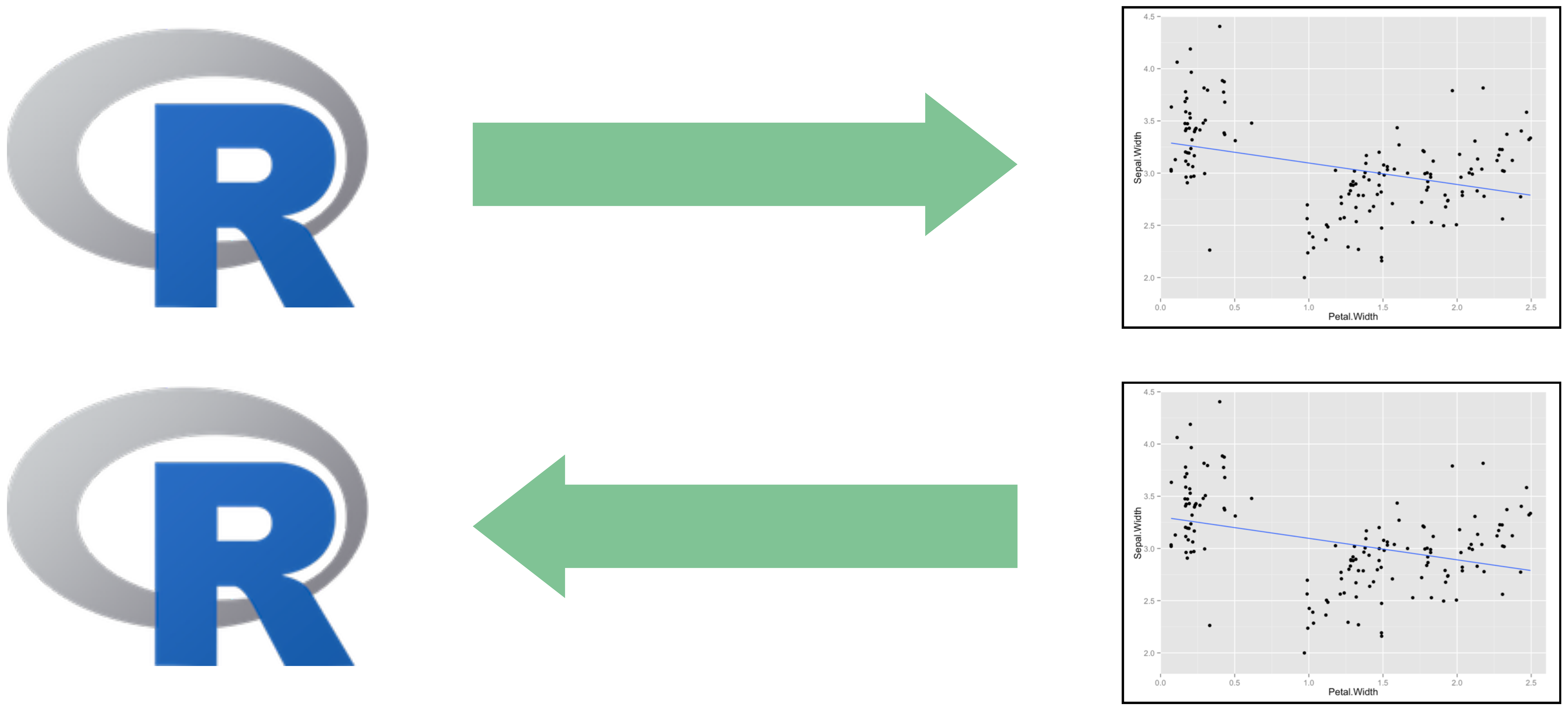
**reactiveValues()** to **make your own** reactive values.

# Recap


Trigger arbitrary code
observeEvent()
observe()
run(this)
Modularize reactions
reactive()
Prevent reactions
isolate()
input$x
expression()
output$y
Update
Create your own reactive values
reactiveValues()
*Input()
Delay reactions
eventReactive()
Render reactive output
render*()

## Interactive plots

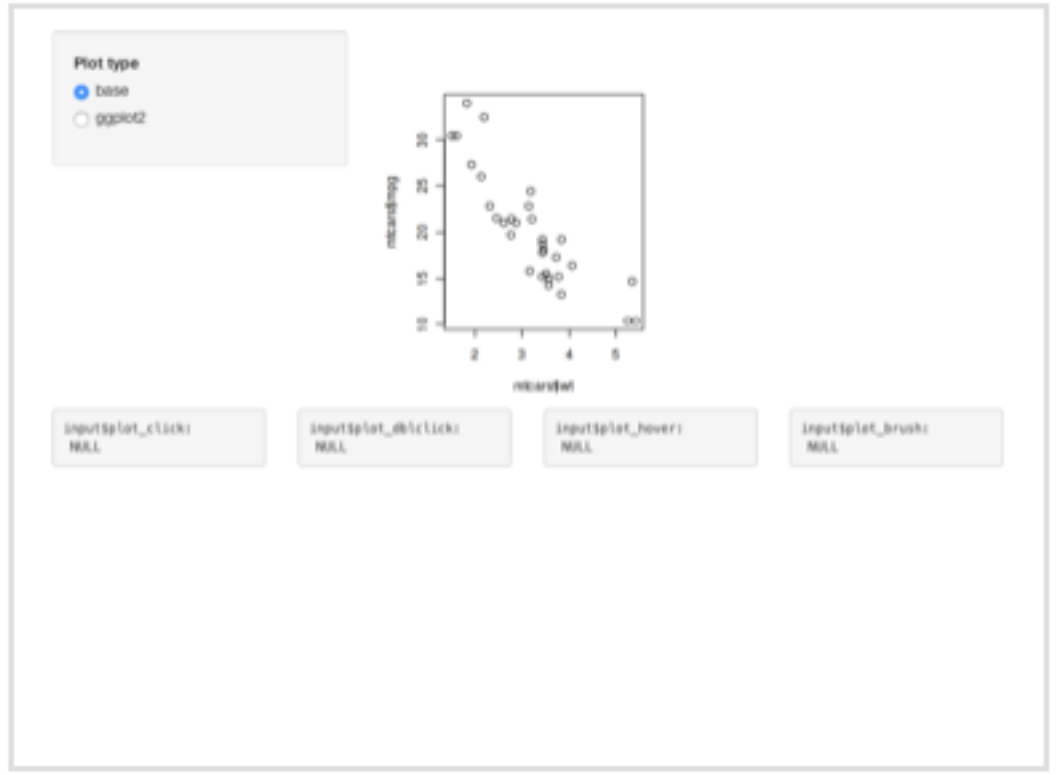
## Plots and images can be both outputs *and* inputs.



## demos from the **Shiny Gallery**

### Interactive plots

These examples show how to use Shiny's interactive plotting features


Plot interaction - basic

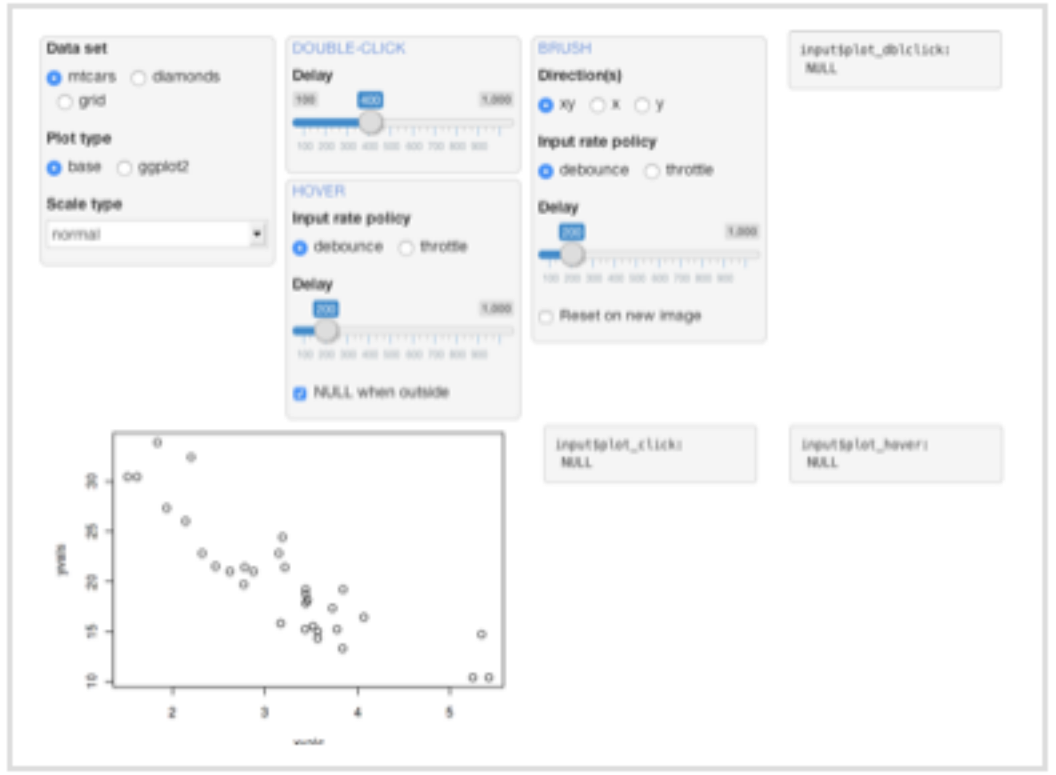
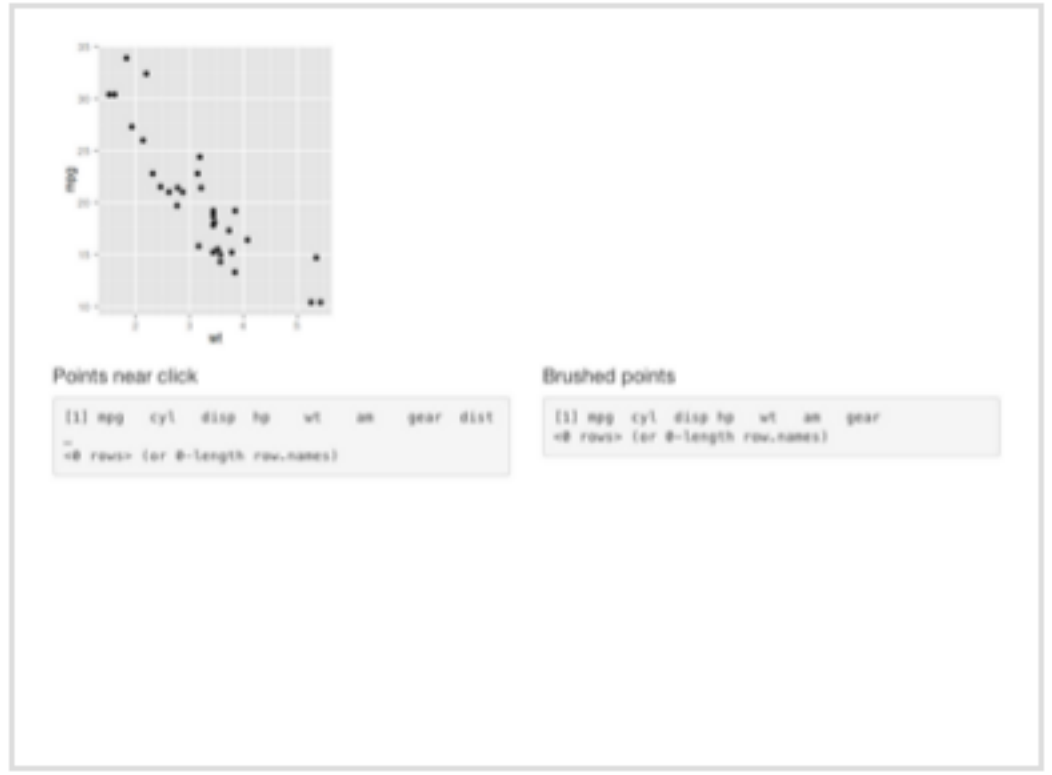
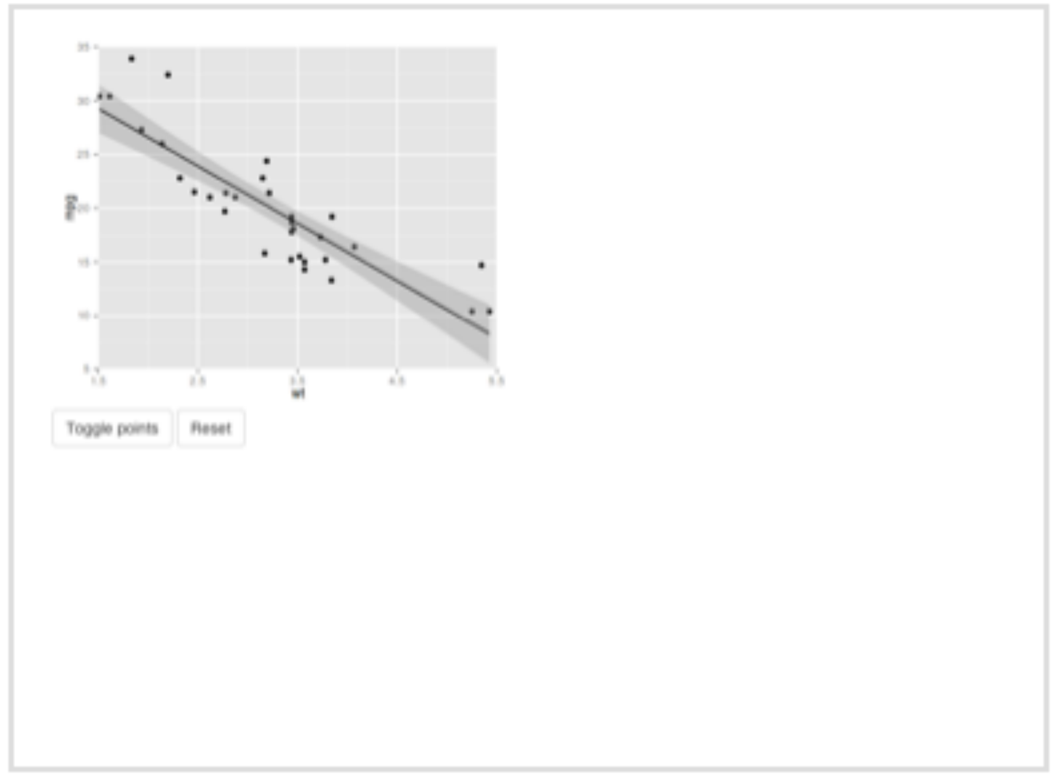
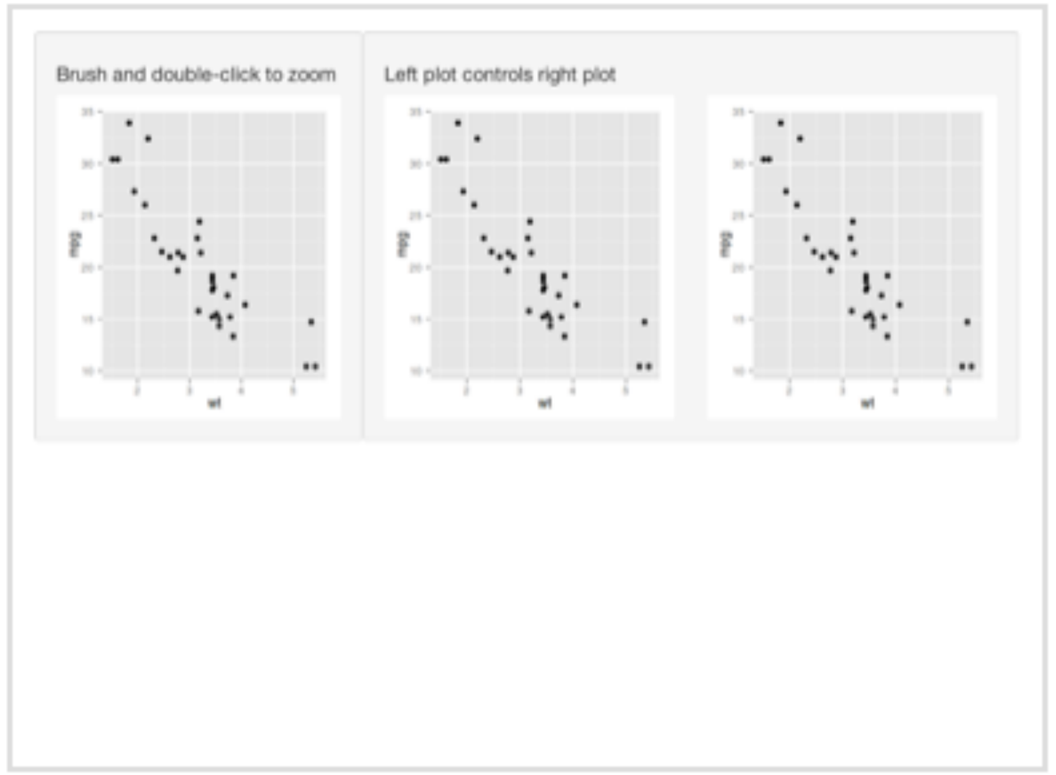

Plot interaction - advanced

Image interaction - basic


Plot interaction - selecting points


Plot interaction - exclude


Plot interaction - zoom

## plotOutput()

To collect input values, add **click**, **dblclick**, **hover**, or **brush** arguments.

```
plotOutput(…, click = "myclick")
```

stores value as

```
input$myclick
```

## Your Turn

Run the app on the following slide or this fancier version:

- shiny.calvin.edu/rpruim/ShinyDemos/InteractivePlots/

Then explore how the values of

- `clicked`,
- `dblclicked`,
- `hovered`, and
- `brushed`

change as you manipulate the plot with you mouse.

```r
ui <- fluidPage(
  plotOutput("plot", click = "click", dblclick = "dblclick",
    hover = "hover", brush = "brush"),
  fluidRow(
    column(3, "Clicked",        verbatimTextOutput("clicked")),
    column(3, "Double Clicked", verbatimTextOutput("dblclicked")),
    column(3, "Hovered",        verbatimTextOutput("hovered")),
    column(3, "Brushed",        verbatimTextOutput("brushed"))
  ))
server <- function(input, output) {
  output$plot       <- renderPlot(qplot(wt, mpg, data = mtcars))
  output$clicked    <- renderPrint(input$click)
  output$dblclicked <- renderPrint(input$dblclick)
  output$hovered    <- renderPrint(input$hover)
  output$brushed    <- renderPrint(input$brush)
}
shinyApp(ui, server)
```

**fancy version @ shiny.calvin.edu/rpruim/ShinyDemos/InteractivePlots/**

# plotOutput()

**Location of mouse click** (in x and y coordinates)

**Location of double click** (in x and y coordinates)

**Location of stationary mouse** (in x and y)

**Bounding coordinates of brush box** (in x and y)

```
plotOutput(…,
  click = "click",
  dblclick = "dblclick",
  hover = "hover",
  brush = "brushed"
)
```

# nearPoints()

Returns a data frame of points near a click

data frame to return subset of (should match plot)

click input object

x variable in plot (not needed with ggplot2)

```
nearPoints(mtcars, input$click, xvar = "wt",
           yvar = "mpg", threshold = 5)
```

y variable in plot (not needed with ggplot2)

include points that fall within this many pixels of click

# brushedPoints()

Returns a data frame of points within a brushed area

data frame to return subset of (should match plot)

brush input object

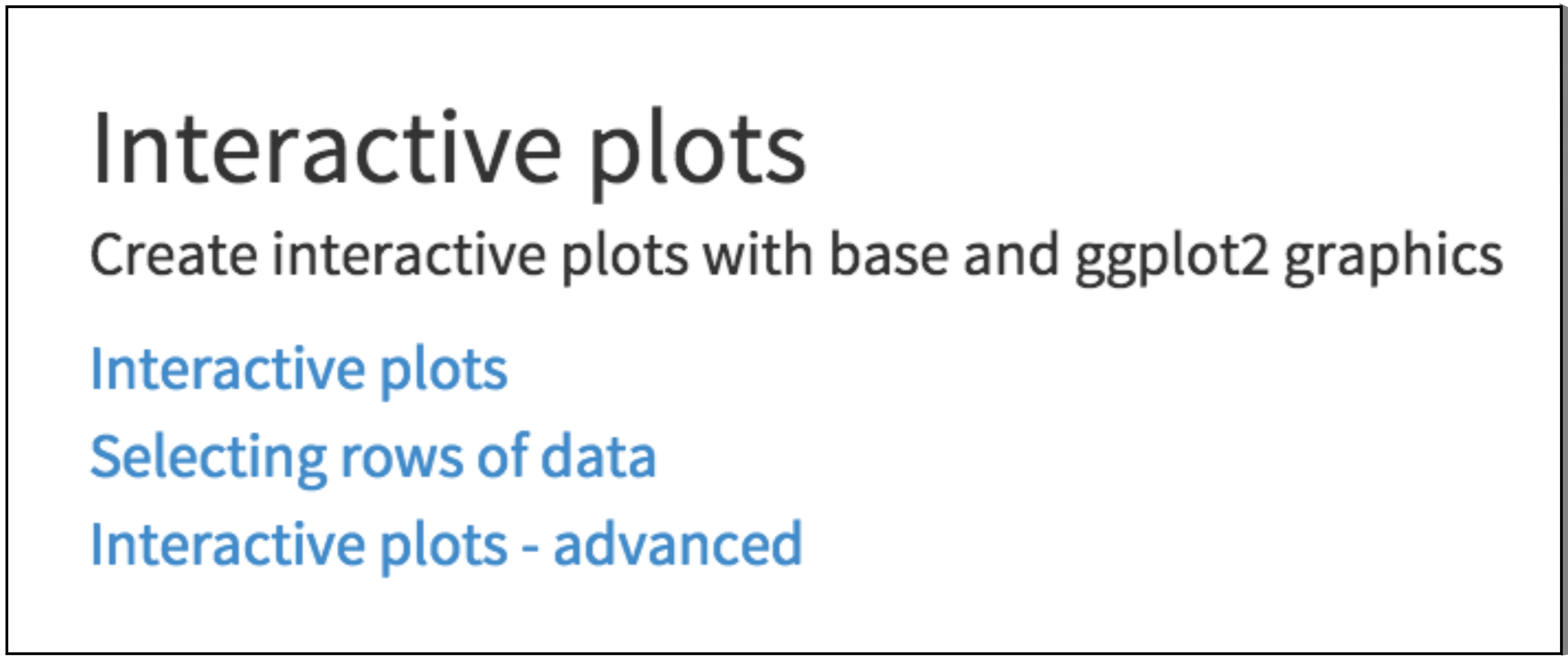
```
brushedPoints(mtcars, input$brush,
              xvar = "wt", yvar = "mpg")
```

x variable in plot
(not needed with ggplot2)

y variable in plot
(not needed with ggplot2)

## Learn more

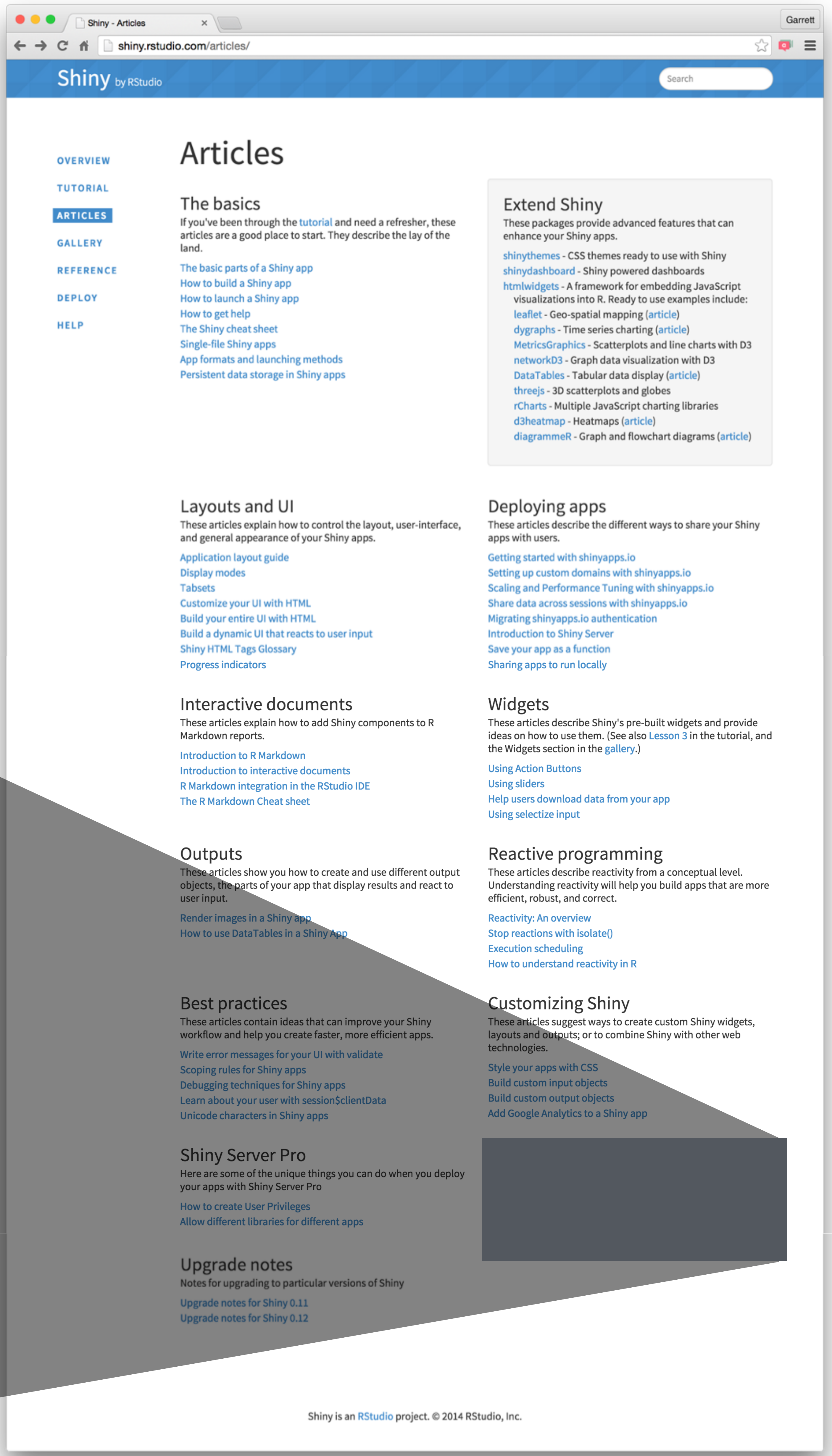
shiny.rstudio.com/articles



Interactive plots

Create interactive plots with base and ggplot2 graphics

Interactive plots
Selecting rows of data
Interactive plots - advanced



Articles

The basics

If you've been through the tutorial and need a refresher, these articles are a good place to start. They describe the lay of the land.

The basic parts of a Shiny app
How to build a Shiny app
How to launch a Shiny app
How to get help
The Shiny cheat sheet
Single-file Shiny apps
App formats and launching methods
Persistent data storage in Shiny apps

Extend Shiny

These packages provide advanced features that can enhance your Shiny apps.

shinythemes - CSS themes ready to use with Shiny
shinydashboard - Shiny powered dashboards
htmlwidgets - A framework for embedding JavaScript visualizations into R. Ready to use examples include:
leaflet - Geo-spatial mapping (article)
dygraphs - Time series charting (article)
MetricsGraphics - Scatterplots and line charts with D3
networkD3 - Graph data visualization with D3
DataTables - Tabular data display (article)
threejs - 3D scatterplots and globes
rCharts - Multiple JavaScript charting libraries
d3heatmap - Heatmaps (article)
diagrammeR - Graph and flowchart diagrams (article)

Layouts and UI

These articles explain how to control the layout, user-interface, and general appearance of your Shiny apps.

Application layout guide
Display modes
Tabsets
Customize your UI with HTML
Build your entire UI with HTML
Build a dynamic UI that reacts to user input
Shiny HTML Tags Glossary
Progress indicators

Deploying apps

These articles describe the different ways to share your Shiny apps with users.

Getting started with shinyapps.io
Setting up custom domains with shinyapps.io
Scaling and Performance Tuning with shinyapps.io
Share data across sessions with shinyapps.io
Migrating shinyapps.io authentication
Introduction to Shiny Server
Save your app as a function
Sharing apps to run locally

Interactive documents

These articles explain how to add Shiny components to R Markdown reports.

Introduction to R Markdown
Introduction to interactive documents
R Markdown integration in the RStudio IDE
The R Markdown Cheat sheet

Widgets

These articles describe Shiny's pre-built widgets and provide ideas on how to use them. (See also Lesson 3 in the tutorial, and the Widgets section in the gallery.)

Using Action Buttons
Using sliders
Help users download data from your app
Using selectize input

Outputs

These articles show you how to create and use different output objects, the parts of your app that display results and react to user input.

Render images in a Shiny app
How to use DataTables in a Shiny App

Reactive programming

These articles describe reactivity from a conceptual level. Understanding reactivity will help you build apps that are more efficient, robust, and correct.

Reactivity: An overview
Stop reactions with isolate()
Execution scheduling
How to understand reactivity in R

Best practices

These articles contain ideas that can improve your Shiny workflow and help you create faster, more efficient apps.

Write error messages for your UI with validate
Scoping rules for Shiny apps
Debugging techniques for Shiny apps
Learn about your user with session$clientData
Unicode characters in Shiny apps

Customizing Shiny

These articles suggest ways to create custom Shiny widgets, layouts and outputs; or to combine Shiny with other web technologies.

Style your apps with CSS
Build custom input objects
Build custom output objects
Add Google Analytics to a Shiny app

Shiny Server Pro

Here are some of the unique things you can do when you deploy your apps with Shiny Server Pro

How to create User Privileges
Allow different libraries for different apps

Upgrade notes

Notes for upgrading to particular versions of Shiny

Upgrade notes for Shiny 0.11
Upgrade notes for Shiny 0.12

Shiny is an RStudio project. © 2014 RStudio, Inc.

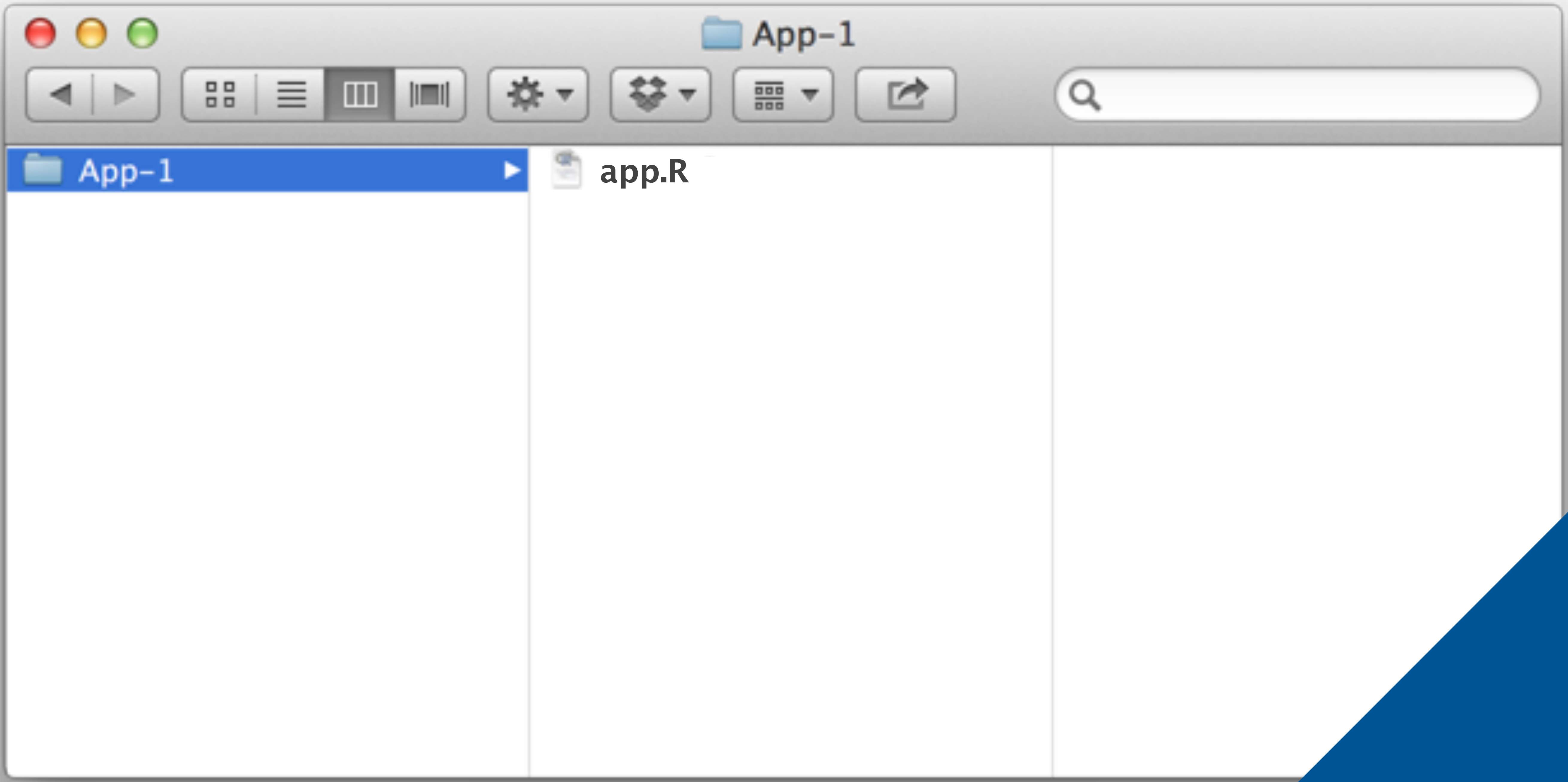
## Share

your app

# How to save your app

One directory with every file the app needs:

- app.R *(your script which ends with a call to shinyApp())*
- datasets, images, css, helper scripts, etc.



You must use this exact name (**app.R**)

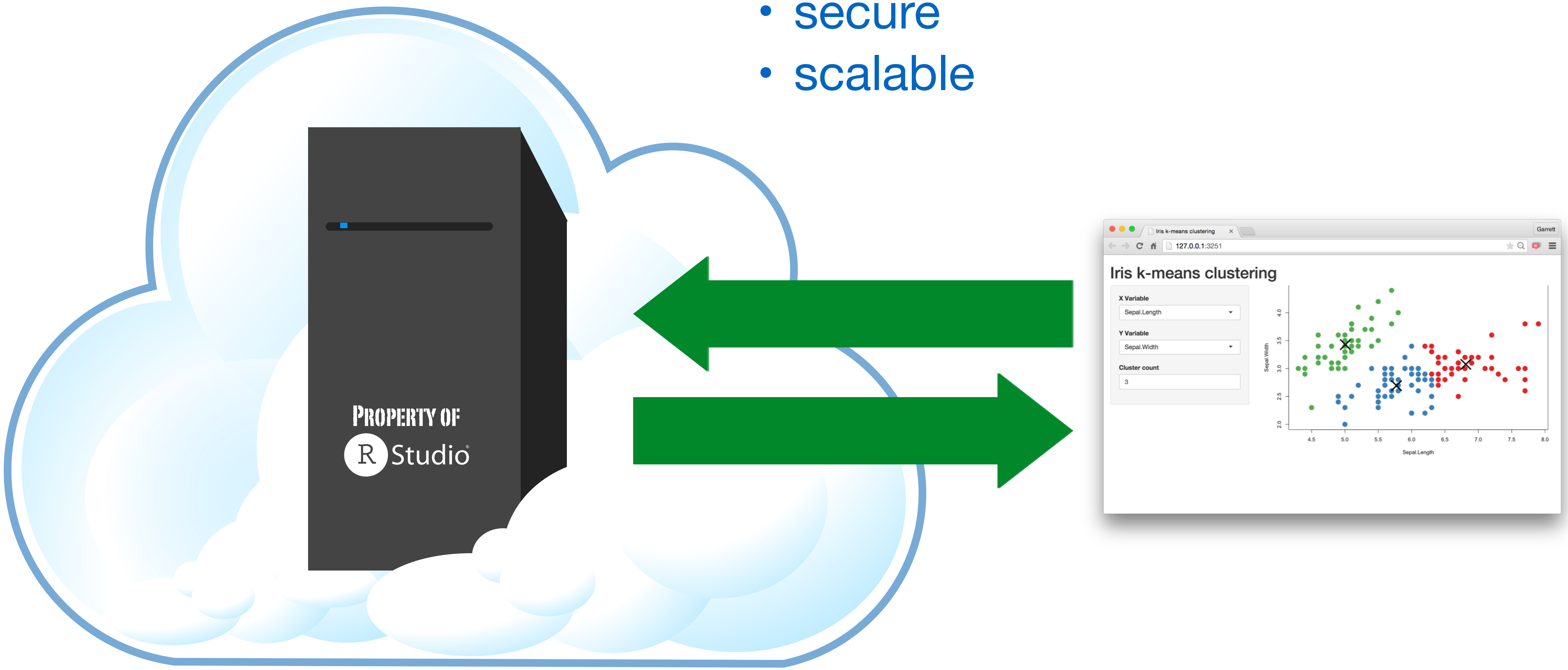
# shinyapps.io

by RStudio®

# Shinyapps.io

A server maintained by RStudio

- easy to use
- secure
- scalable



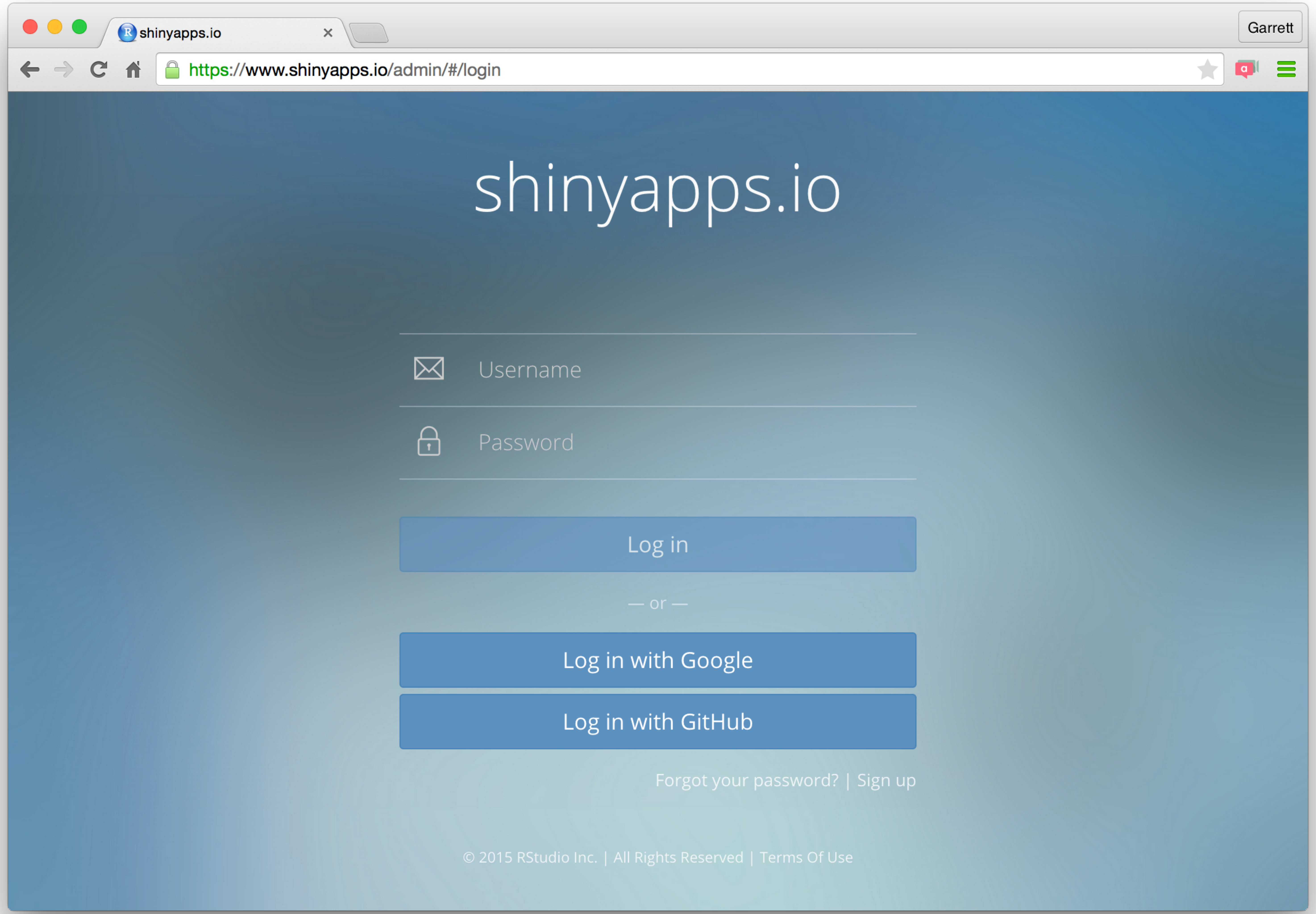
Iris k-means clustering

X Variable: Sepal.Length

Y Variable: Sepal.Width

Cluster count: 3

## Hassle-free cloud hosting for Shiny
www.shinyapps.io


shinyapps.io

https://www.shinyapps.io/admin/#/login

shinyapps.io

Username

Password

Log in

— or —

Log in with Google

Log in with GitHub

Forgot your password? | Sign up

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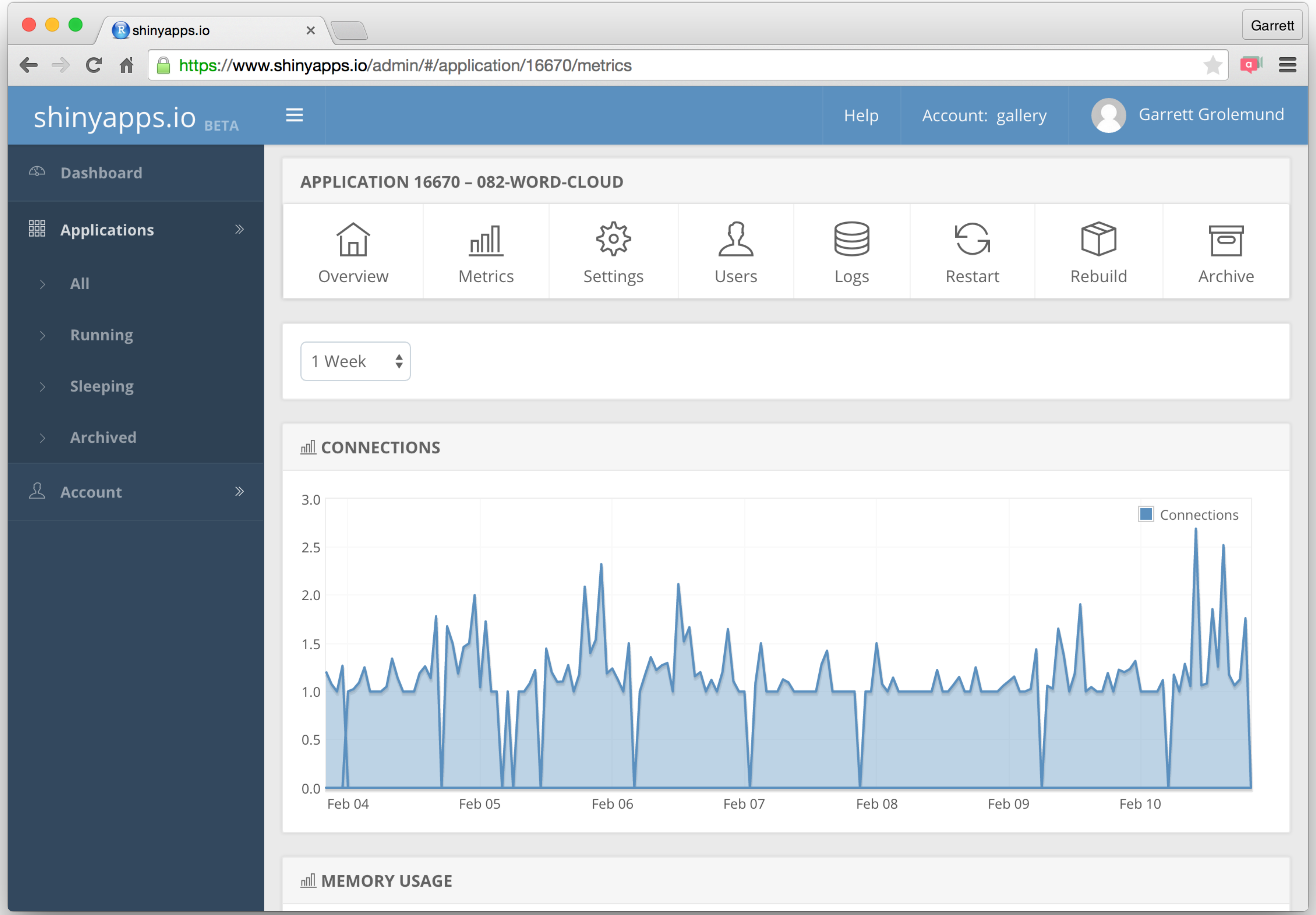
Calvin COLLEGE 1876

slides at: www.calvin.edu/~rpruim/talks/

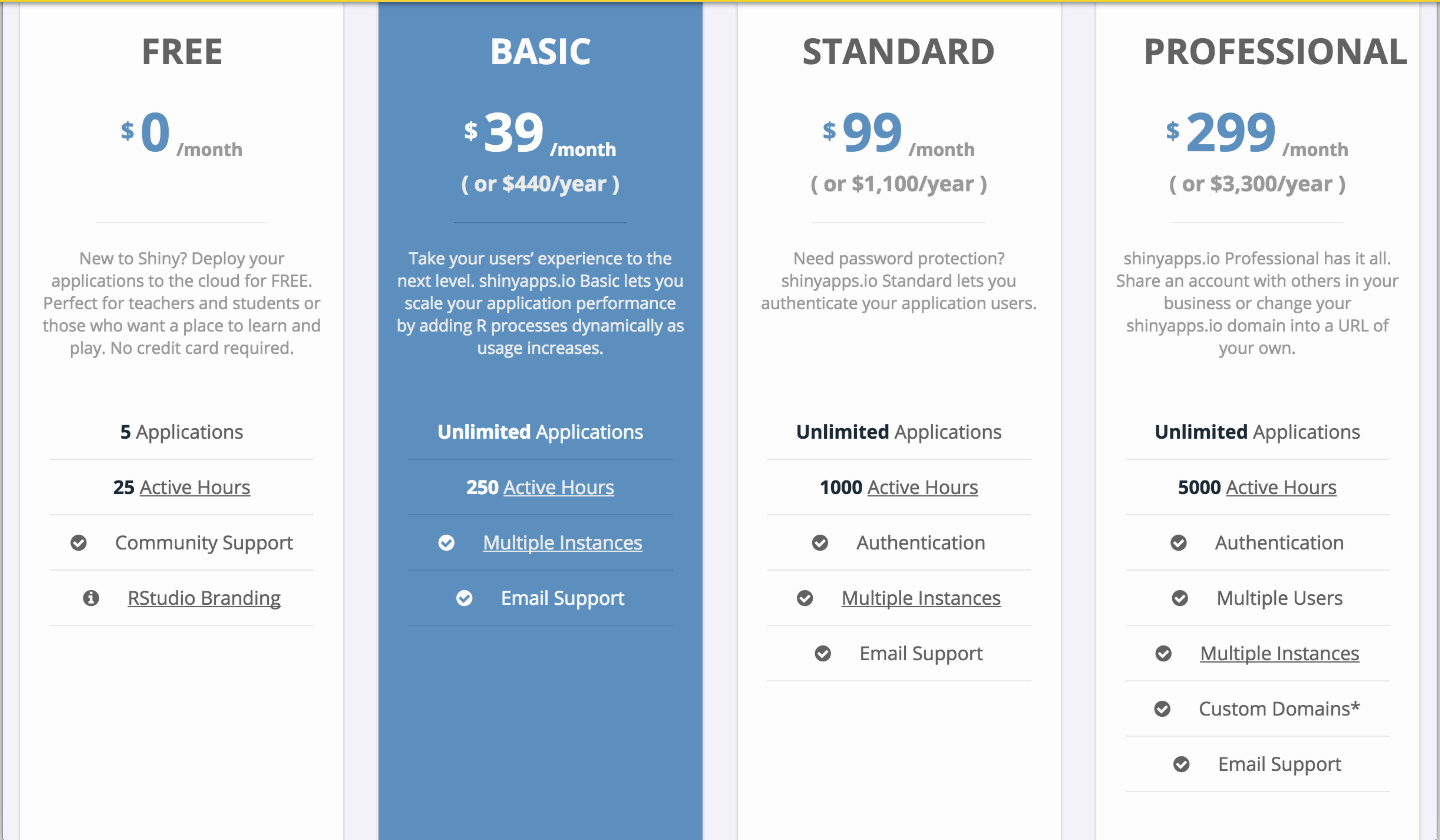
## Hassle-free cloud hosting for Shiny
[shinyapps.io](https://www.shinyapps.io)



APPLICATION 16670 – 082-WORD-CLOUD

CONNECTIONS

MEMORY USAGE



## FREE

$0 /month

New to Shiny? Deploy your applications to the cloud for FREE. Perfect for teachers and students or those who want a place to learn and play. No credit card required.

- **5** Applications
- **25** Active Hours
- ✓ Community Support
- ℹ RStudio Branding

## BASIC

$39 /month

( or $440/year )

Take your users' experience to the next level. shinyapps.io Basic lets you scale your application performance by adding R processes dynamically as usage increases.

- **Unlimited** Applications
- **250** Active Hours
- ✓ Multiple Instances
- ✓ Email Support

## STANDARD

$99 /month

( or $1,100/year )

Need password protection? shinyapps.io Standard lets you authenticate your application users.

- **Unlimited** Applications
- **1000** Active Hours
- ✓ Authentication
- ✓ Multiple Instances
- ✓ Email Support

## PROFESSIONAL

$299 /month

( or $3,300/year )

shinyapps.io Professional has it all. Share an account with others in your business or change your shinyapps.io domain into a URL of your own.

- **Unlimited** Applications
- **5000** Active Hours
- ✓ Authentication
- ✓ Multiple Users
- ✓ Multiple Instances
- ✓ Custom Domains*
- ✓ Email Support

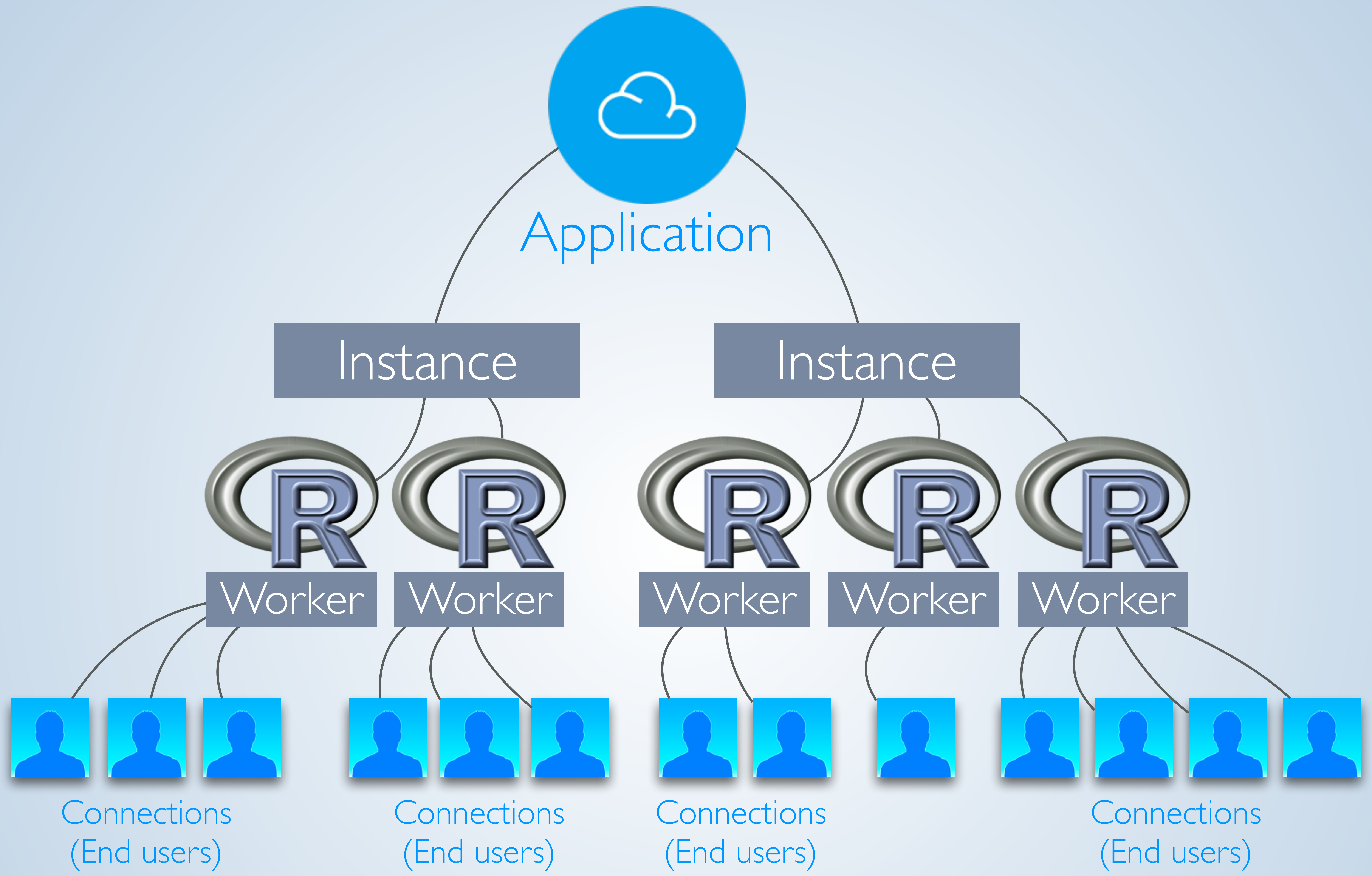
## Build your own server

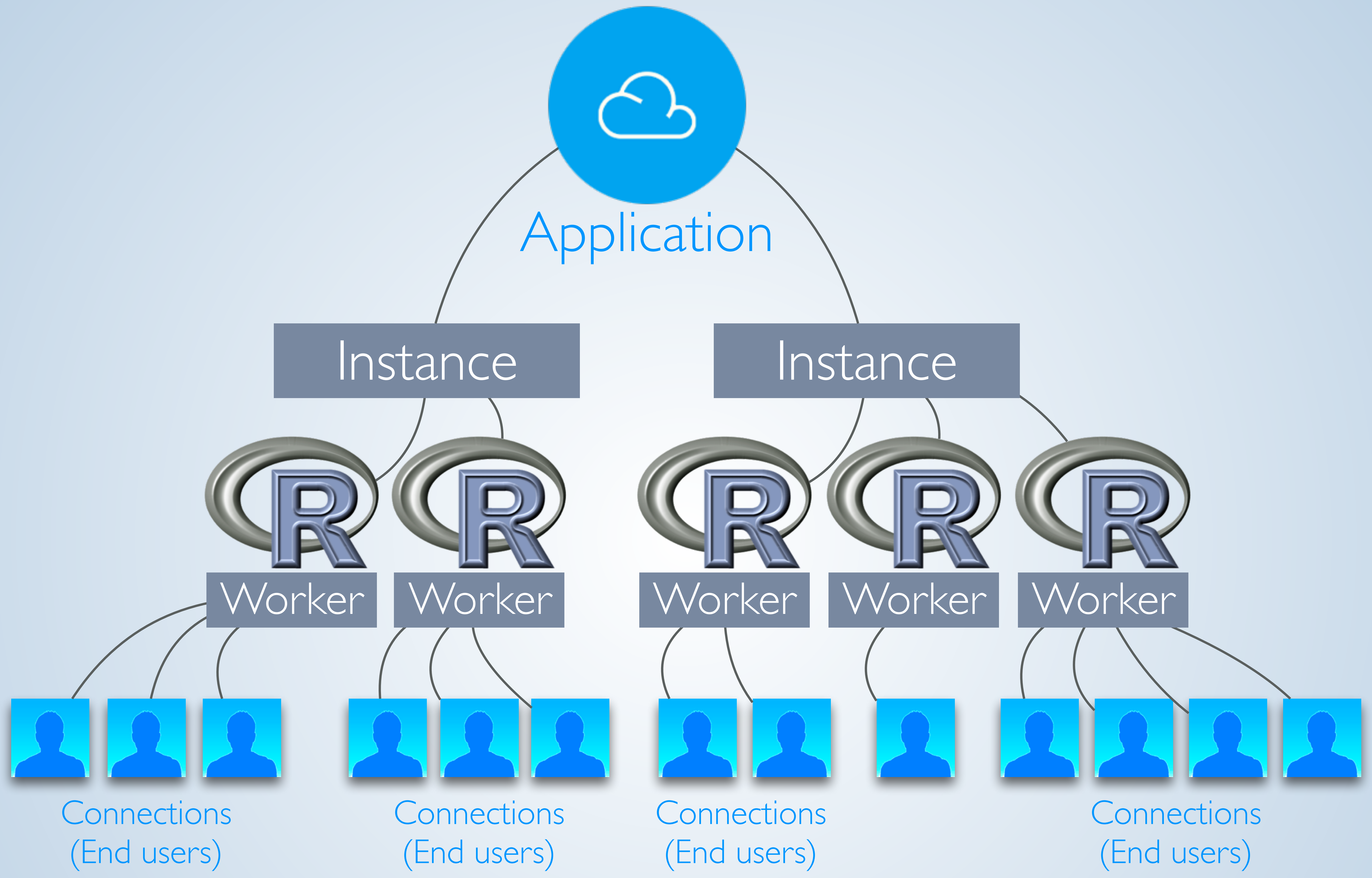
## Shiny Server Pro

www.rstudio.com/products/shiny/shiny-server/

- ✓ **Secure access**
  LDAP, GoogleAuth, SSL, and more
- ✓ **Performance**
  fine tune at app and server level
- ✓ **Management**
  monitor and control resource use
- ✓ **Support**
  direct priority support

45 day evaluation free trial


Application
Instance
Instance
Worker
Worker
Worker
Worker
Worker
Connections (End users)
Connections (End users)
Connections (End users)
Connections (End users)


Application
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Connections
(End users)
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(End users)
Connections
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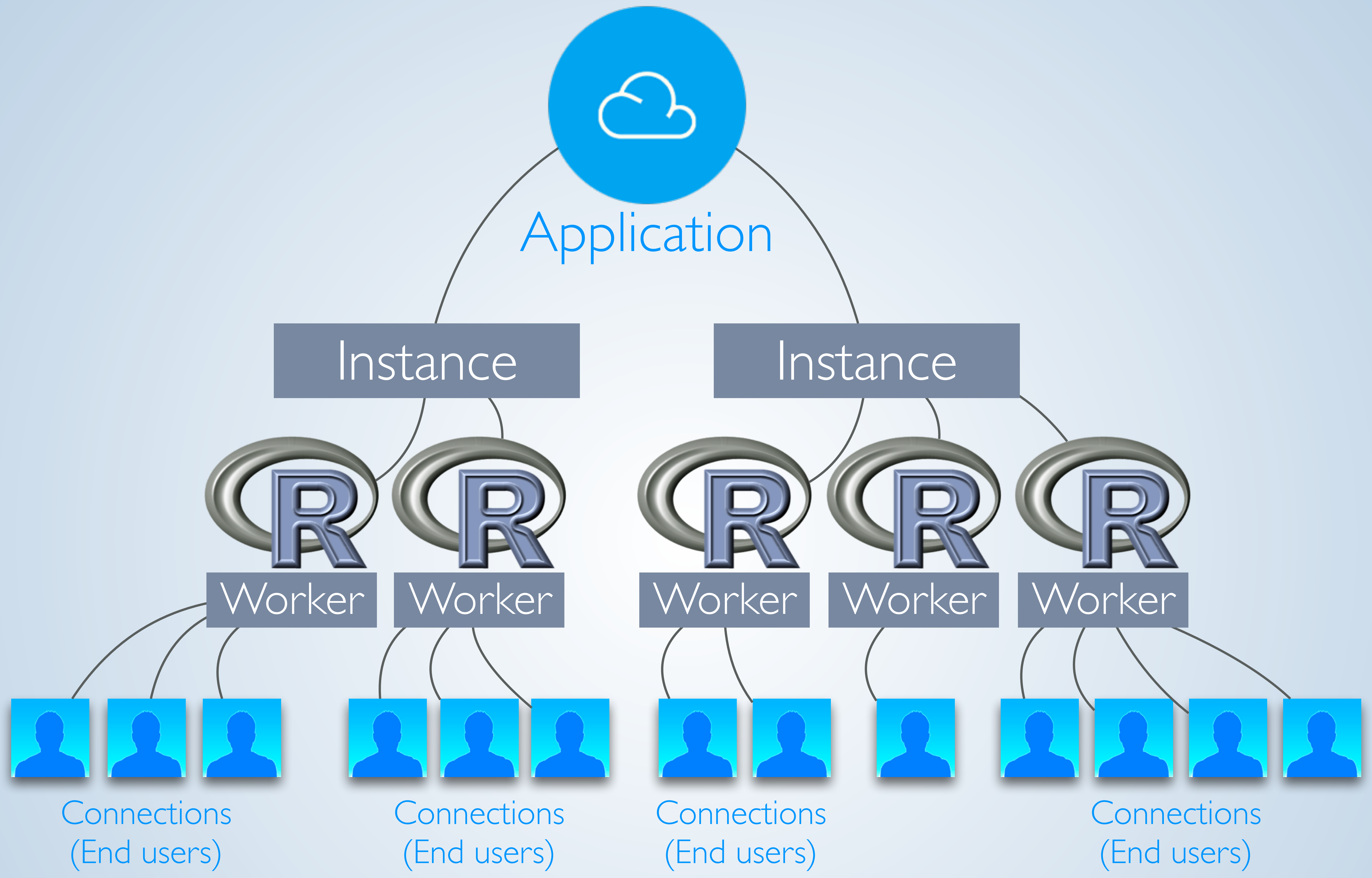
Connections
(End users)

RStudio

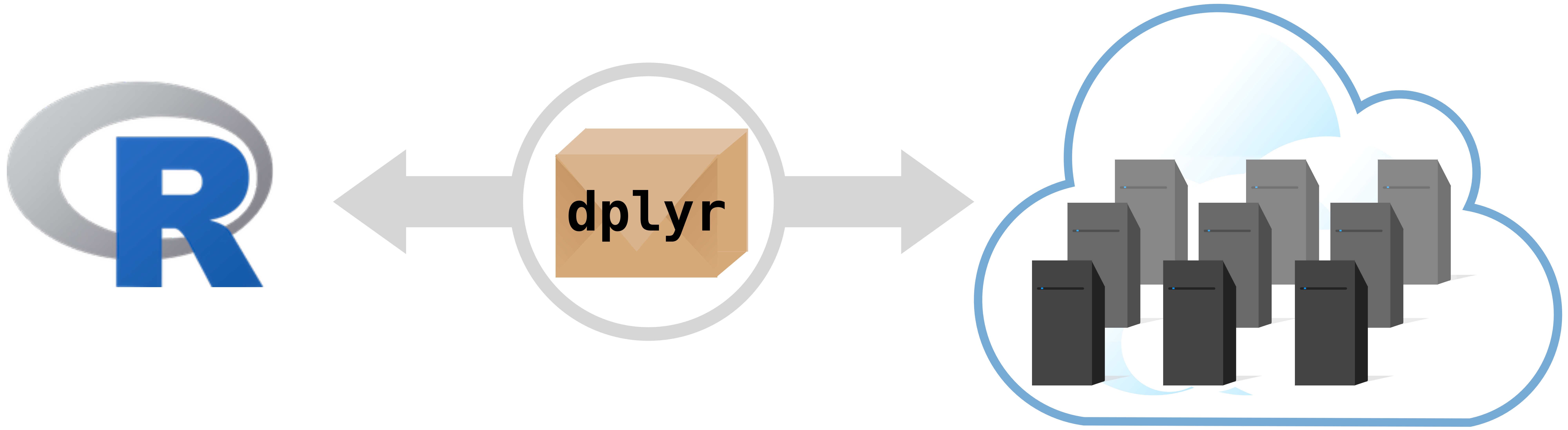

Application
Instance
Instance
Worker
Worker
Worker
Worker
Worker
Connections (End users)
Connections (End users)
Connections (End users)
Connections (End users)

RStudio

## Advice for
## Big Data

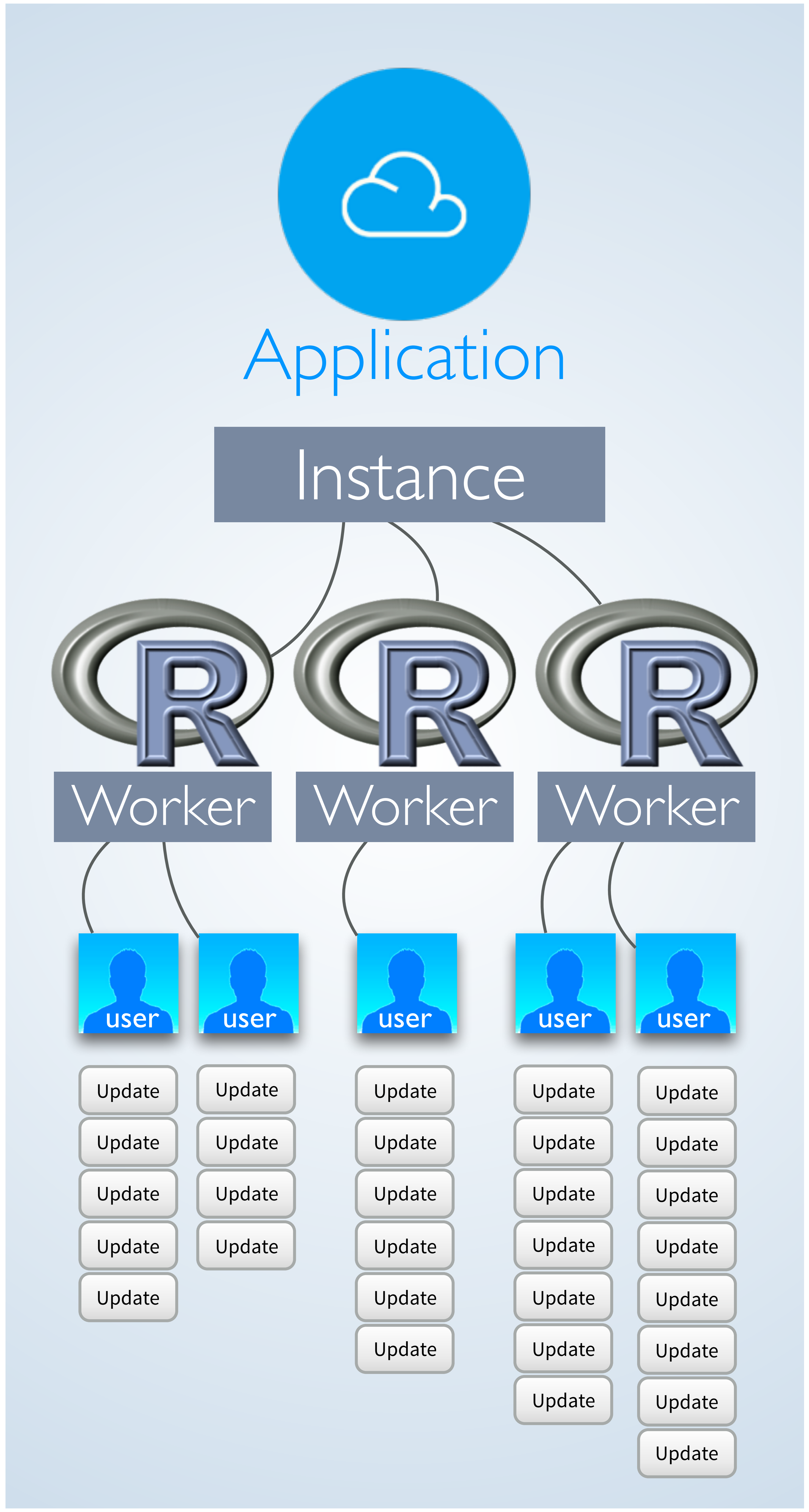
# General Strategy

1. Store data in out of memory warehouse
2. Use an R Package to interact with warehouse



## Big Data and Shiny

1. **Avoid** unnecessary repetitions

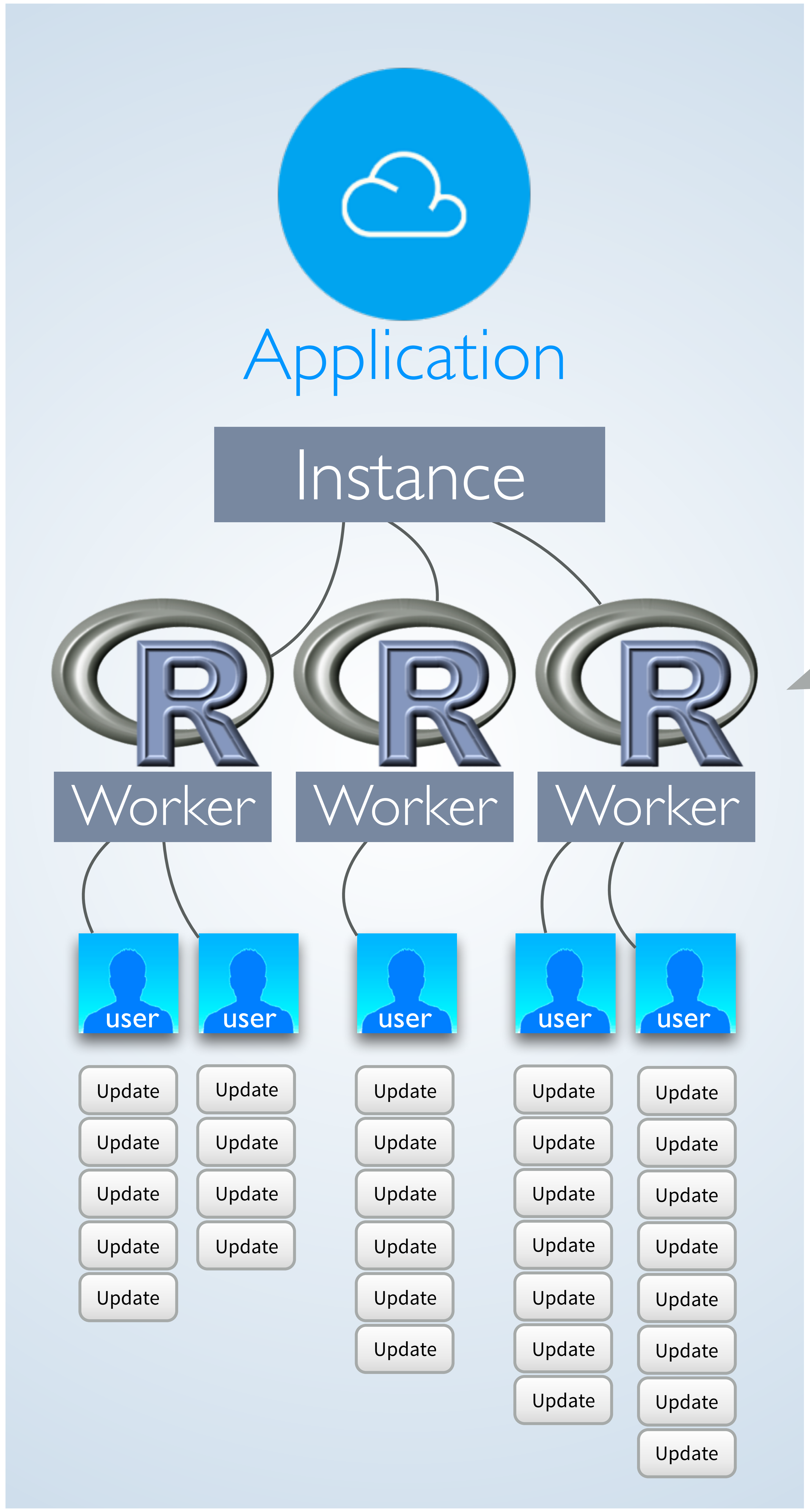


```
library(shiny)

ui <- fluidPage(
  sliderInput(inputId = "num",
    label = "Choose a number",
    value = 25, min = 1,
    max = 100),
  plotOutput("hist")
)

server <- function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$num))
  })
}

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



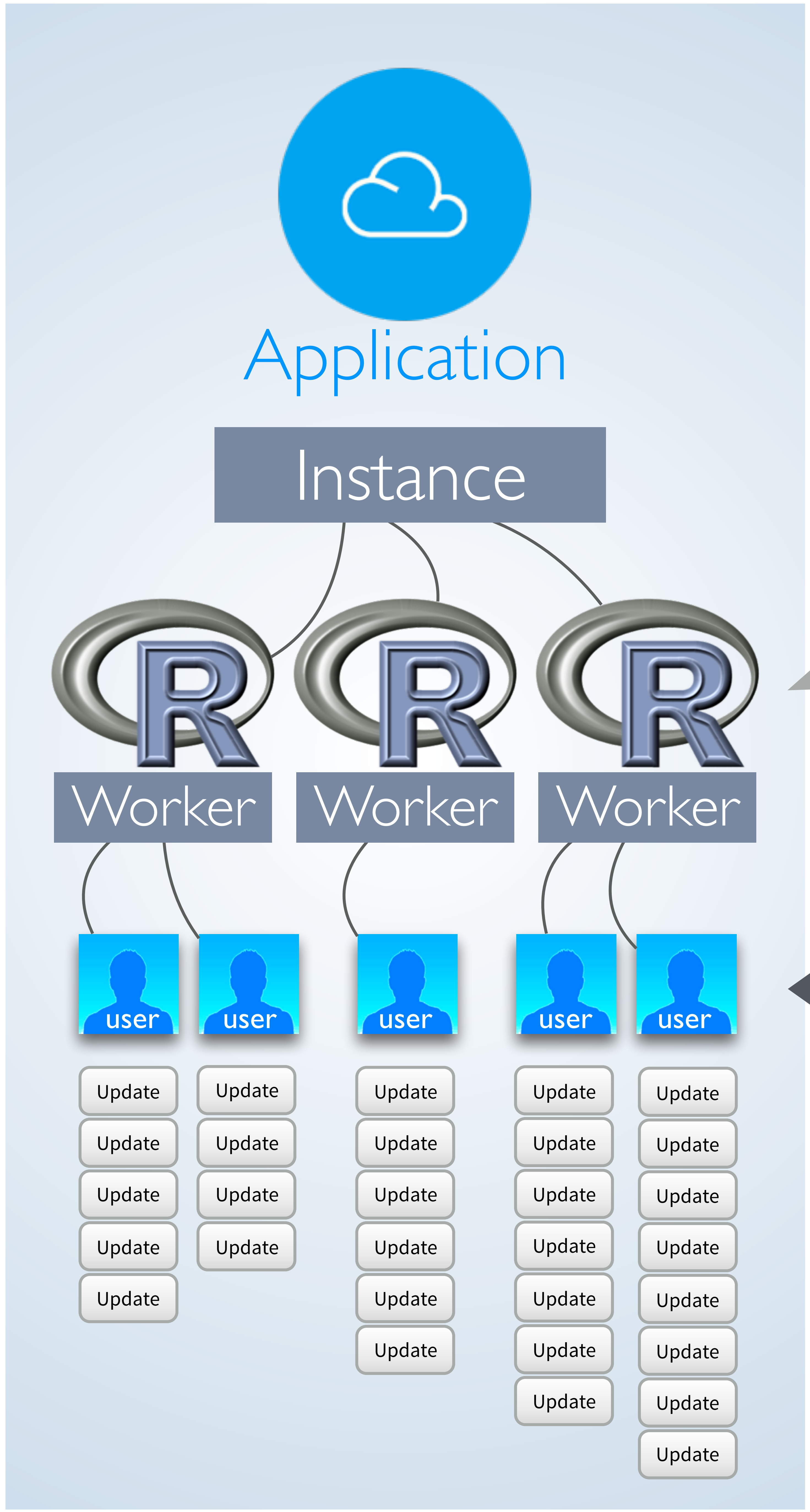
Code outside the server function will be run once per R worker

```
library(shiny)

ui <- fluidPage(
  sliderInput(inputId = "num",
    label = "Choose a number",
    value = 25, min = 1,
    max = 100),
  plotOutput("hist")
)

server <- function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$num))
  })
}

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



Code outside the server function will be run once per R worker

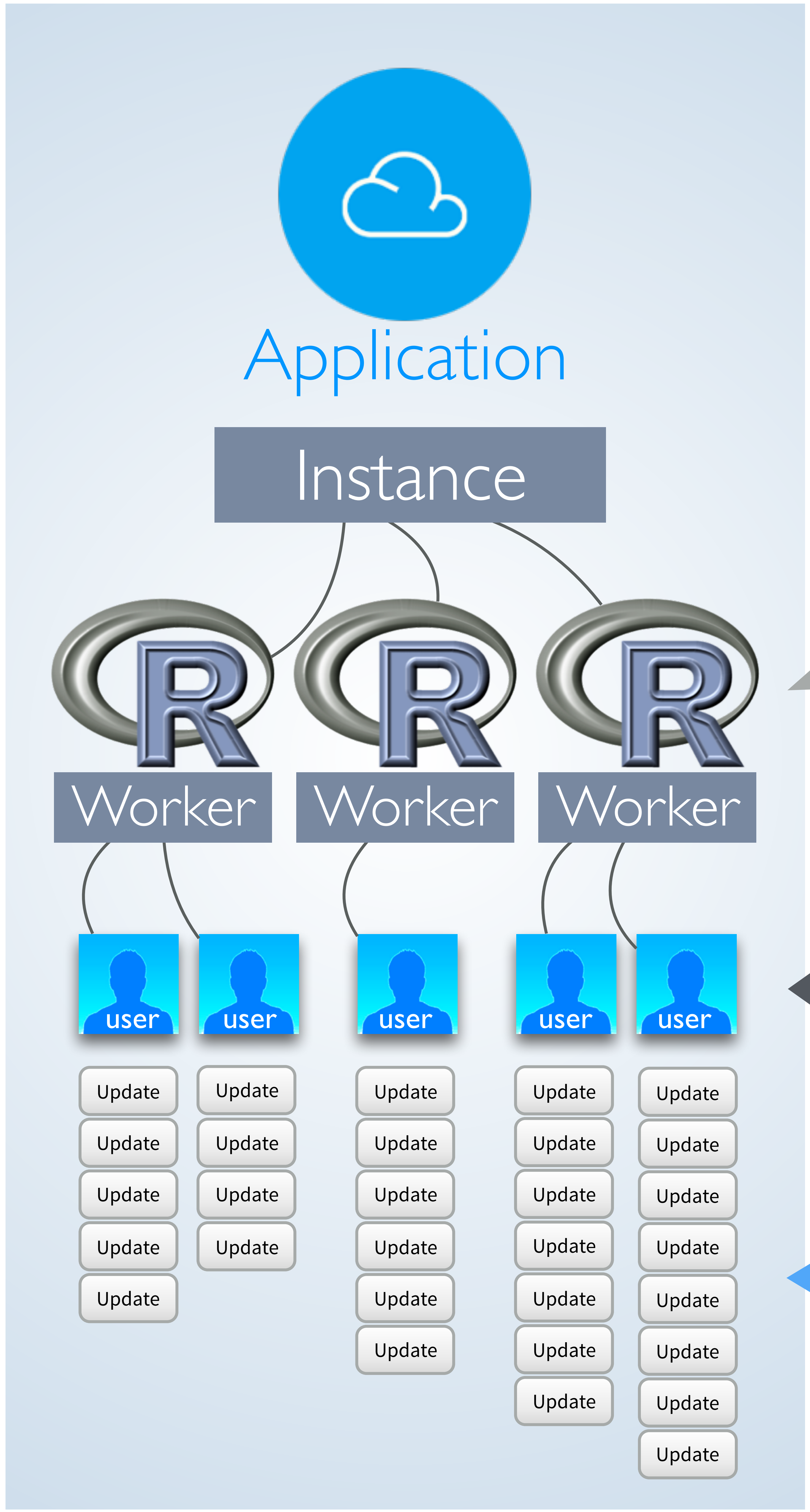
Code inside the server function will be run once per connection

```
library(shiny)

ui <- fluidPage(
  sliderInput(inputId = "num",
    label = "Choose a number",
    value = 25, min = 1,
    max = 100),
  plotOutput("hist")
)

server <- function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$num))
  })
}

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



Code outside the server function will be run once per R worker

Code inside the server function will be run once per connection

Code inside of a reactive function will be run once per reaction

```
library(shiny)

ui <- fluidPage(
  sliderInput(inputId = "num",
    label = "Choose a number",
    value = 25, min = 1,
    max = 100),
  plotOutput("hist")
)

server <- function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$num))
  })
}

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

## Big Data and Shiny

1. **Avoid** unnecessary repetitions
2. **Cache** expensive operations with reactive expressions

## A reactive expression is special in two ways

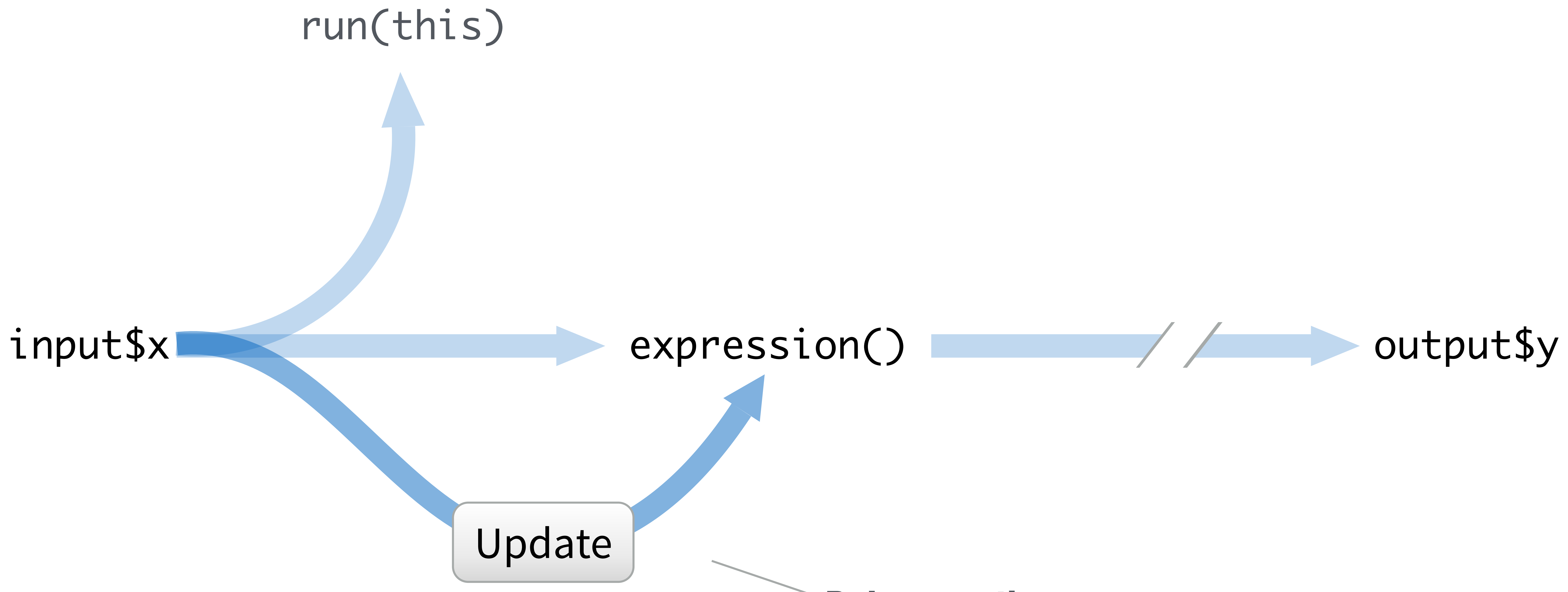
```
data()
```

1 You call a reactive expression like a function

2 Reactive expressions **cache** their values
(the expression will return its most recent value, unless it has become invalidated)

# Big Data and Shiny

1. **Avoid** unnecessary repetitions
2. **Cache** expensive operations with reactive expressions
3. **Delay** expensive operations



**Delay reactions**

eventReactive()

# eventReactive()

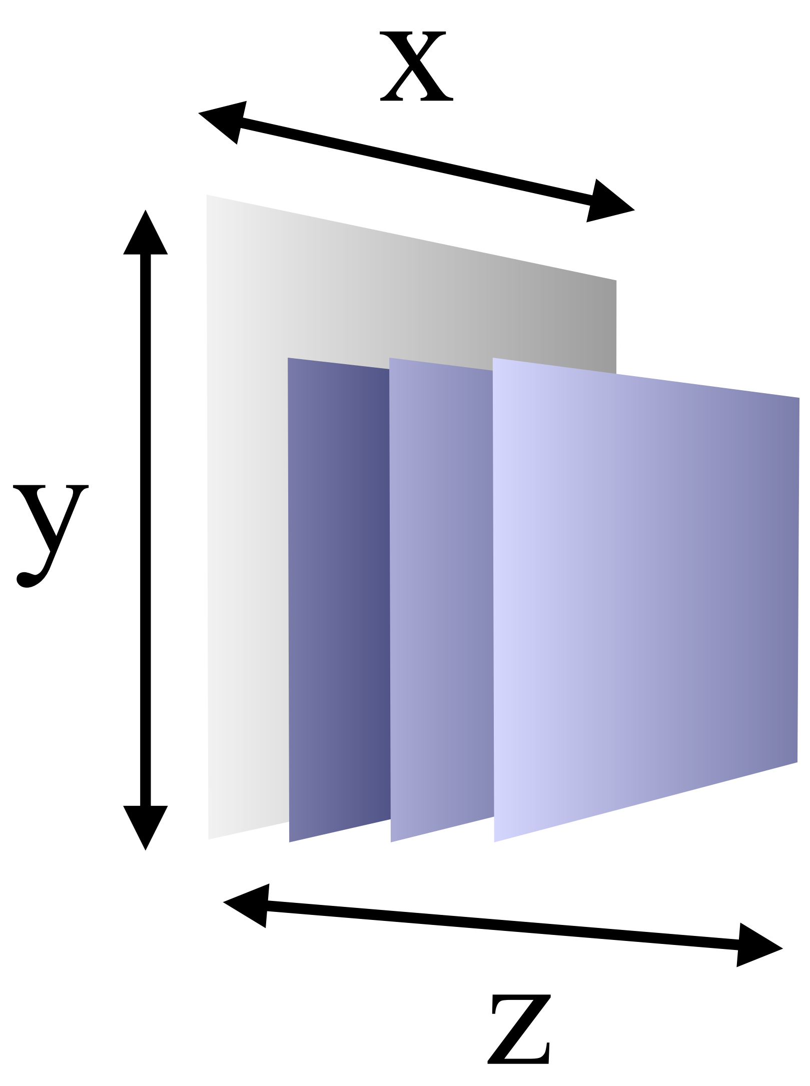
```
data <- eventReactive(input$go, { rnorm(input$num) })
```

Builds an object that: notifies objects that use it that they are invalid

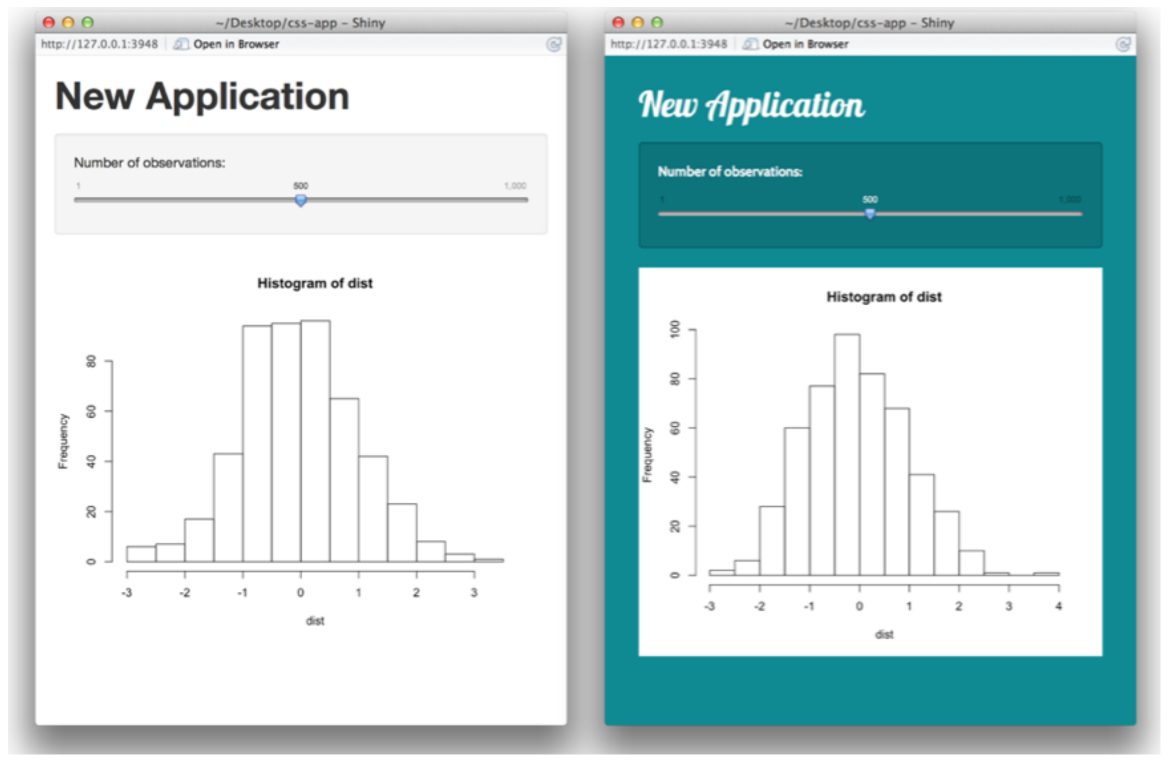
When notified by: this or these reactive value(s) **and no others**

## Where next?

Add static elements



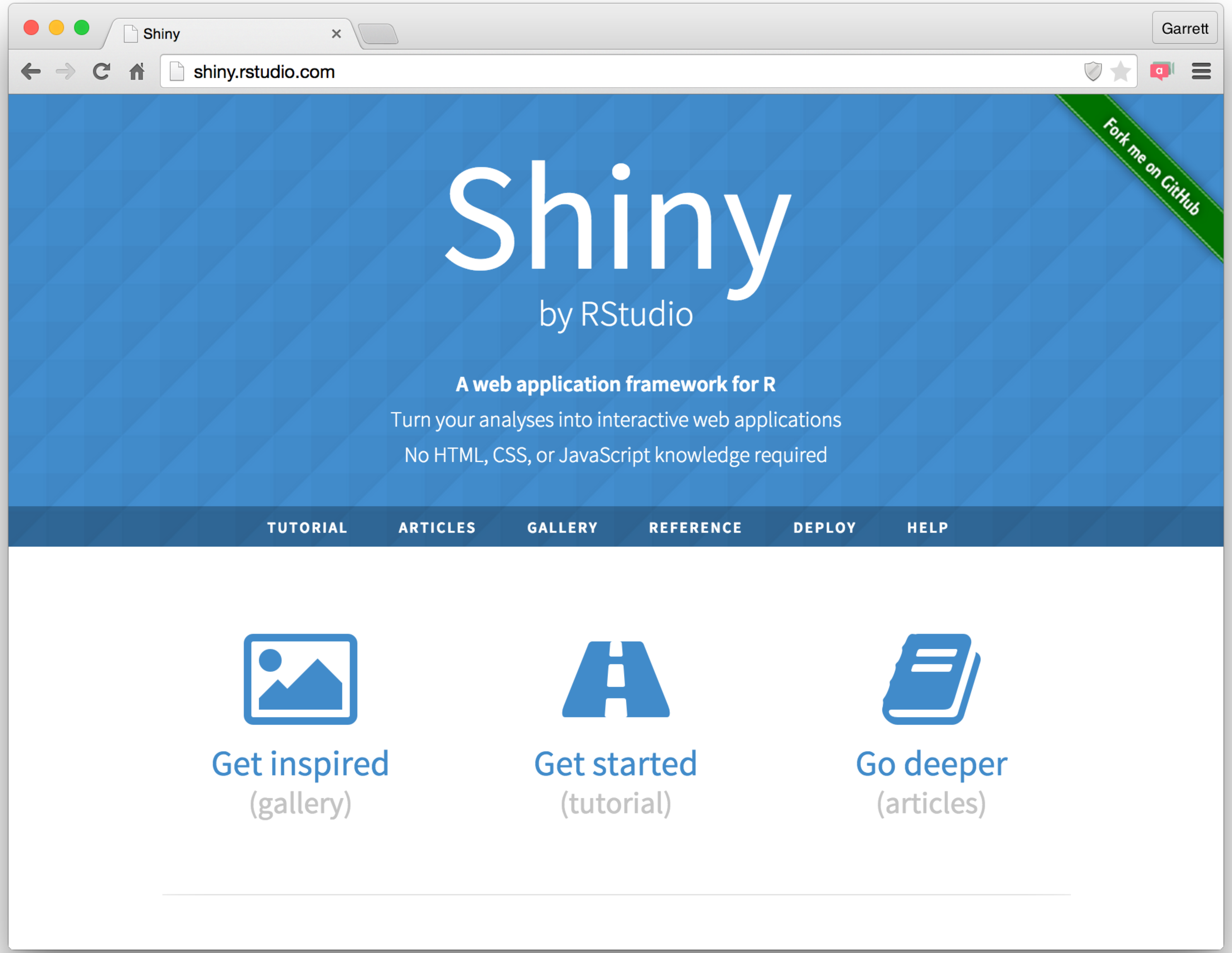
Lay out elements



Style elements with CSS

# The Shiny Development Center

shiny.rstudio.com


Shiny
shiny.rstudio.com

Fork me on GitHub

Shiny
by RStudio

**A web application framework for R**
Turn your analyses into interactive web applications
No HTML, CSS, or JavaScript knowledge required

TUTORIAL ARTICLES GALLERY REFERENCE DEPLOY HELP

Get inspired (gallery)
Get started (tutorial)
Go deeper (articles)