

# Web apps in R with Shiny

2020-08-22

apps/goog-index/app.R

# Web apps in R

## Reactivity



# Web apps in R

## Reactivity

## Design and User Interface (UI)



**Web apps in R**

Reactivity

Design and User Interface (UI)

**Dashboards**



## **Your Turn 1**

**Open a new Shiny file (file > New File > Shiny Web App)**

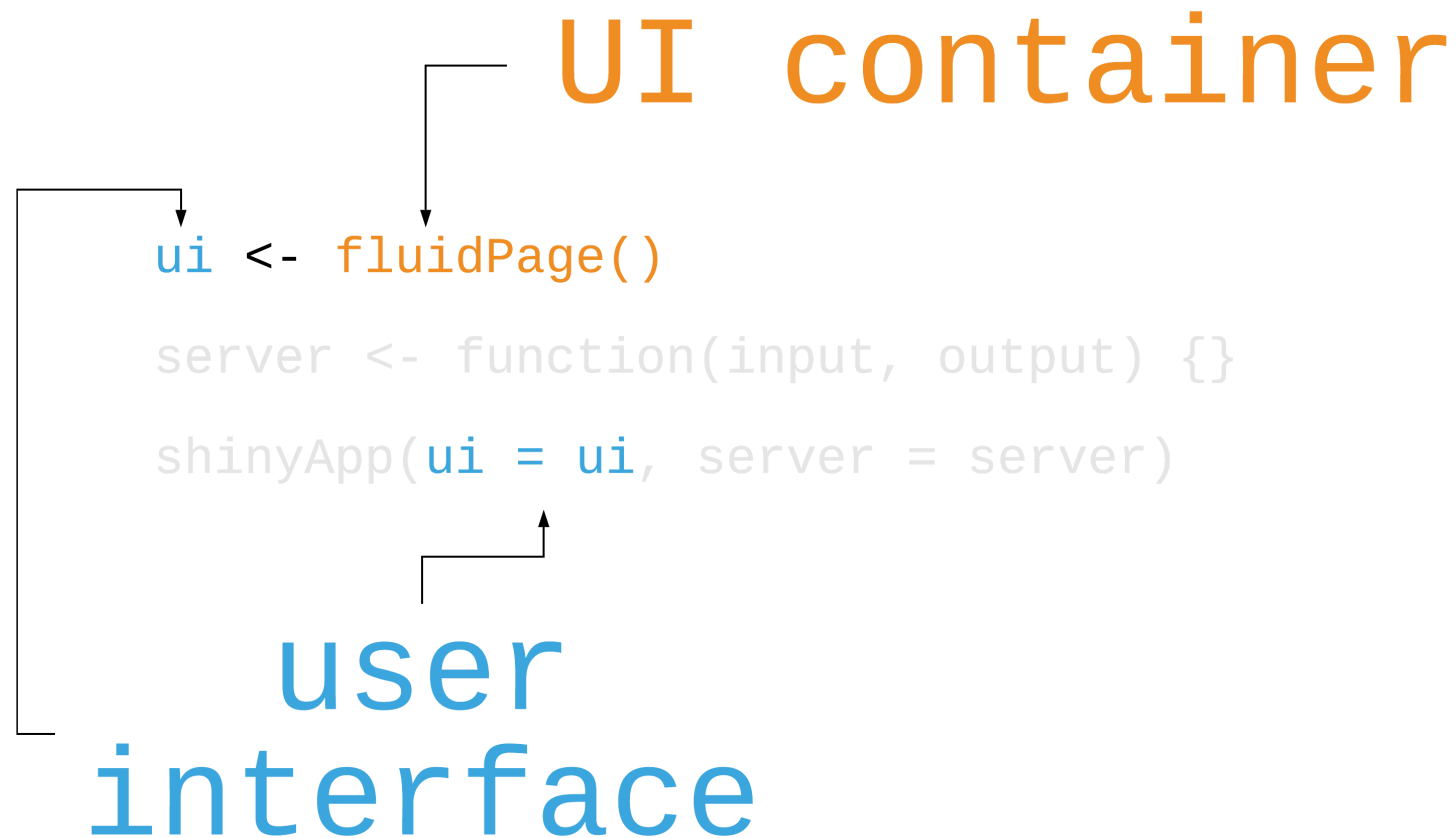
**Run the app**

**Stop the app from running**

# Anatomy of a shiny app

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

# Anatomy of a shiny app





# Anatomy of a shiny app

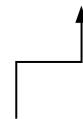
server function

```
ui <- fluidPage()
```



```
server <- function(input, output) {}
```

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



server logic

# Anatomy of a shiny app

app components

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

run app

The diagram illustrates the components of a Shiny application and how they are used to run it. The text 'app components' is in blue, and 'run app' is in orange. Three lines of code are shown: 'ui <- fluidPage()', 'server <- function(input, output) {}', and 'shinyApp(ui = ui, server = server)'. An arrow points from 'app components' to the 'ui' variable in the first line. Another arrow points from 'app components' to the 'server' variable in the second line. A third arrow points from 'run app' to the 'shinyApp' function in the third line.



# new data alert!



## movies

Where does it come from?

`movies.Rdata`

	title	title_type	genre	runtime	mpaa_rating	stud
1	Filly Brown	Feature Film	Drama	80	R	Indo
2	The Dish	Feature Film	Drama	101	PG-13	Warr
3	Waiting for Guffman	Feature Film	Comedy	84	R	Sony
4	The Age of Innocence	Feature Film	Drama	139	PG	Colu
5	Malevolence	Feature Film	Horror	90	R	Anch
6	Old Partner	Documentary	Documentary	78	Unrated	Shca
7	Lady Jane	Feature Film	Drama	142	PG-13	Para
8	Mad Dog Time	Feature Film	Drama	93	R	MGM
9	Beauty Is Embarrassing	Documentary	Documentary	88	Unrated	Inde
10	The Snowtown Murders	Feature Film	Drama	119	Unrated	IFC F
11	Superman II	Feature Film	Action & Adventure	127	PG	Warr
12	Leap of Faith	Feature Film	Drama	108	PG-13	Para
13	The Royal Tenenbaums	Feature Film	Comedy	110	R	Buer
14	School for Scoundrels	Feature Film	Comedy	100	PG-13	MGM
15	Rhinestone	Feature Film	Comedy	111	PG	20th
16	Burn After Reading	Feature Film	Drama	96	R	Focu
17	The Doors	Feature Film	Drama	140	R	Sony
18	The Wood	Feature Film	Drama	106	R	Para
19	Jason X	Feature Film	Horror	91	R	New
20	Dragon Wars	Feature Film	Drama	90	PG-13	Sony
21	Fallen	Feature Film	Drama	124	R	Warr
22	The Gleaners and I	Documentary	Documentary	82	Unrated	Zeitg

How can I use it?

```
load("movies.Rdata")  
View(movies)
```



*this loads it in your  
global environment*

## **Your Turn 2**

**Open apps/movies\_01.R**

**Try to identify the components of the app**

**Run the app**

**Stop the app**

# movies\_01.R

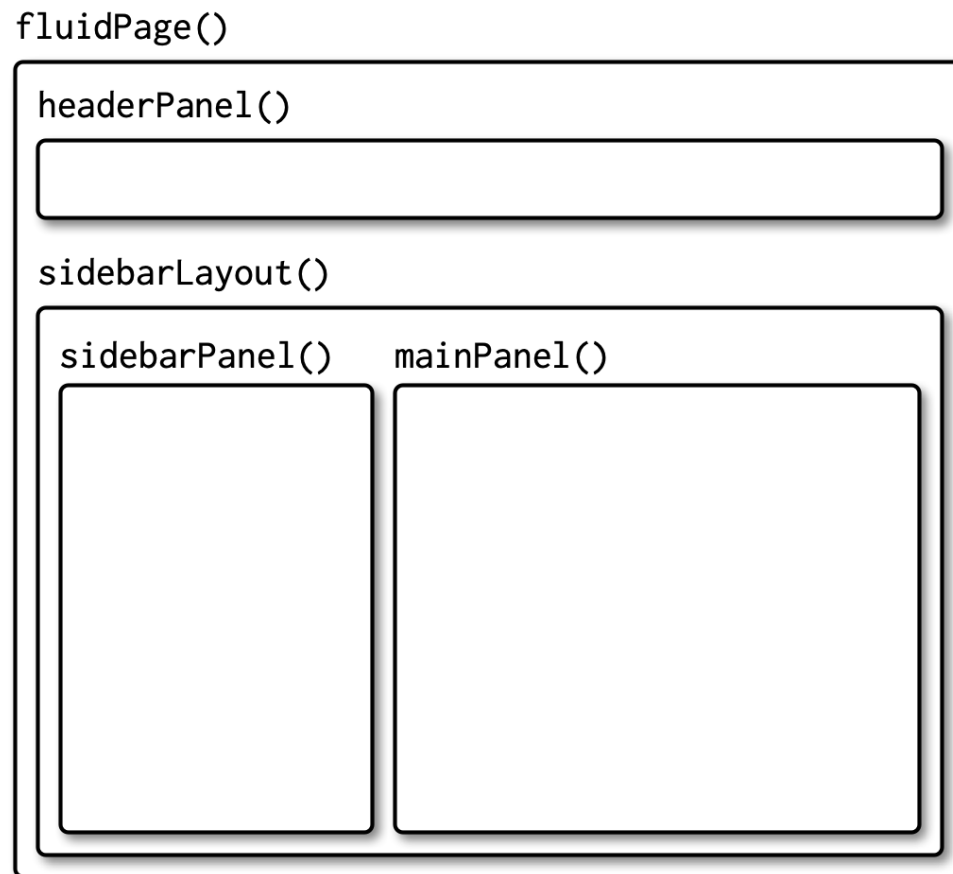


Image by Hadley Wickham

# Sidebar layouts

```
ui <- fluidPage(  
  headerPanel(),  
  sidebarLayout(  
    sidebarPanel(  
      # Inputs  
    ),  
    mainPanel(  
      # Outputs  
    )  
  )  
)
```

# Sidebar inputs

```
sidebarPanel(  
  selectInput(  
    inputId = "y",  
    label = "Y-axis:",  
    choices = c("..."),  
    selected = "audience_score"  
  ),  
  selectInput(  
    inputId = "x",  
    label = "X-axis:",  
    choices = c("..."),  
    selected = "critics_score"  
  )  
)
```

# Sidebar inputs

```
sidebarPanel(  
  selectInput(  
    inputId = "y",  
    label = "Y-axis:",  
    choices = c("..."),  
    selected = "audience_score"  
  ),  
  selectInput(  
    inputId = "x",  
    label = "X-axis:",  
    choices = c("..."),  
    selected = "critics_score"  
  )  
)
```



# Sidebar inputs

```
sidebarPanel(  
  selectInput(  
    inputId = "y",  
    label = "Y-axis:",  
    choices = c("..."),  
    selected = "audience_score"  
  ),  
  selectInput(  
    inputId = "x",  
    label = "X-axis:",  
    choices = c("..."),  
    selected = "critics_score"  
  )  
)
```

# Main panel outputs

```
mainPanel(  
  plotOutput(outputId = "scatterplot")  
)
```

# Main panel outputs

```
mainPanel(  
  plotOutput(outputId = "scatterplot")  
)
```

# Server

```
server <- function(input, output) {  
  output$scatterplot <- renderPlot({  
    ggplot(  
      data = movies,  
      aes_string(x = input$x, y = input$y)  
    ) +  
      geom_point()  
  })  
}
```

# Server

```
server <- function(input, output) {  
  output$scatterplot <- renderPlot({  
    ggplot(  
      data = movies,  
      aes_string(x = input$x, y = input$y)  
    ) +  
    geom_point()  
  })  
}
```

# Main panel outputs

```
mainPanel(  
  plotOutput(outputId = "scatterplot")  
)
```

# Server

```
server <- function(input, output) {  
  output$scatterplot <- renderPlot({  
    ggplot(  
      data = movies,  
      aes_string(x = input$x, y = input$y)  
    ) +  
    geom_point()  
  })  
}
```

# Server

```
server <- function(input, output) {  
  output$scatterplot <- renderPlot({  
    ggplot(  
      data = movies,  
      aes_string(x = input$x, y = input$y)  
    ) +  
    geom_point()  
  })  
}
```



# Sidebar inputs

```
sidebarPanel(  
  selectInput(  
    inputId = "y",  
    label = "Y-axis:",  
    choices = c("..."),  
    selected = "audience_score"  
  ),  
  selectInput(  
    inputId = "x",  
    label = "X-axis:",  
    choices = c("..."),  
    selected = "critics_score"  
  )  
)
```

# Server

```
server <- function(input, output) {  
  output$scatterplot <- renderPlot({  
    ggplot(  
      data = movies,  
      aes_string(x = input$x, y = input$y)  
    ) +  
    geom_point()  
  })  
}
```

# Run the app

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

## Your Turn 3

**Add new select menu to color the points. Use the following arguments:** `inputId = "z", label = "Color by:", choices = c("title_type", "genre", "mpaa_rating", "critics_rating", "audience_rating"), selected = "mpaa_rating"`

**Use this variable in the aesthetics of the ggplot function as the color argument**

**Run the app in the Viewer Pane**

## Your Turn 3 (solution: movies\_02.R)

```
# in sidebarPanel()
selectInput(
  inputId = "z",
  label = "Color by:",
  choices = c("..."), # truncated
  selected = "mpaa_rating"
)
```

```
# in server <- function(input, output) {}
output$scatterplot <- renderPlot({
  ggplot(
    data = movies,
    aes_string(x = input$x, y = input$y, color = input$z)
  ) +
    geom_point()
})
```

# Shiny : : CHEAT SHEET

## 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 an app. Wrap with **runApp()** if calling from a sourced script or inside a function.

## SHARE YOUR APP

- Host it on **shinyapps.io**, a cloud based service from RStudio. To do so:
  - Create a free or professional account at <http://shinyapps.io>
  - Click the Publish icon in RStudio IDE, or run `rsconnect::deployApp()` ("path to directory")
- Purchase **RStudio Connect**, a publishing platform for R and Python. [www.rstudio.com/products/connect/](http://www.rstudio.com/products/connect/)
- Build your own **Shiny Server** [www.rstudio.com/products/shiny-server/](http://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:

- Refer to outputs with **output\$<id>**
- Refer to inputs with **input\$<id>**
- Wrap code in a **render\*()** function before saving to output

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

**ui.R** contains everything you would save to ui. **server.R** ends with the function you would save to server. No need to call **shinyApp()**.

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

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

## Outputs

**render\*** and **"Output"** functions work together to add R output to the UI

**DT::renderDataTable**(expr, options, callback, escape, env, quoted, choices)

**renderImage**(expr, env, quoted, choices)

**renderPlot**(expr, width, height, res, env, quoted, func)

**renderPrint**(expr, env, quoted, func)

**renderTable**(expr, env, quoted, func)

**renderText**(expr, env, quoted, func)

**renderUI**(expr, env, quoted, func)

**dataTableOutput**(outputId, icon, ...)

**imageOutput**(outputId, width, height, click, clickId, hover, hoverDelay, inline, hoverDelayType, brush, clickId, hoverId)

**plotOutput**(outputId, width, height, click, clickId, hover, hoverDelay, inline, hoverDelayType, brush, clickId, hoverId)

**verbatimTextOutput**(outputId)

**tableOutput**(outputId)

**textOutput**(outputId, container, inline)

**uiOutput**(outputId, inline, container, ...)

**htmlOutput**(outputId, inline, container, ...)

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## Inputs

collect values from the user

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

**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, selection, 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)

Choice 1  
Choice 2  
Choice 3  
Check me



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

☒ Choice 2 **checkboxInput**(inputId, label, value)

☐ Choice 3 **dateInput**(inputId, label, value, min, max, format, startview, weekstart, language)

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

**Choose File** **fileInput**(inputId, label, multiple,

## Your Turn 4

**Add a slider input to control the alpha level of the scatterplot points. Don't forget to label it!**

**Set min to 0 and max to 1. Choose a default for value**

**Use the value from this input in the plot**

**Run the app**

## Your Turn 4 (solution: movies\_03.R)

```
# in sidebarPanel()  
sliderInput(  
  inputId = "alpha",  
  label = "Alpha:",  
  min = 0,  
  max = 1,  
  value = 0.5  
)
```

```
# in server <- function(input, output) {}  
output$scatterplot <- renderPlot({  
  ggplot(  
    data = movies,  
    aes_string(x = input$x, y = input$y, color = input$z)  
  ) +  
    geom_point(alpha = input$alpha)  
})
```



## Shiny :: CHEAT SHEET

### Basics

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### APP TEMPLATE

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ui <- fluidPage()
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  shinyApp(ui = ui, server = server)
}
```

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- Build your own Shiny Server [www.rstudio.com/products/shiny-server/](https://www.rstudio.com/products/shiny-server/)



### Building an App

Complete the template by adding arguments to `fluidPage()` and a body to the `server` function.

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

Save your template as an **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,
    placeholderText = "N/A")
)
server <- function(input, output) {
  output$hist <- renderPlot({
    hist(rnorm(input$n))
  })
}
```

Save each app as a directory that holds 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** - (optional) defines objects available to both ui.R and server.R
- DESCRIPTION** - (optional) used in showcase mode
- README** - (optional) data, scripts, etc.
- other files** - (optional) directory of files to share with web browsers (images, CSS, JS, etc.) Must be named "www"

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

**DT::renderDataTable**(expr, options, callback, escape, env, quoted, deleteFile)

**renderImage**(expr, env, quoted, deleteFile)

**renderPlot**(expr, width, height, res, ..., env, quoted, func)

**renderPrint**(expr, env, quoted, func, width)

**renderText**(expr, env, quoted, func)

**renderUI**(expr, env, quoted, func)

**dataTableOutput**(outputId, icon, ...)

**imageOutput**(outputId, width, height, click, dblclick, hover, hoverDelay, inline, hoverDelayType, brush, clickId, hoverId)

**plotOutput**(outputId, width, height, click, dblclick, hover, hoverDelay, inline, hoverDelayType, brush, clickId, hoverId)

**verbatimTextOutput**(outputId)

**tableOutput**(outputId)

**textOutput**(outputId, inline, container, ...)

**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.

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

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

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

**dateInput**(inputId, label, value, min, max, format, startDate, weekStart, language)

**dateRangeInput**(inputId, label, start, end, min, max, format, startDate, 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, pnt, post)

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

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

## Outputs - `render*()` and `*Output()` functions work together to add

**DT::renderDataTable**(expr, options, callback, escape, env, quoted) **works with** **dataTableOutput**

**renderImage**(expr, env, quoted, deleteFile) **works with** **imageOutput**(outputId, click, dblclick, hover, hoverDelayType)

**renderPlot**(expr, width, height, res, ..., env, quoted, func) **works with** **plotOutput**(outputId, dblclick, hover, hoverDelayType)

**renderPrint**(expr, env, quoted, func, width) **works with** **verbatimTextOutput**

**renderTable**(expr, ..., env, quoted, func) **works with** **tableOutput**(outputId)

**renderText**(expr, env, quoted, func) **works with** **textOutput**(outputId)

**renderUI**(expr, env, quoted, func) **works with** **uiOutput**(outputId) & **htmlOutput**(outputId)

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## Your Turn 5

**Add a new `output` in server using `DT::renderDataTable()`. Inside of the render function, create a data table with `DT::datatable()`**

**Set `data = movies[, 1:7]`, `options = list(pageLength = 10)`, and `rownames = FALSE`**

**Add the output to `mainPanel()` in ui using `DT::dataTableOutput()`**

**Run the app**

## Your Turn 5 (solution: movies\_04.R)

```
# in mainPanel()  
DT::dataTableOutput(outputId = "moviestable")
```

```
# in server <- function(input, output) {}  
output$moviestable <- DT::renderDataTable({  
  DT::datatable(  
    data = movies[, 1:7],  
    options = list(pageLength = 10),  
    rownames = FALSE  
  )  
})
```

# Your Turn 6

**Add a title to your app with** `headerPanel()`

**Make the input choices nicer by making the vector named, e.g.** `choices = c("IMDB rating" = "imdb_rating", ...)`

**Clean up your axes titles with:**

`str_replace_all()` **to replace \_ with " "**

`str_to_title()` **to change to title case**

# Your Turn 6

`str_replace_all()` takes three arguments,

```
str_replace_all(  
  string = "lord_of_the_rings",  
  pattern = "_",  
  replacement = " "  
)
```

`str_to_title()` converts the case of a string to title case.

```
str_to_title("lord of the rings")
```

## Your Turn 6 (solution: movies\_05.R)

```
# in fluidPage()  
headerPanel("Movie browser")
```

```
# in sidebarPanel()  
selectInput(  
  ...,  
  choices = c(  
    "IMDB rating" = "imdb_rating",  
    "IMDB number of votes" = "imdb_num_votes",  
    "Critics Score" = "critics_score",  
    "Audience Score" = "audience_score",  
    "Runtime" = "runtime"  
  )  
)
```

## Your Turn 6 (solution: movies\_05.R)

```
# in server <- function(input, output) {}
output$scatterplot <- renderPlot({
  ggplot(
    data = movies,
    aes_string(x = input$x, y = input$y, color = input$z)
  ) +
  geom_point(alpha = input$alpha) +
  labs(
    x = str_to_title(str_replace_all(input$x, "_", " ")),
    y = str_to_title(str_replace_all(input$y, "_", " ")),
    color = str_to_title(str_replace_all(input$z, "_", " "))
  )
})
```

# Directory Structure

```
|--name_of_app  
  |-- app.R
```

```
|--name_of_app  
  |-- ui.R  
  |-- server.R  
  |-- global.R  
  |-- www  
    |-- image.png
```



# Sharing your app

# Sharing your app

**shinyapps.io**

# Sharing your app

shinyapps.io

## Shiny Server

# Sharing your app

shinyapps.io

Shiny Server

**RStudio Connect or Shiny Server Pro**

## Your Turn 7

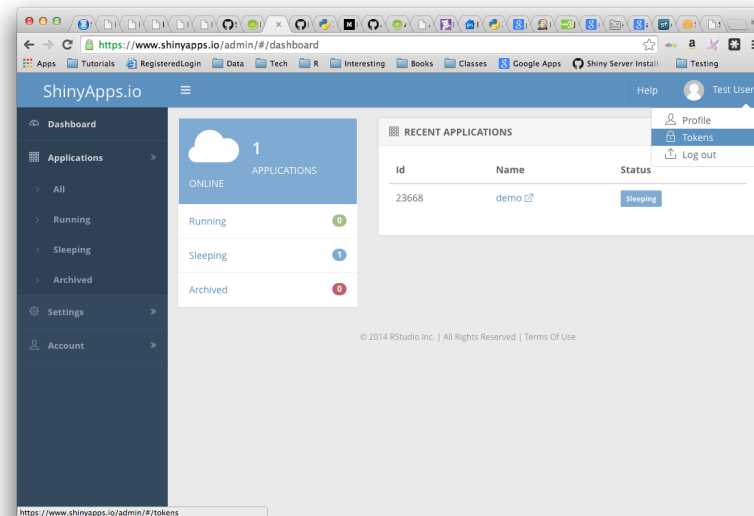
Create folder called `movies_app`

Move any of the (working) app files into this folder, along with `movies.Rdata`

Go to <http://shinyapps.io>. Sign up for an account ([instructions](#)).

# Your turn 7

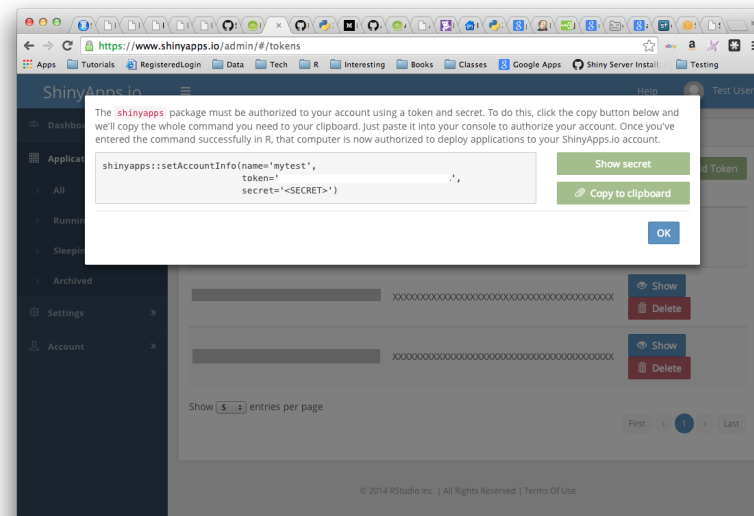
**Click on the 'Tokens' option under your username (upper right corner)**



# Your Turn 7

## Click 'Show' button on the 'Token' page

**Copy this to the clipboard, paste it into the console in the RStudio IDE, hit Enter**



# Resources

**Shiny Website:** A collection of articles  
on Shiny

**Mastering Shiny:** A Work-in-progress  
book from Hadley Wickham