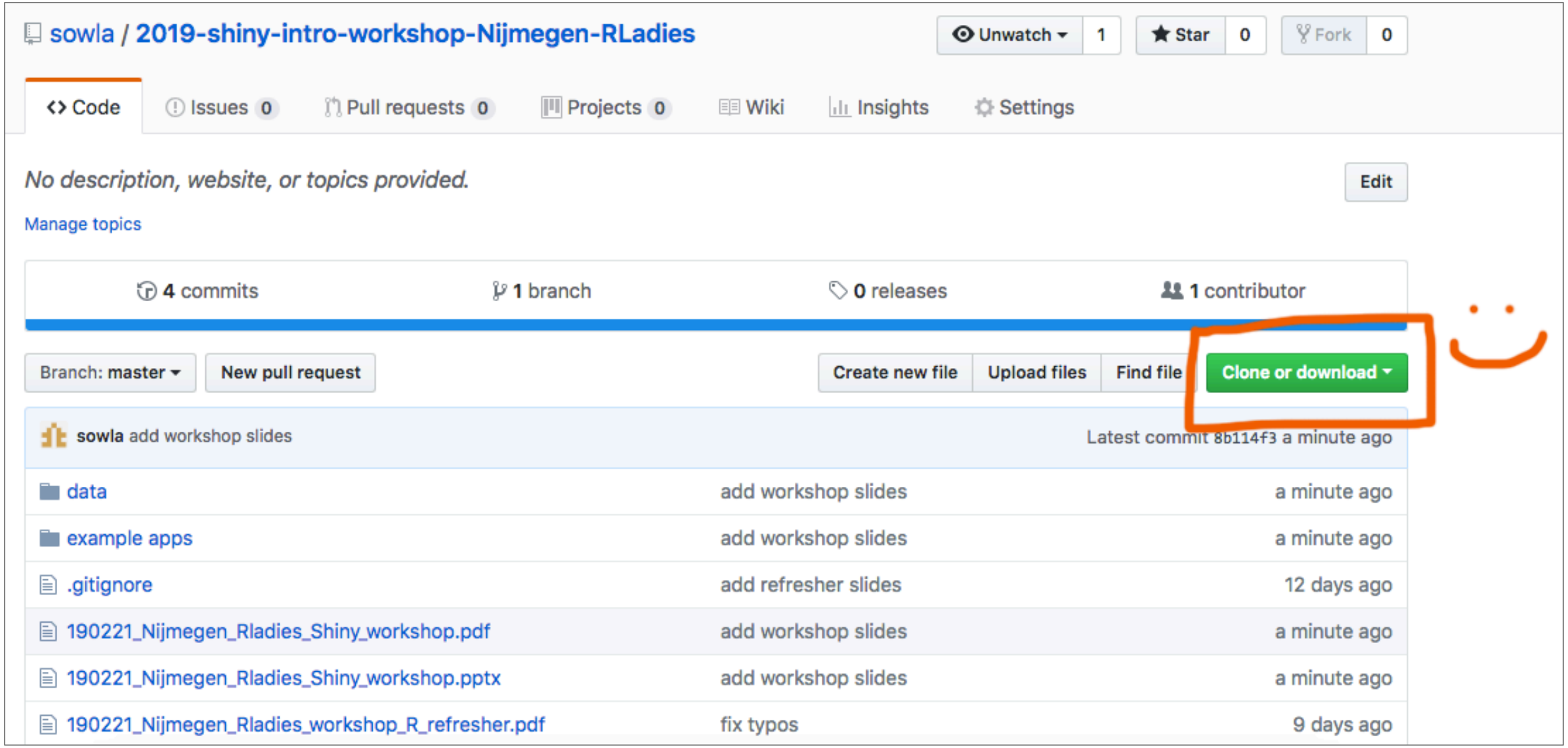


Please download this github repository: https://bit.ly/2BLmoGW

Introduction to Shiny

R-Ladies Nijmegen 21/02/19

Hi!

I'm Suthira Owlarn :)

- Biologist/postdoc in Kerstin Bartscherer's Tissue Regeneration lab
  - MPI for Molecular Biomedicine (Münster)
  - Hubrecht Institute (Utrecht)
- R newbie (~1.5 years)
- Shiny enthusiast!

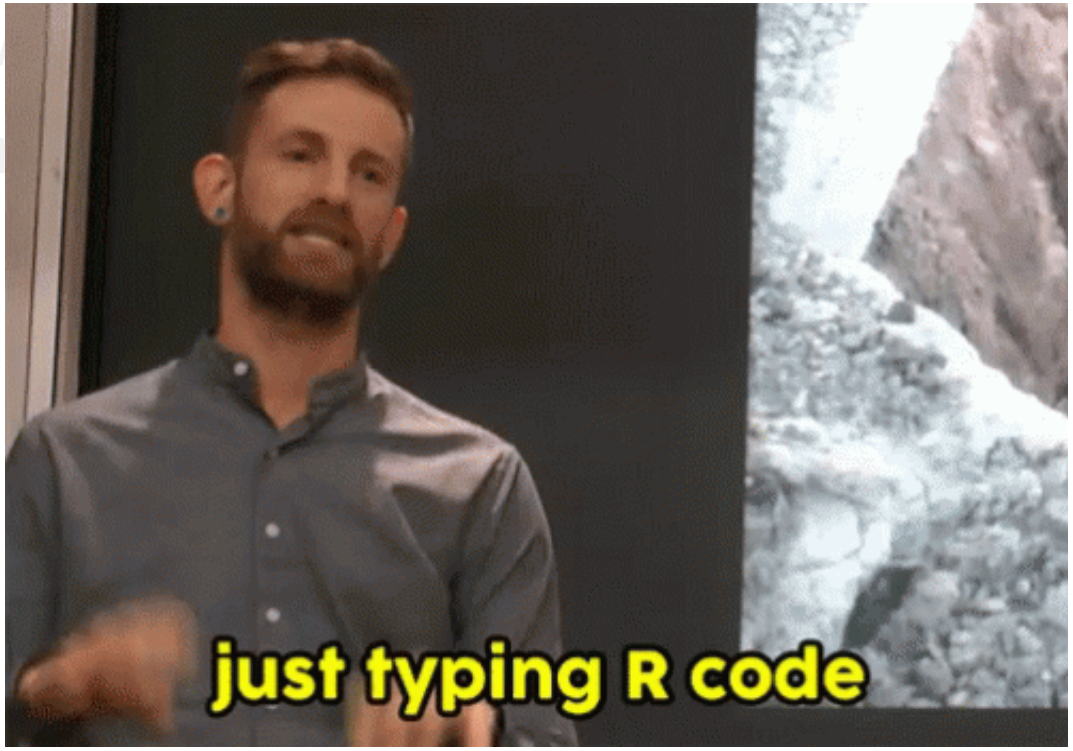
@s_owla sowla

Tonight’s plan

1. Introduction + demo
2. Build a sample app together (with short exercises)
3. Build your own app (longer hands-on session)
4. Q&A/summary

Tonight's plan

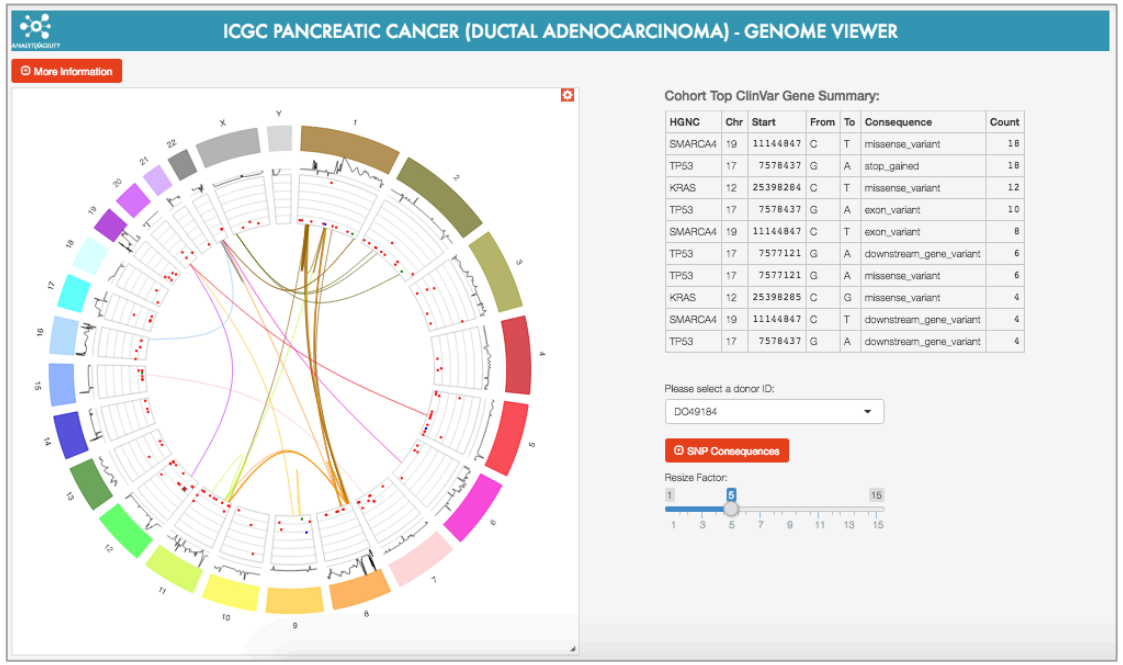
1. Introduction + demo
2. Build a sample app together (with short exercises)
3. Build your ow
4. Q&A/summa



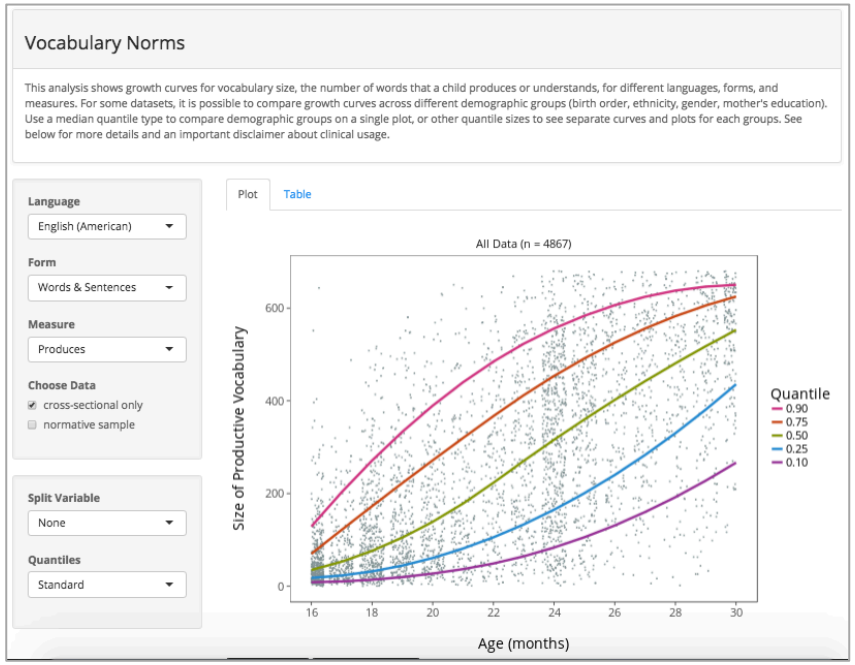
GIF by
Mara Averick
(@dataandme)

Shiny

A quick and easy way to provide a user-friendly interface to your analysis



ICGC pancreatic cancer genome viewer



Word Bank

shiny.rstudio.com/gallery

Demo

"OH, NO -- THAT'S JUST THE PROTOTYPE."

Getting started

sowla / 2019-shiny-intro-workshop-Nijmegen-RLadies

Unwatch 1 | Star 0 | Fork 0

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Insights | Settings

No description, website, or topics provided.

Edit

Manage topics

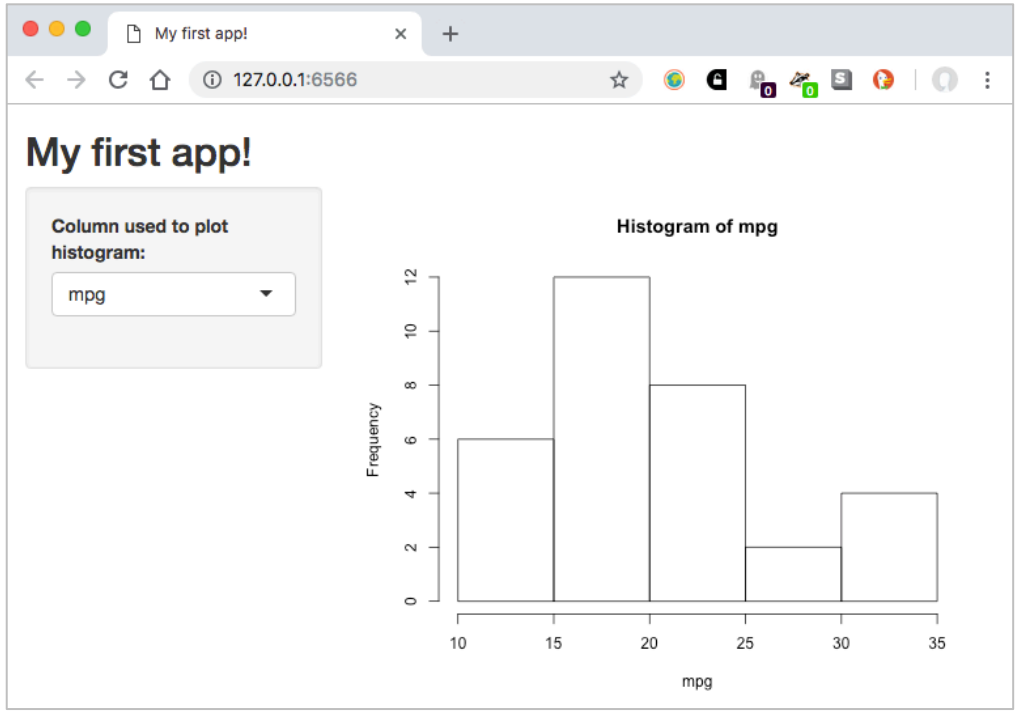
4 commits | 1 branch | 0 releases | 1 contributor

Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

sowla add workshop slides — Latest commit 8b114f3 a minute ago

data	add workshop slides	a minute ago
example apps	add workshop slides	a minute ago
.gitignore	add refresher slides	12 days ago
190221_Nijmegen_Rladies_Shiny_workshop.pdf	add workshop slides	a minute ago
190221_Nijmegen_Rladies_Shiny_workshop.pptx	add workshop slides	a minute ago

How does shiny work?




```r
# plot a histogram

hist(
  x = my_data[["mpg"]],
  main = paste("Histogram of", "mpg"),
  xlab = "mpg"
)
```

Translate R code into code for the user interface (UI)

Use R to do the server calculations behind the scene

How does shiny work?

- Shiny hides many of the complexities :D

- Many possible inputs and outputs
- Lots of other customisations possible

- But first we'll focus on building one app together, step-by-step

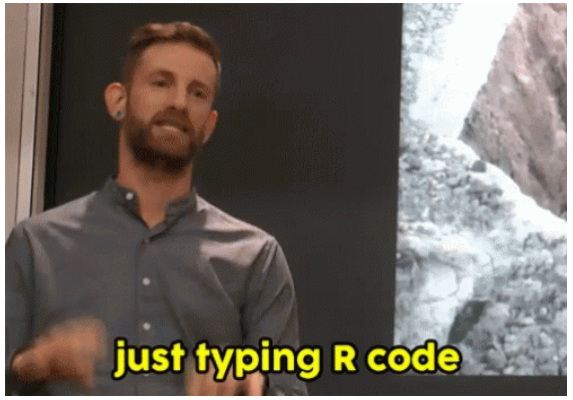
Our target shiny app

Let's have a look at the app we're trying to build:

- Open **1-target-app.R**
- Start the app ("run app"; top right of script panel)
- Explore the app
- Stop the app ("stop"; top right of console panel)

3-5 minutes

- If you have extra time:
  - Go back to the browser
  - What happens when you try to use the app? Why?



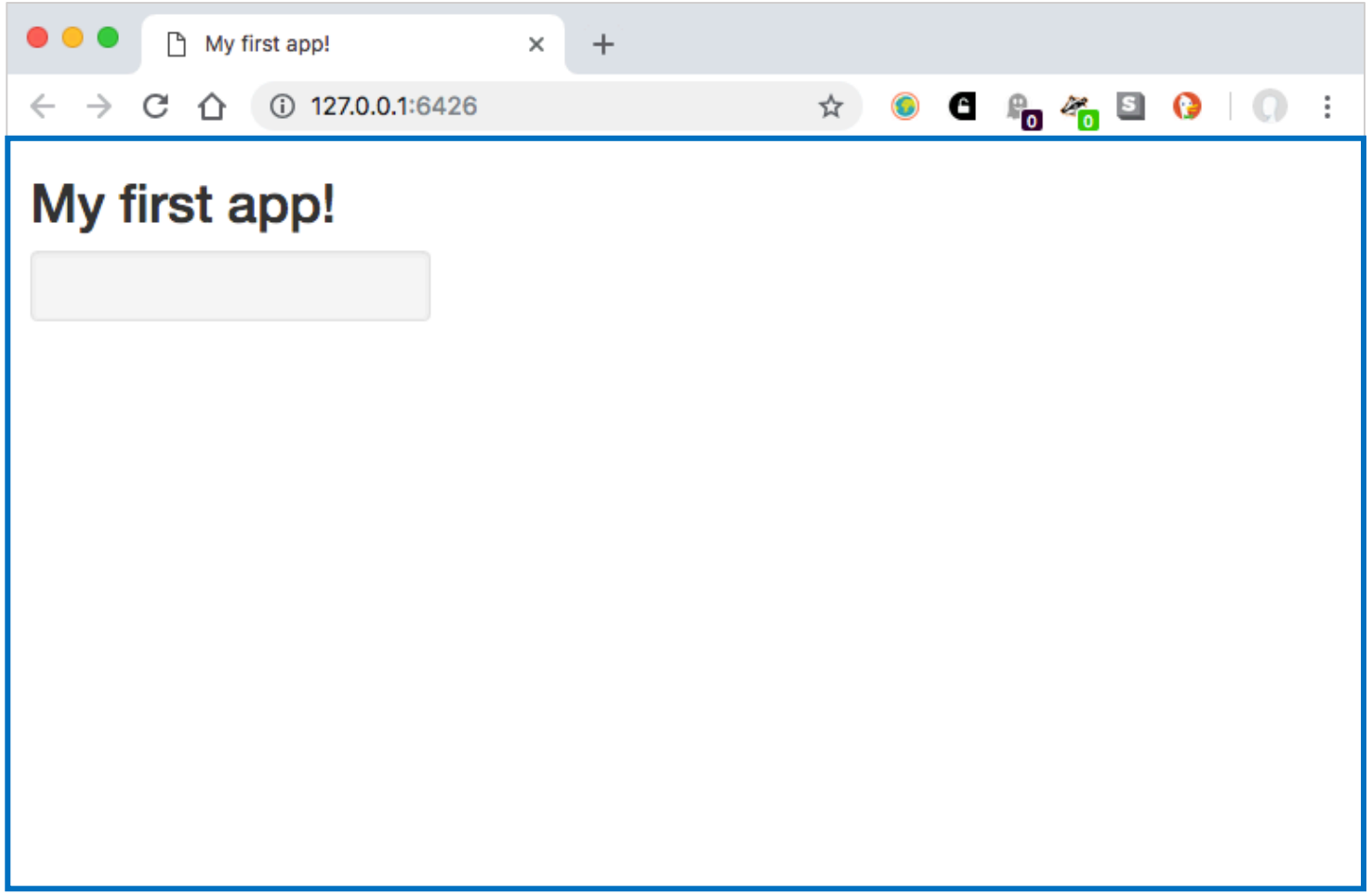
A minimal shiny app

2-app-very-basic1.R:

```
library(shiny)

shinyApp(
  ui = "",                                  # what to go on the web page
  server = function(input, output) {}  # calculations done in R
)
```

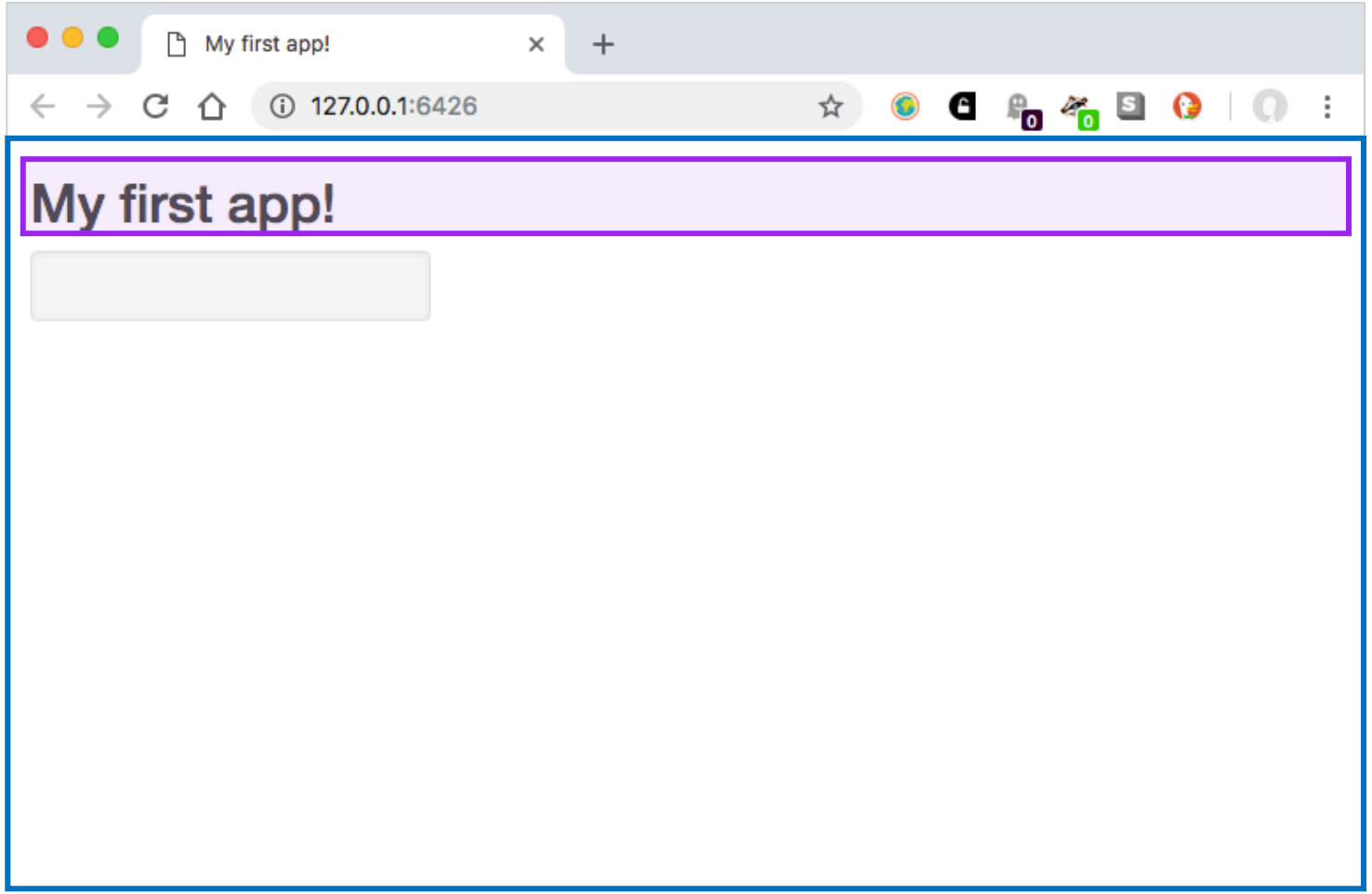
Building a user interface

```
ui <-
  fluidPage(
    titlePanel("My first app!"),
    sidebarLayout(
      sidebarPanel(),



      mainPanel()


    )
  )
```



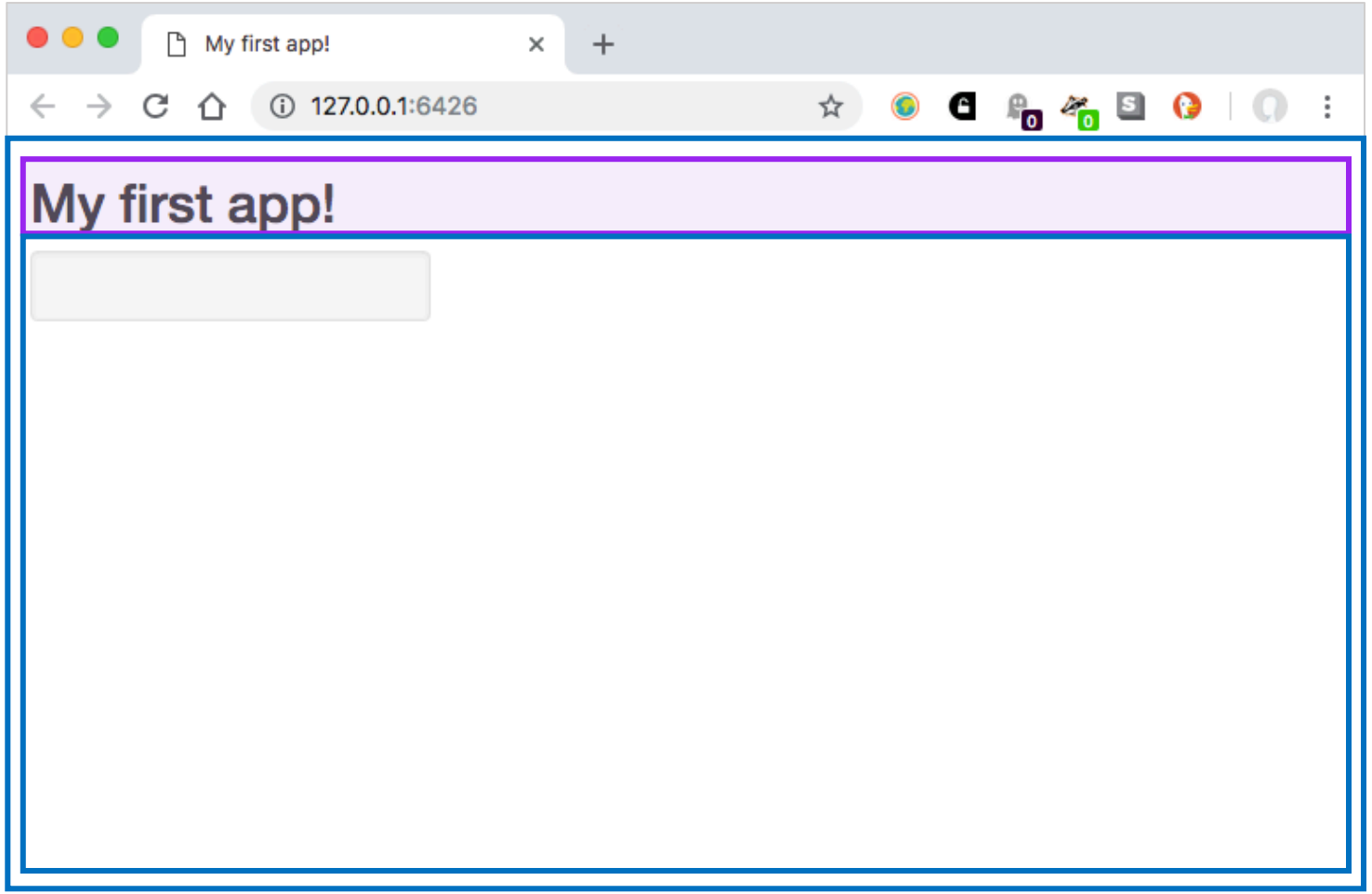
Building a user interface

```
ui <-
  fluidPage(
    titlePanel("My first app!"),
    sidebarLayout(
      sidebarPanel(),



      mainPanel()


    )
  )
```



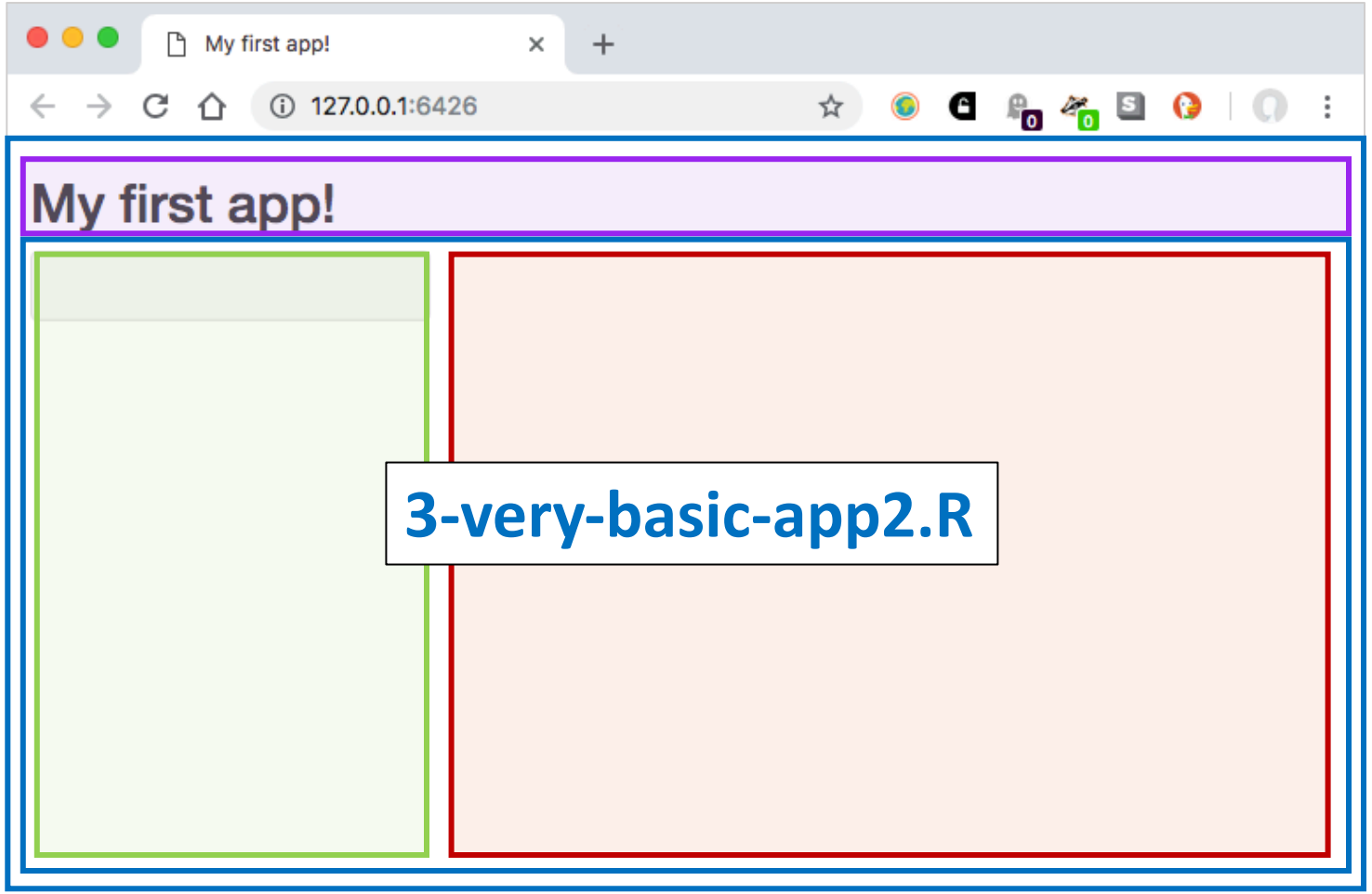
Building a user interface

```
ui <-
  fluidPage(
    titlePanel("My first app!"),
    sidebarLayout(
      sidebarPanel(),



      mainPanel()


    )
  )
```



Building a user interface

```
ui <-
  fluidPage(
    titlePanel("My first app!"),
    sidebarLayout(
      sidebarPanel(),



      mainPanel()


    )
  )
```



Building a user interface

```r
ui <-
  fluidPage(
    titlePanel("My first app!"),
    sidebarLayout(
      sidebarPanel(),


      mainPanel()

    )
  )
```

Value of ui in 3-very-basic-app2.R:

```html
<div class="container-fluid">
  <h2>My first app!</h2>
  <div class="row">
    <div class="col-sm-4">
      <form class="well"></form>
    </div>
    <div class="col-sm-8">
    </div>
  </div>
</div>
```

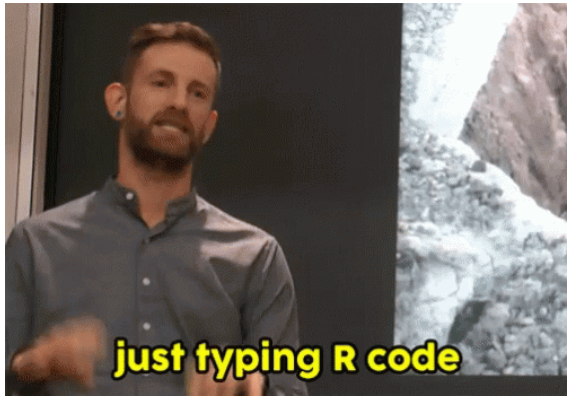
Building a user interface: your turn

Could you open **3-very-basic-app2.R** and:

1. change the title of your app?
2. move the sidebar panel to the right?

- If you have extra time:
  - Did your neighbours use the same method as you?
  - There's more than one way to do this! :)

3-5 minutes



Building a user interface: your turn

Canonical way:

```
ui <-
  fluidPage(
    titlePanel("My new title!"),
    sidebarLayout(
      position = "right",
      sidebarPanel(),
      mainPanel()
    )
  )
```

Gives the same result:

```
ui <-
  fluidPage(
    h2("My new title!"),
    sidebarLayout(
      mainPanel(),
      sidebarPanel()
    )
  )
```

Building a user interface: your turn

My general mind set:

- use the canonical way when there is one!
- check documentation/internet for “lesser known” canonical way(s)
- but don’t be afraid to be creative when there isn’t one! :)

Building a user interface: inputs

Action

actionButton(inputId, label, icon, …)

Link

actionLink(inputId, label, icon, …)

Check me

checkboxInput(inputId, label, value)

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

Choose File

fileInput(inputId, label, multiple, accept)

1

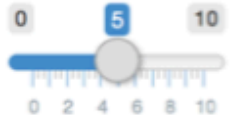
numericInput(inputId, label, value, min, max, step)

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()**)



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)

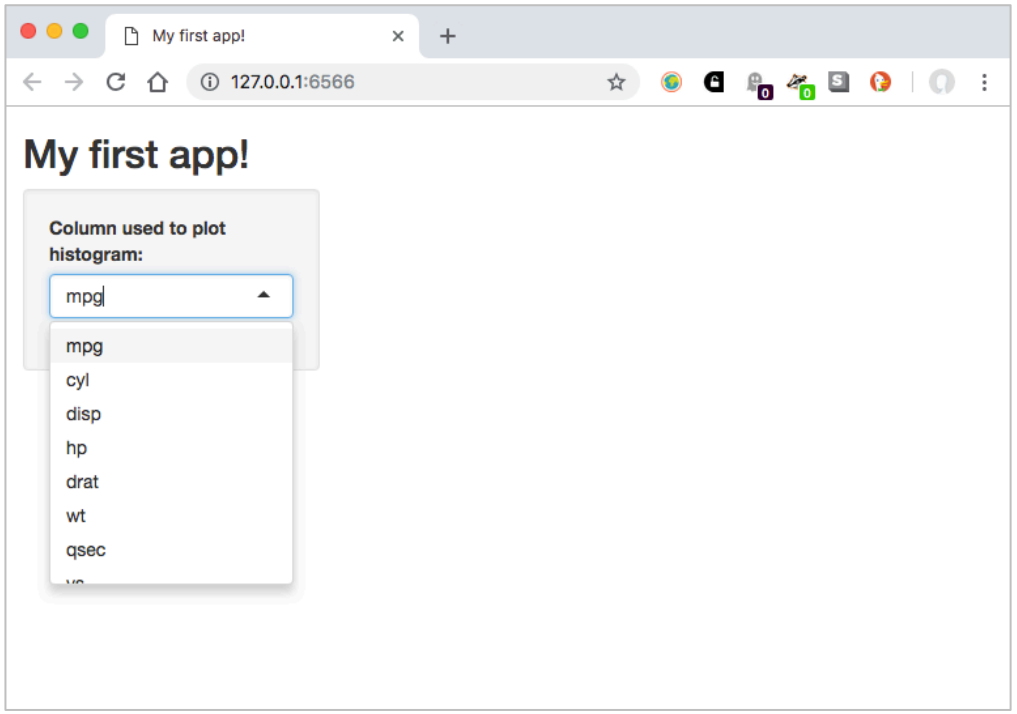
Enter text

textInput(inputId, label, value)

From Rstudio's Shiny cheatsheet

Building a user interface: inputs

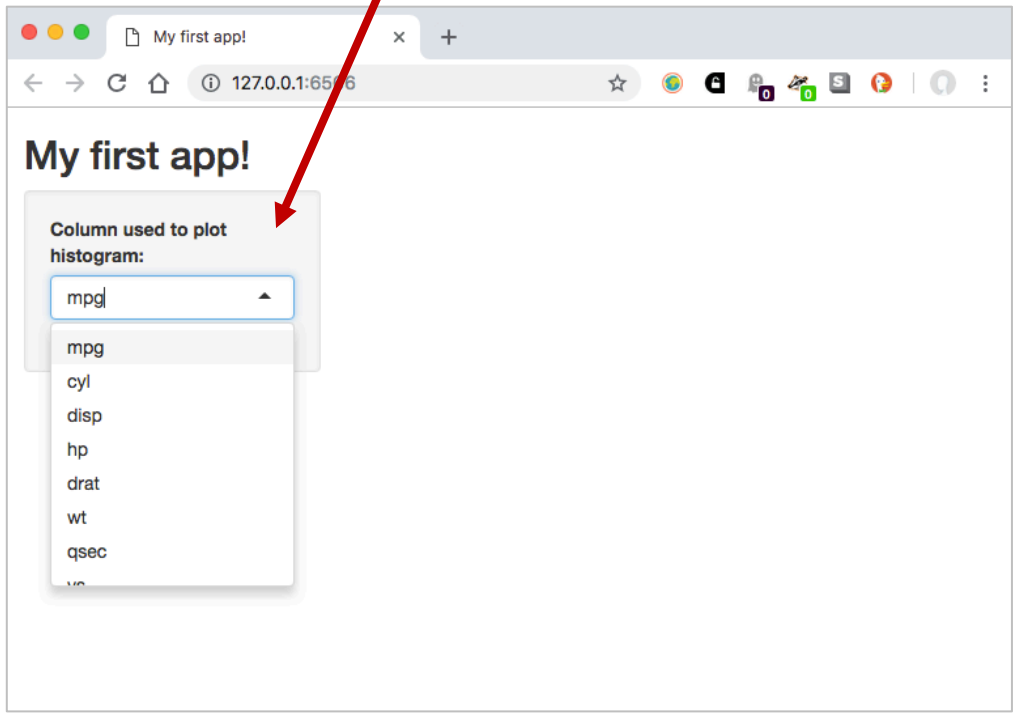
```
sidebarLayout(
  sidebarPanel(
    selectInput(
      inputId = "column",
      label = "Column used to plot histogram:",
      choices = names(mtcars)
    )
  ),
  mainPanel(
    plotOutput(outputId = "plot")
  )
)
```



Building a user interface: inputs

```
sidebarLayout(
  sidebarPanel(
    selectInput(
      inputId = "column",
      label = "Column used to plot histogram:",
      choices = names(mtcars)
    )
  ),
  mainPanel(
    plotOutput(outputId = "plot")
  )
)
```

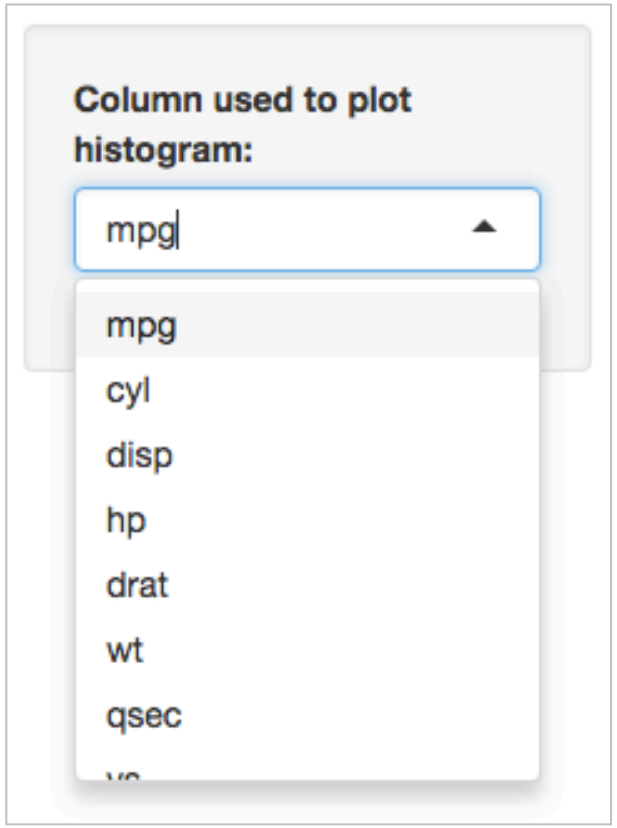
The input element goes in the sidebar panel



Building a user interface: inputs

```
sidebarLayout(
  sidebarPanel(
    selectInput(
      inputId = "column",
      label = "Column used to plot histogram:",
      choices = names(mtcars)
    )
  ),
  mainPanel(
    plotOutput(outputId = "plot")
  )
)
```

Type of input
(dropdown menu)



Building a user interface: inputs

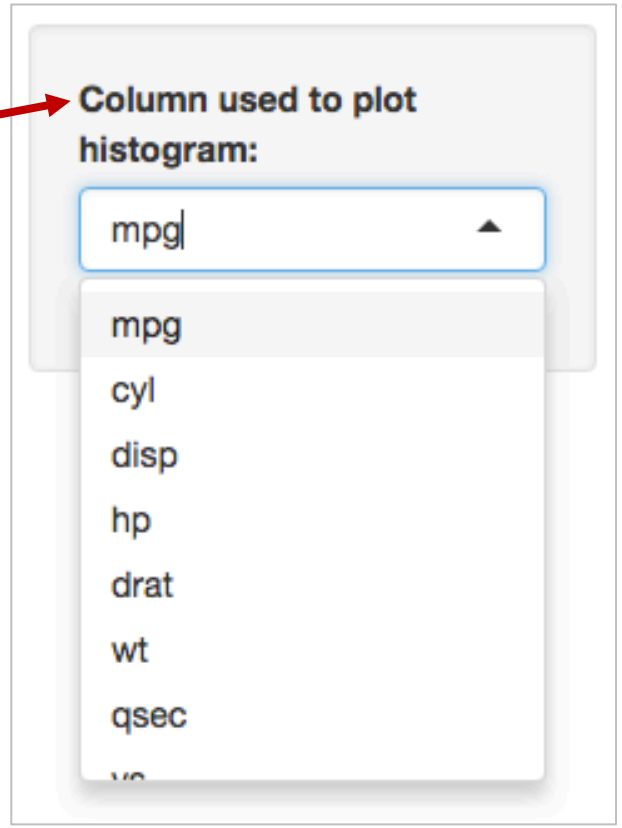
```
sidebarLayout(
  sidebarPanel(
    selectInput(
      inputId = "column",
      label = "Column used to plot histogram:",
      choices = names(mtcars)
    )
  ),
  mainPanel(
    plotOutput(outputId = "plot")
  )
)
```

Unique ID so we can retrieve the correct values from it

Building a user interface: inputs

```
sidebarLayout(
  sidebarPanel(
    selectInput(
      inputId = "column",
      label = "Column used to plot histogram:",
      choices = names(mtcars)
    )
  ),
  mainPanel(
    plotOutput(outputId = "plot")
  )
)
```

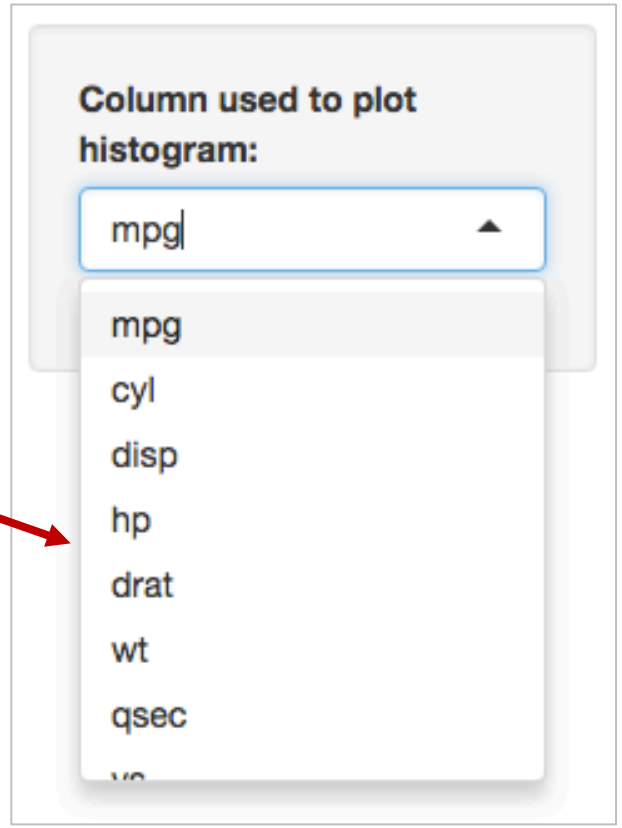
Label to show above the input



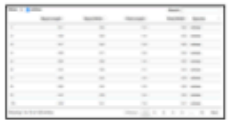
Building a user interface: inputs

```
sidebarLayout(
  sidebarPanel(
    selectInput(
      inputId = "column",
      label = "Column used to plot histogram:",
      choices = names(mtcars)
    )
  ),
  mainPanel(
    plotOutput(outputId = "plot")
  )
)
```

Choices to give in the dropdown menu



Building a user interface: outputs



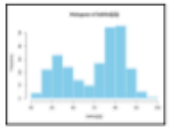
DT::**renderDataTable**(expr, options, callback, escape, env, quoted)

works with

dataTableOutput(outputId, icon, …)

renderImage(expr, env, quoted, deleteFile)

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

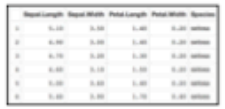


renderPlot(expr, width, height, res, …, env, quoted, func)

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)

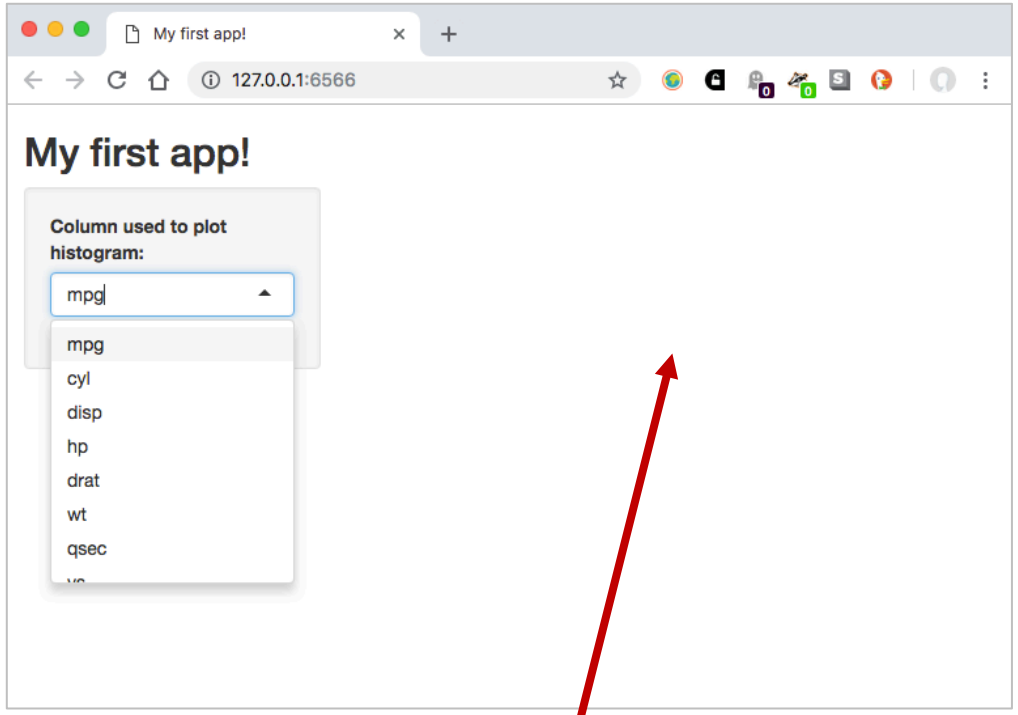
uiOutput(outputId, inline, container, …)

& **htmlOutput**(outputId, inline, container, …)

From Rstudio's Shiny cheatsheet

Building a user interface: outputs

```
sidebarLayout(
  sidebarPanel(
    selectInput(
      inputId = "column",
      label = "Column used to plot histogram:",
      choices = names(mtcars)
    )
  ),
  mainPanel(
    plotOutput(outputId = "plot")
  )
)
```



The output element will go in the main panel

Building a user interface: your turn

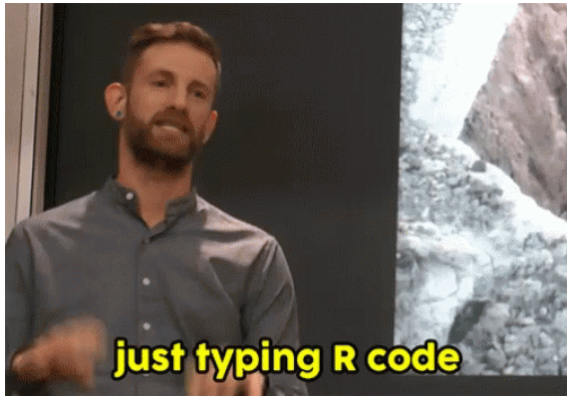
Sticking with **3-very-basic-app2.R**, could you:

1. add a **`selectInput`** element for selecting the **`my_data`** column to plot?
   - Don't forget: input ID, label and choices
2. add a **`plotOutput`** area for the histogram?
   - Don't forget: output ID

5-15 minutes

- If you have extra time:

  Type e.g. **`` `?selectInput` ``** to see available arguments and try changing some of the defaults!



Building a user interface: summary

```
ui <- ""

server <- function(input, output) {

}

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

```
...
selectInput(
  inputId = "column",
  label = "Column used to plot histogram:",
  choices = names(my_data)
)
...
```

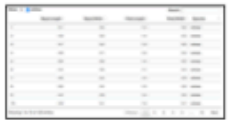
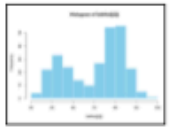
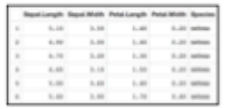
```
...

plotOutput(
  outputId = "plot"
)

...
```

Start with a minimal template, then build on it

*Input() code:
- define input UI
(- where input UI goes)

*Output() code:
- what output accepted
(- where output goes)

Writing the server logic: revisiting outputs

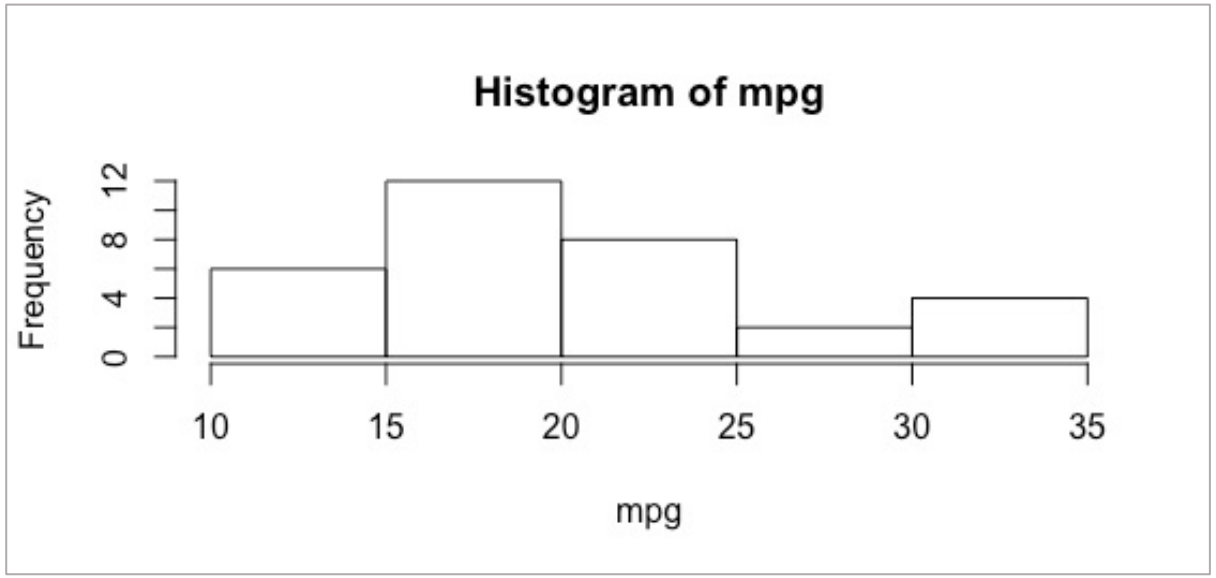
	DT::**renderDataTable**(expr, options, callback, escape, env, quoted)	works with	**dataTableOutput**(outputId, icon, …)
	renderImage(expr, env, quoted, deleteFile)		**imageOutput**(outputId, width, height, click, dblclick, hover, hoverDelay, hoverDelayType, brush, clickId, hoverId, inline)
	**renderPlot**(expr, 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, …)

From Rstudio's Shiny cheatsheet

Writing the server logic: revisiting outputs

Generic R code:

```
# plot a histogram of mtcars$mpg

hist(
  x = mtcars[["mpg"]],
  main = paste("Histogram of", "mpg"),
  xlab = "mpg"
)
```



Writing the server logic: revisiting outputs

Generic R code:

```
# plot a histogram of mtcars$mpg

hist(
  x = mtcars[["mpg"]],
  main = paste("Histogram of", "mpg"),
  xlab = "mpg"
)
```

Shiny server code:

```
# shiny output version
  output$plot <- renderPlot({
    hist(
      x = mtcars[["mpg"]],
      main = paste("Histogram of", "mpg"),
      xlab = "mpg"
    )
  })
```

Writing the server logic: revisiting outputs

What kind of output (matches type in UI code)

```
# relevant ui code:

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

```
# relevant server code:
  output$plot <- renderPlot({
    hist(
      x = mtcars[["mpg"]],
      main = paste("Histogram of", "mpg"),
      xlab = "mpg"
    )
  })
```

Writing the server logic: revisiting outputs

Where the output should appear (matches output ID in UI code)

```
# relevant ui code:

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

```
# relevant server code:
  output$plot <- renderPlot({
    hist(
      x = mtcars[["mpg"]],
      main = paste("Histogram of", "mpg"),
      xlab = "mpg"
    )
  })
```

Writing the server logic: revisiting outputs

`output` is a named list, values can be stored with the help of `$`

```
# relevant ui code:

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

```
# relevant server code:
  output$plot <- renderPlot({
    hist(
      x = mtcars[["mpg"]],
      main = paste("Histogram of", "mpg"),
      xlab = "mpg"
    )
  })
```

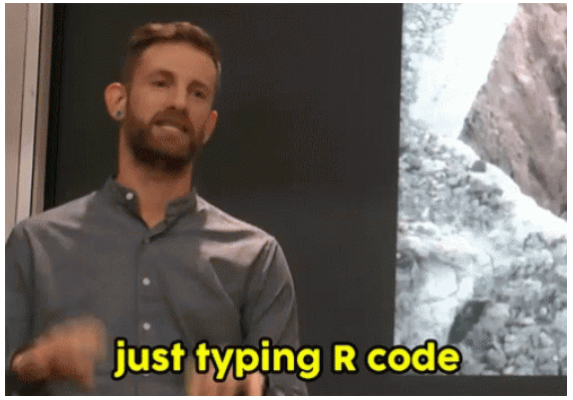
Writing the server logic: your turn

Without looking at previous slides, could you:

1. Edit the server logic as explained in **5-app-with-server1.R**

- If you have extra time:
  - What other attributes in the output might you want to change?
  - What kind of inputs would you need?
  - Which input elements might be suitable for them? (see this widget gallery for ideas)

3-5 minutes



Writing the server logic: linking inputs and outputs

Incorporating the input in the server code to generate the output:

- what does our input data look like?
- can't type into console while shiny app is running..
- **`print()`** and **`cat()`** are your friends!

Let's try with **6-app-with-server2.R**

Reactivity: notice the code is rerun every time we pick a new input

-> this is why the output will update as the input changes

Writing the server logic: linking inputs and outputs

`input` is also a named list; values can be retrieved with `$`

```
# relevant ui code:
selectInput(

  inputId = "column",
  label = "Column used to
plot histogram:",
  choices = names(mtcars)

)
```

```
# linked to input
  output$plot <- renderPlot({
    hist(
      x = mtcars[[input$column]],
      main = paste("Histogram of", input$column),
      xlab = input$column
    )
  })
```

Writing the server logic: linking inputs and outputs

Which input to retrieve data from (matches input ID in UI code)

```
# relevant ui code:
selectInput(

  inputId = "column",
  label = "Column used to
plot histogram:",
  choices = names(mtcars)

)
```

```
# linked to input
  output$plot <- renderPlot({
    hist(
      x = mtcars[[input$column]],
      main = paste("Histogram of", input$column),
      xlab = input$column
    )
  })
```

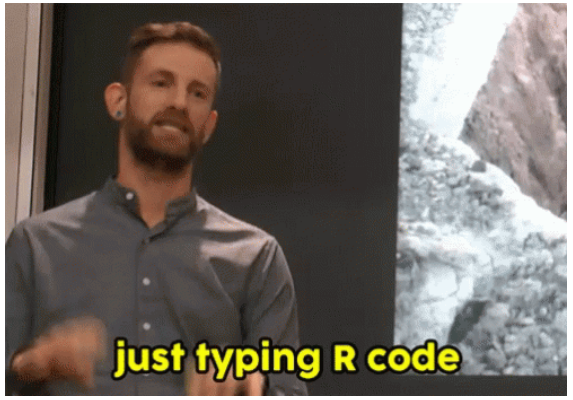
Writing the server logic: your turn

Without looking at previous slides, could you:

1. Edit the server logic in **6-app-with-server2.R** so the output changes depending on the input

- If you have extra time:
  - What other attributes in the output might you want to change?
  - What kind of inputs would you need?
  - Which input elements might be suitable for them? (see this widget gallery for ideas)

3-5 minutes



Building a user interface: summary

```
output$plot <- renderPlot({

  hist(x =
    mtcars[[input$col]]
  )

})
```

Use input values in calculation function with input$*input_id*

```
output$plot <- renderPlot({

  hist(x =
    mtcars[[input$col]]
  )

})
```

Wrap calculation function with render*().

```
output$plot <- renderPlot({

  hist(x =
    mtcars[[input$col]]
  )

})
```

Assign function output to output$*output_id*

Adding complexity: reading data from a file

see **8-csv-data.R**

Before:

```
# "read in" data
my_data <- mtcars
```

After:

```
# read in data
my_data <-
  read.csv("../data/mtcars.csv", row.names = 1)
```

Adding complexity: reading data from a file

Before:

```
# "read in" data
my_data <- mtcars
```

After:

First column is row names

```
# read in data
my_data <-
  read.csv("../data/mtcars.csv", row.names = 1)
```

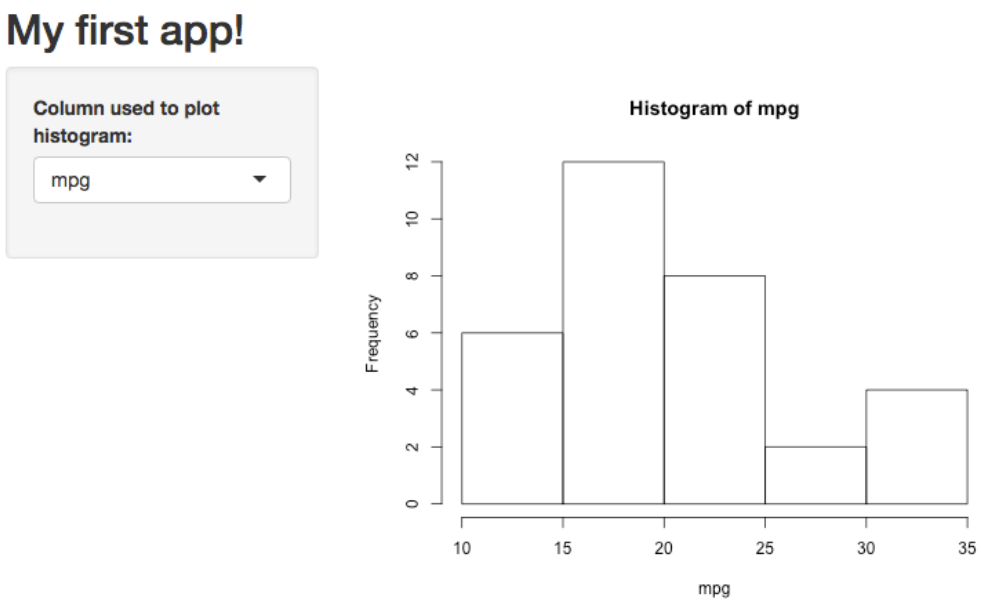
Function to read file

Path to file

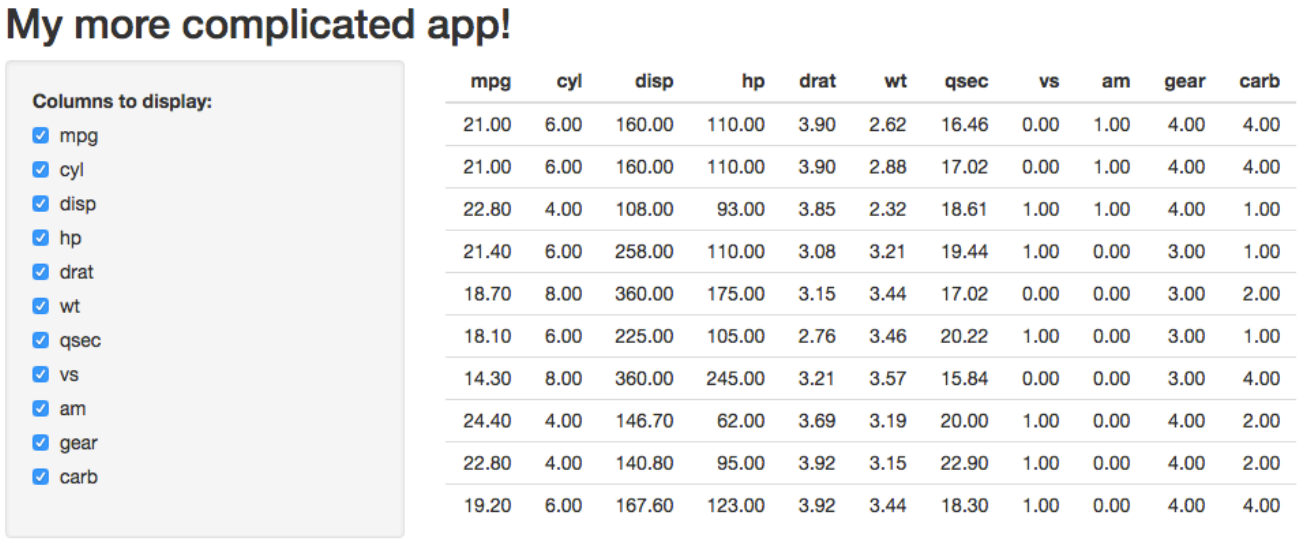
Adding complexity: replacing inputs/outputs

see **9-replace-io.R**

Before:



After:



mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
21.00	6.00	160.00	110.00	3.90	2.62	16.46	0.00	1.00	4.00	4.00
21.00	6.00	160.00	110.00	3.90	2.88	17.02	0.00	1.00	4.00	4.00
22.80	4.00	108.00	93.00	3.85	2.32	18.61	1.00	1.00	4.00	1.00
21.40	6.00	258.00	110.00	3.08	3.21	19.44	1.00	0.00	3.00	1.00
18.70	8.00	360.00	175.00	3.15	3.44	17.02	0.00	0.00	3.00	2.00
18.10	6.00	225.00	105.00	2.76	3.46	20.22	1.00	0.00	3.00	1.00
14.30	8.00	360.00	245.00	3.21	3.57	15.84	0.00	0.00	3.00	4.00
24.40	4.00	146.70	62.00	3.69	3.19	20.00	1.00	0.00	4.00	2.00
22.80	4.00	140.80	95.00	3.92	3.15	22.90	1.00	0.00	4.00	2.00
19.20	6.00	167.60	123.00	3.92	3.44	18.30	1.00	0.00	4.00	4.00

Adding complexity: replacing inputs/outputs

Change output

```
# relevant ui code:

mainPanel(
  tableOutput(outputId = "table")
)
```

```
# relevant server code:
  output$table <- renderTable({

    mtcars[1:10]

  })
```

Adding complexity: replacing inputs/outputs

Change output

```
# relevant ui code:

mainPanel(
  tableOutput(outputId = "table")
)
```

```
# relevant server code:
  output$table <- renderTable({

    mtcars[1:10]

  })
```

Adding complexity: replacing inputs/outputs

How do you plan to transform the data?

```
# relevant ui code:
checkboxGroupInput(
  inputId = "columns",
  label = "Columns to display:",
  choices = names(my_data),
  selected = names(my_data)
)
```

```
# relevant server code:
  output$table <- renderTable({

    mtcars[1:10, 1:3, drop = FALSE]

  })
```

Pick which column(s) to show

Adding complexity: replacing inputs/outputs

What's the corresponding input for that?

```
# relevant ui code:
checkboxGroupInput(
  inputId = "columns",
  label = "Columns to display:",
  choices = names(my_data),
  selected = names(my_data)
)
```

```
# relevant server code:
  output$table <- renderTable({

    mtcars[1:10, 1:3, drop = FALSE]

  })
```

Adding complexity: replacing inputs/outputs

What does your input look like?

```
# relevant ui code:
checkboxGroupInput(
  inputId = "columns",
  label = "Columns to display:",
  choices = names(my_data),
  selected = names(my_data)
)
```

```
# relevant server code:
  output$table <- renderTable({

    cat(input$columns)
    cat(class(input$columns))

    mtcars[1:10, 1:3, drop = FALSE]

  })
```

Adding complexity: replacing inputs/outputs

Link input to output

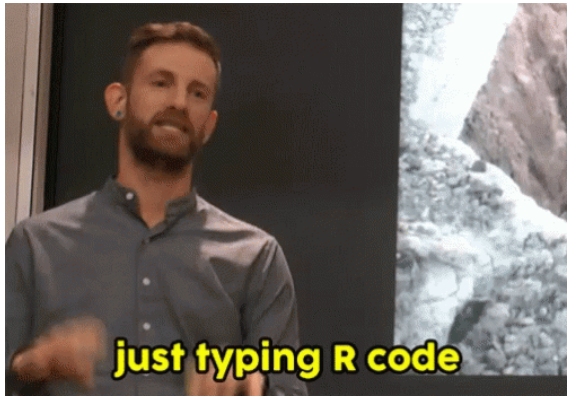
```
# relevant ui code:
checkboxGroupInput(
  inputId = "columns",
  label = "Columns to display:",
  choices = names(my_data),
  selected = names(my_data)
)
```

```
# relevant server code:
  output$table <- renderTable({

    mtcars[1:10, input$columns,
      drop = FALSE]

  })
```

Adding complexity: your turn!

- Multiple inputs
  - using two variables and adding shape/colour option
  - allowing users to add their own text for title/labels
  - giving a choice between base and ggplot
- Multiple/different outputs
  - add table of summary statistics
  - add a logo and text summarising data
- Different data
  - read in your own data
  - use the survey data

Until 8:20pm



Reminder: inputs

Action

actionButton(inputId, label, icon, …)

Link

actionLink(inputId, label, icon, …)

Check me

checkboxInput(inputId, label, value)

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

Choose File

fileInput(inputId, label, multiple, accept)

1

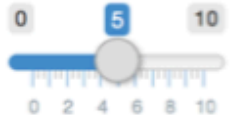
numericInput(inputId, label, value, min, max, step)

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()**)



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

Apply Changes

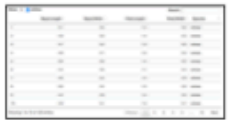
submitButton(text, icon)
(Prevents reactions across entire app)

Enter text

textInput(inputId, label, value)

From Rstudio's Shiny cheatsheet

Reminder: revisiting outputs



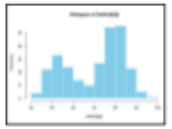
DT::**renderDataTable**(expr, options, callback, escape, env, quoted)

works with

dataTableOutput(outputId, icon, …)

renderImage(expr, env, quoted, deleteFile)

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

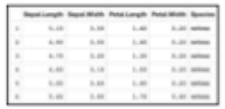


renderPlot(expr, width, height, res, …, env, quoted, func)

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, …)

From Rstudio's Shiny cheatsheet

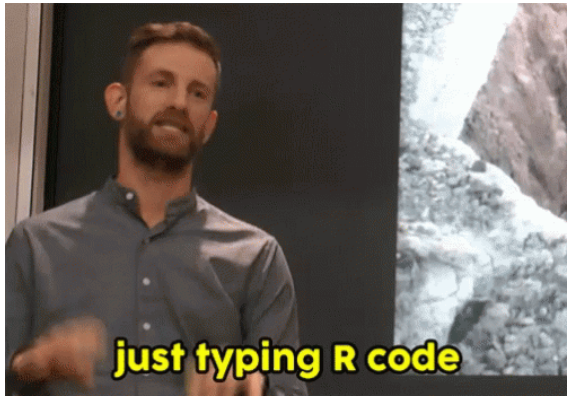
Adding complexity: your turn (more advanced)!

Do you plan to have users upload their data onto your app?

Example in: **10-uploaded-data.R**

Requires **`reactive()`**, **`observeEvent()`** and **`req()`**

Until 8:20pm



Tips

- My general workflow
  1. Analyse/visualise the data until you're clear what you want to show
  2. Write functions that work outside of a shiny app
  3. Imagine/draw the layout, then write the UI code (provides structure)
  4. Edit the functions into server code
  5. Repeat if you want to add more features!

- Cmd/Ctrl + I to auto-indent for readability
- **`cat()`**, **`print()`** and **`verbatimText`** for simple debugging
- **`switch()`/`dplyr::case_when()`** as alternatives to multiple if/else

Using the Right tools Saves A Lot of pain

Tools/resources that make our lives easier

- shiny.rstudio.com
  - gallery
  - tutorial, cheatsheet
  - reference or type ?<*function_name*> in your console
  - articles, e.g. debugging shiny apps (quite different from normal scripts)
- Shiny section of Rstudio community

- More from me:
  - shiny "extensions" talk and corresponding notes for more tools!
  - feel free to ask me questions: @s_owla on twitter/message me on meetup :)

Tools/resources that make our lives easier: your turn!

- I (and I think many others) would love to learn from you! :)

- R-Ladies chapters
- R-Ladies rotating curator twitter account
- R user groups
- Put your code on github
- Share your ideas/code/writing on #rstats twitter
- So many more ways!!

On-going! :)