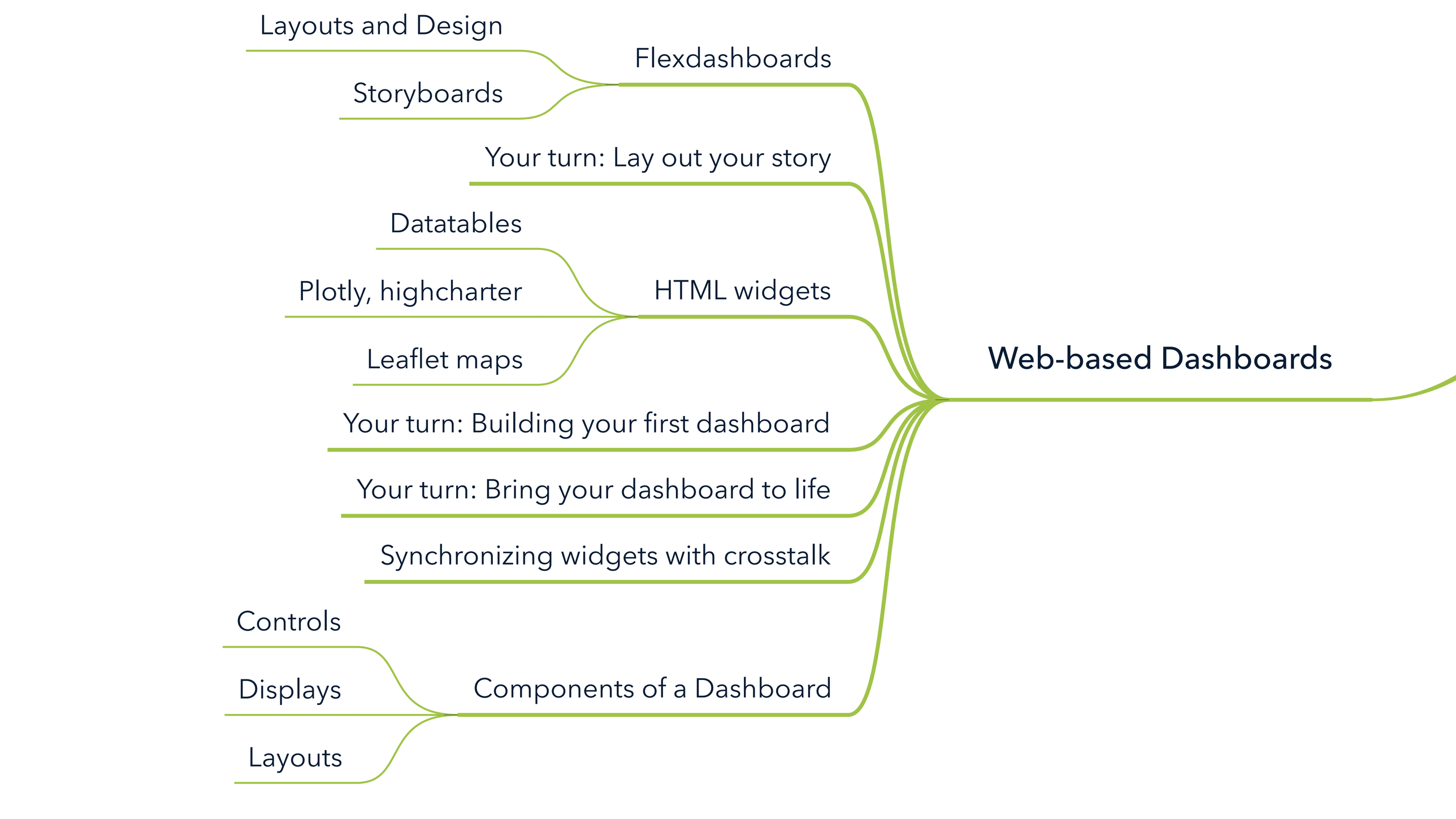
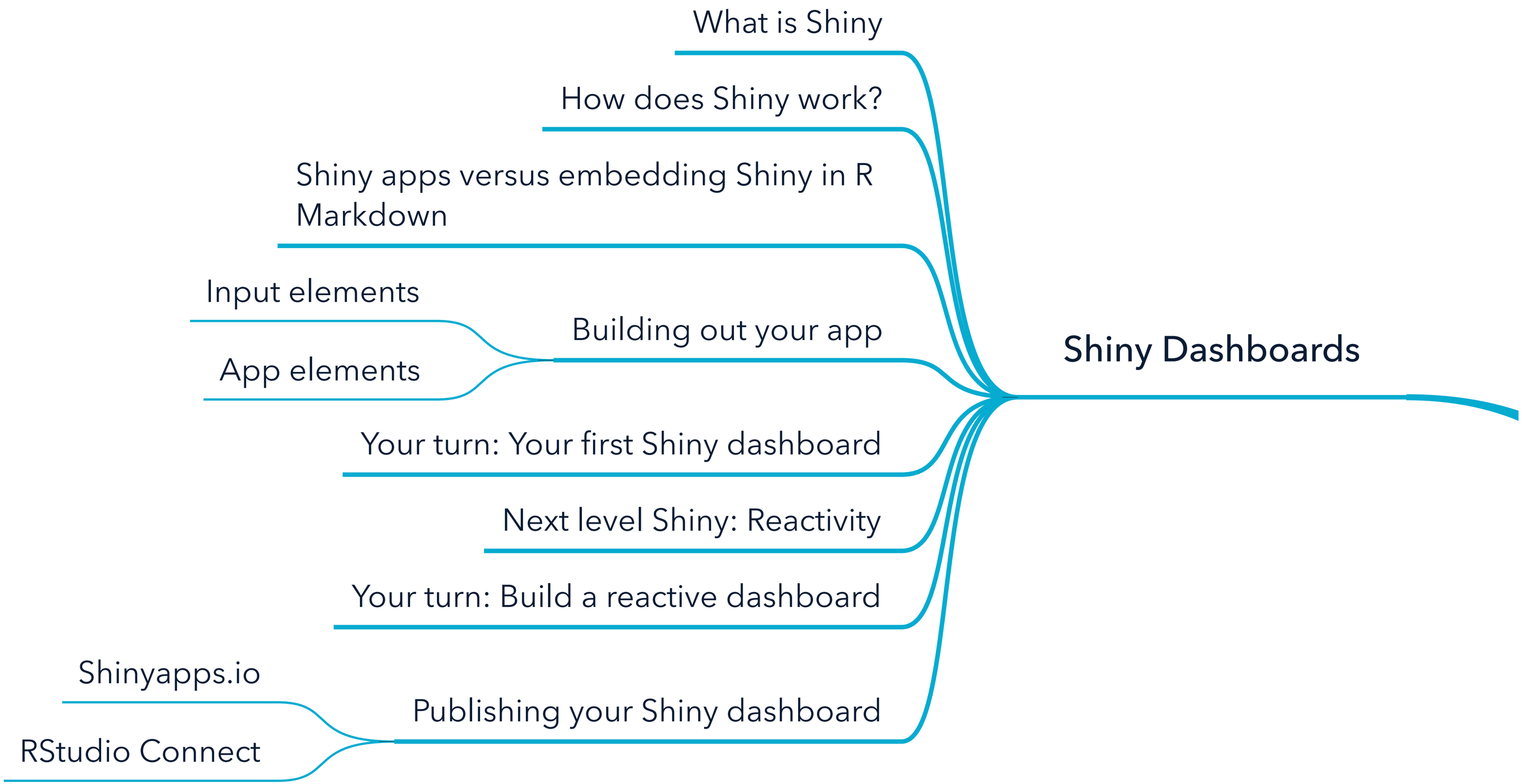
R Markdown and Interactive Dashboards Shiny

Github repo: rstd.io/conf20-rmd-dash

rstudio.cloud workspace: rstd.io/RMAID


Web-based Dashboards
Flexdashboards
Layouts and Design
Storyboards
Your turn: Lay out your story
HTML widgets
Datatables
Plotly, highcharter
Leaflet maps
Your turn: Building your first dashboard
Your turn: Bring your dashboard to life
Synchronizing widgets with crosstalk
Components of a Dashboard
Controls
Displays
Layouts


Shiny Dashboards
What is Shiny
How does Shiny work?
Shiny apps versus embedding Shiny in R Markdown
Building out your app
Input elements
App elements
Your turn: Your first Shiny dashboard
Next level Shiny: Reactivity
Your turn: Build a reactive dashboard
Publishing your Shiny dashboard
Shinyapps.io
RStudio Connect

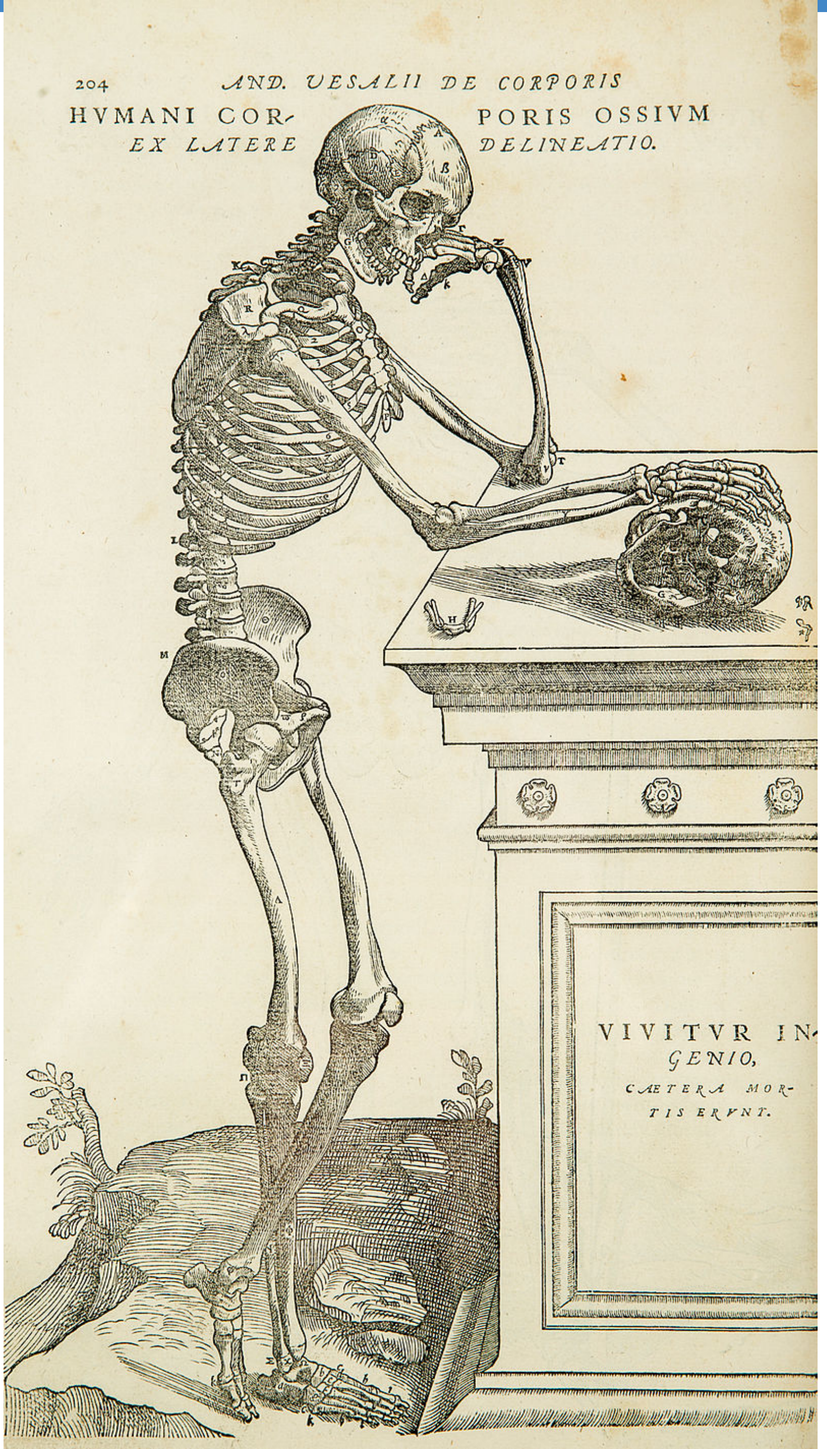
Shiny is an R package that makes it easy to build interactive web apps from R.

shiny.rstudio.com

In This Course We Teach A Subset of Shiny

- Shiny has all the mechanisms to create your own app with a fully custom UI
- In this course, we're teaching the essential inputs and outputs that will working within a flexdashboard layout
- There's much much more to Shiny if you wish to explore it
- Learn more at shiny.rstudio.com
- The Shiny cheat sheet lives at

  https://github.com/rstudio/cheatsheets/raw/master/shiny.pdf

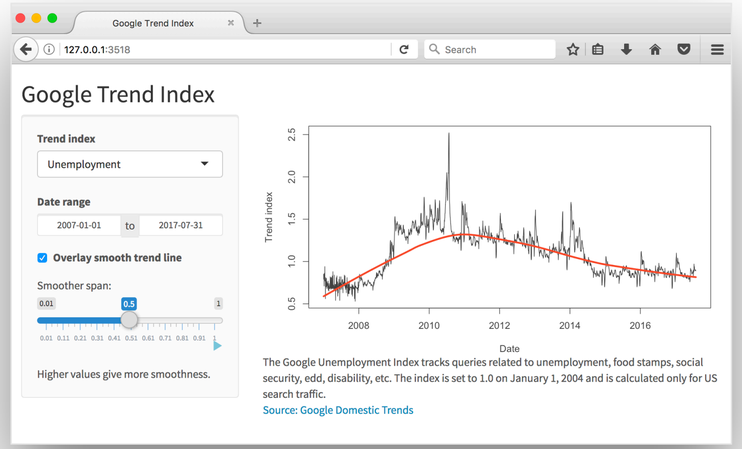


The Anatomy Of A Shiny App Made With Flexdashboard

You'll learn

- What in a Shiny flexdashboard app
- How to build Shiny inputs for your dashboard
- How to render differing types of output

rstd.io/RMAID



Program logic

R code

Layout

R Markdown

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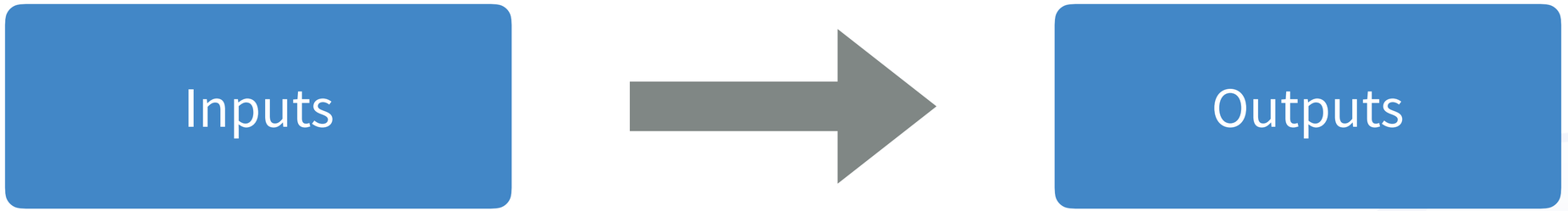
Shiny offers user interface and rendering functions for input and output controls.



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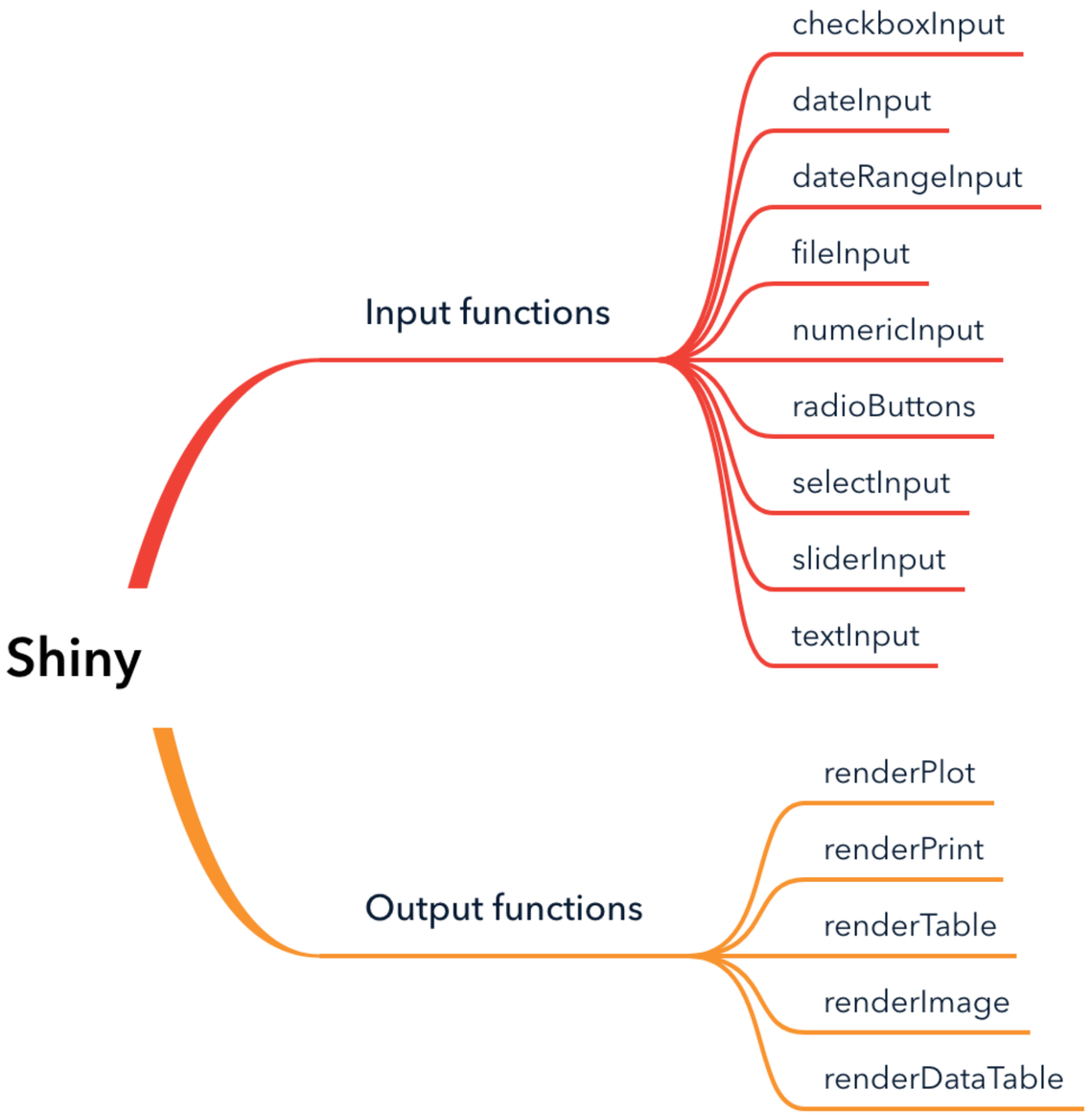
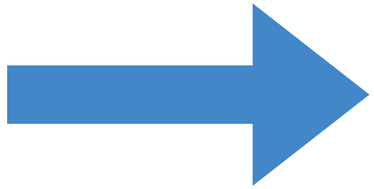
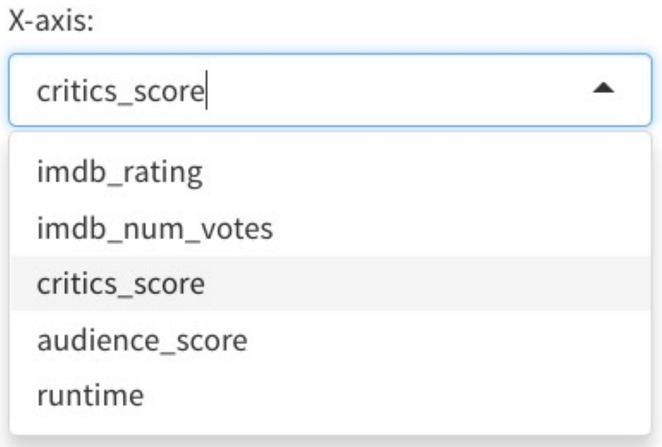

Shiny
Input functions
checkboxInput
dateInput
dateRangeInput
fileInput
numericInput
radioButtons
selectInput
sliderInput
textInput
Output functions
renderPlot
renderPrint
renderTable
renderImage
renderDataTable

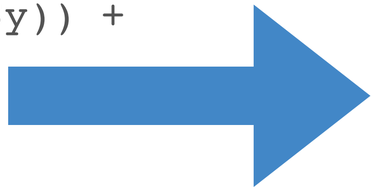
Let's Start With selectInput and renderPlot

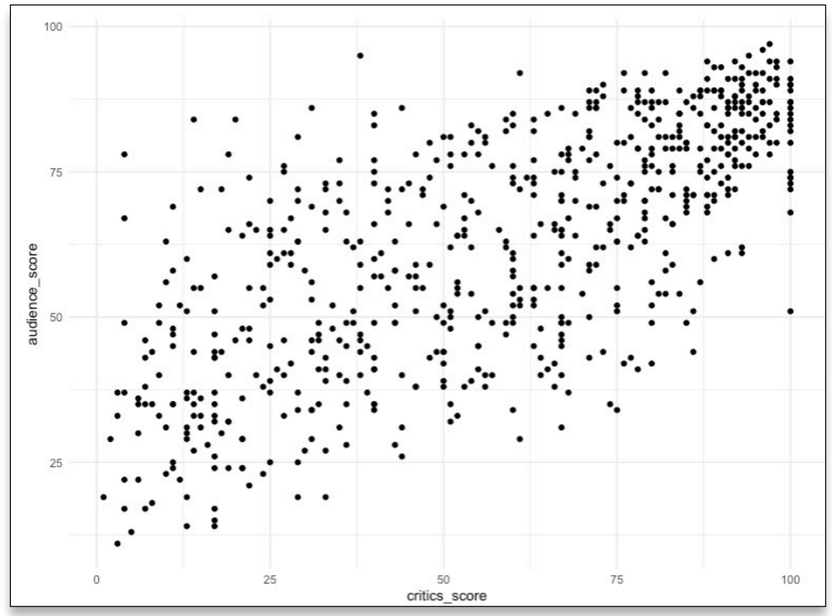
```
selectInput(inputId = "x",
            label = "X-axis:",
            choices = choices,
            selected = "critics_score")
```






```
renderPlot({
    ggplot(data = movies,
           aes_string(x = input$x, y = input$y)) +
      geom_point()
  })
```





Github repo: rstd.io/conf20-rmd-dash

rstudio.cloud workspace: rstd.io/RMAID

Basic Shiny Dashboard Structure

```
---
title: "Movies Dashboard with Shiny Inputs"
output:
  flexdashboard::flex_dashboard:
    orientation: columns
    vertical_layout: fill
  runtime: shiny
---
```

```
```{r setup, include=FALSE}
library(flexdashboard)
library(shiny)
library(ggplot2)
load("data/movies.Rdata")
theme_set(theme_minimal())
```
```

```
## Column {data-width=350}

### Inputs
```

```
```{r}
choices <- c("imdb_rating", "imdb_num_votes", "critics_score", "audience_score", "runtime")

      # Select variable for x-axis ---------------------------------
      selectInput(inputId = "x",     # this is the name of a reactive input variable
                  label = "X-axis:",
                  choices = choices,
                  selected = "critics_score")

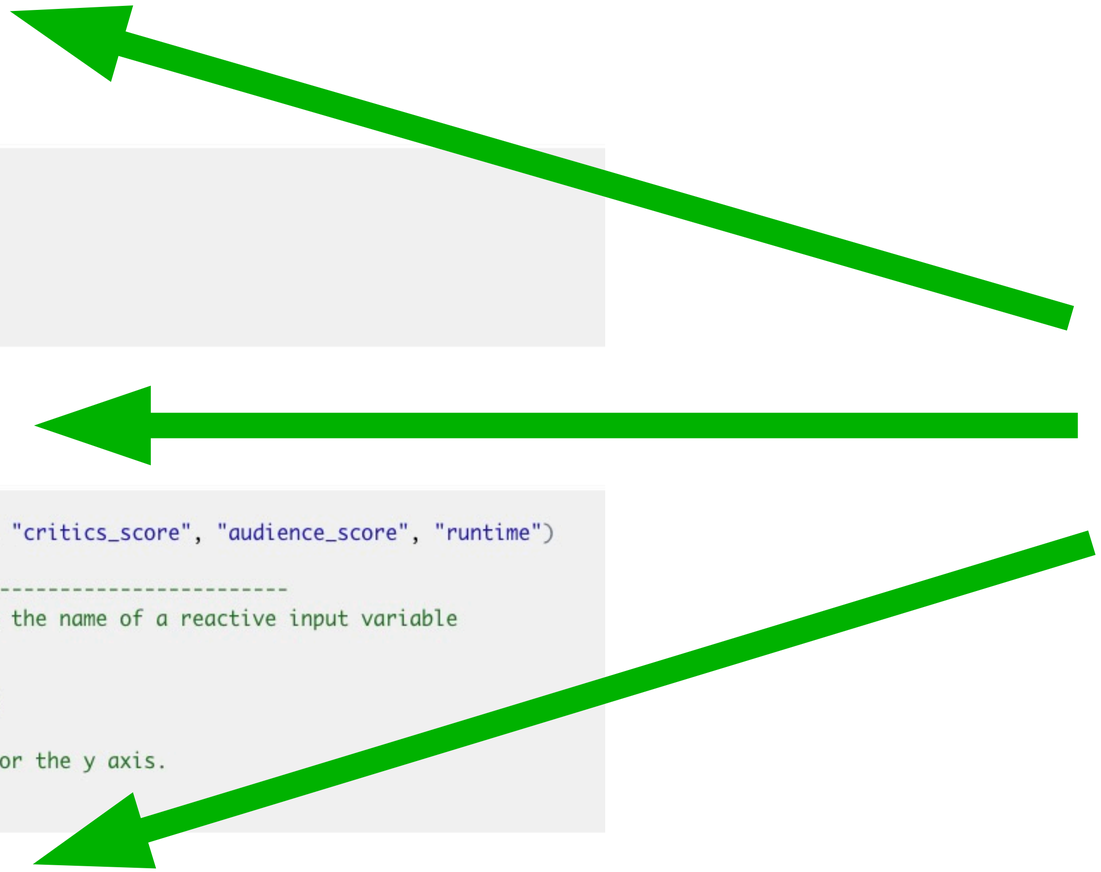
       ### Add another selectInput function for the y axis.

```
```

```
## Column {data-width=550}

### Output
```

```
```{r}
renderPlot({
    ggplot(data = movies, aes_string(x = input$x, y = input$y)) +
      geom_point()
  })
```
```



Flexdashboard with columns orientation

rstudio.cloud workspace: rstd.io/RMAID

Basic Shiny Dashboard Structure

```
---
title: "Movies Dashboard with Shiny Inputs"
output:
  flexdashboard::flex_dashboard:
    orientation: columns
    vertical_layout: fill
  runtime: shiny
---

```{r setup, include=FALSE}
library(flexdashboard)
library(shiny)
library(ggplot2)
load("data/movies.Rdata")
theme_set(theme_minimal())
```

Column {data-width=350}

Inputs

```{r}
choices <- c("imdb_rating", "imdb_num_votes", "critics_score", "audience_score", "runtime")

      # Select variable for x-axis ---------------------------------
      selectInput(inputId = "x",     # this is the name of a reactive input variable
                  label = "X-axis:",
                  choices = choices,
                  selected = "critics_score")

       ### Add another selectInput function for the y axis.

```

Column {data-width=550}

Output

```{r}
renderPlot({
    ggplot(data = movies, aes_string(x = input$x, y = input$y)) +
      geom_point()
  })
```
```

Inputs get created by a Shiny function like `selectInput`.

They appear as variables like `input$x`

rstd.io/RMAID

Basic Shiny Dashboard Structure

```
---
title: "Movies Dashboard with Shiny Inputs"
output:
  flexdashboard::flex_dashboard:
    orientation: columns
    vertical_layout: fill
  runtime: shiny
---

```{r setup, include=FALSE}
library(flexdashboard)
library(shiny)
library(ggplot2)
load("data/movies.Rdata")
theme_set(theme_minimal())
```

Column {data-width=350}

Inputs

```{r}
choices <- c("imdb_rating", "imdb_num_votes", "critics_score", "audience_score", "runtime")

      # Select variable for x-axis ---------------------------------
      selectInput(inputId = "x",     # this is the name of a reactive input variable
                  label = "X-axis:",
                  choices = choices,
                  selected = "critics_score")

       ### Add another selectInput function for the y axis.

```

Column {data-width=550}

Output

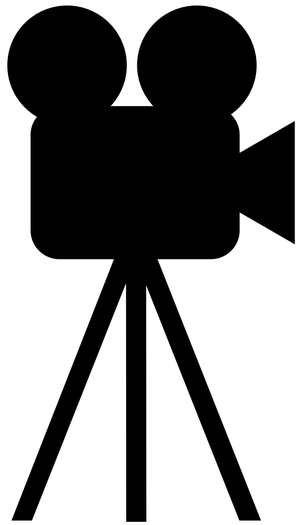
```{r}
renderPlot({
    ggplot(data = movies, aes_string(x = input$x, y = input$y)) +
      geom_point()
  })
```
```

Output usually gets put in another flexdashboard pane using a function like `renderPlot`.

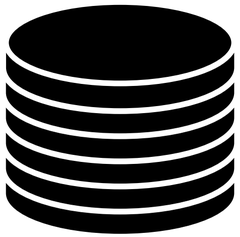
rstudio.cloud workspace: rstd.io/RMAID

What Is This Syntax About?

- renderPlot takes an ggplot output object that generates a plot.
- The code inside the {} is code generates that output object, but it doesn't get evaluated until renderPlot asks it to.
- The funny syntax of `renderPlot({plotting_code})` is simply a way to say, "When you render the plot, use plotting_code to do so".



Let’s build a simple movie browser app!



data/movies.Rdata

Data from IMDB and Rotten Tomatoes on random sample of 651 movies released in the US between 1970 and 2014

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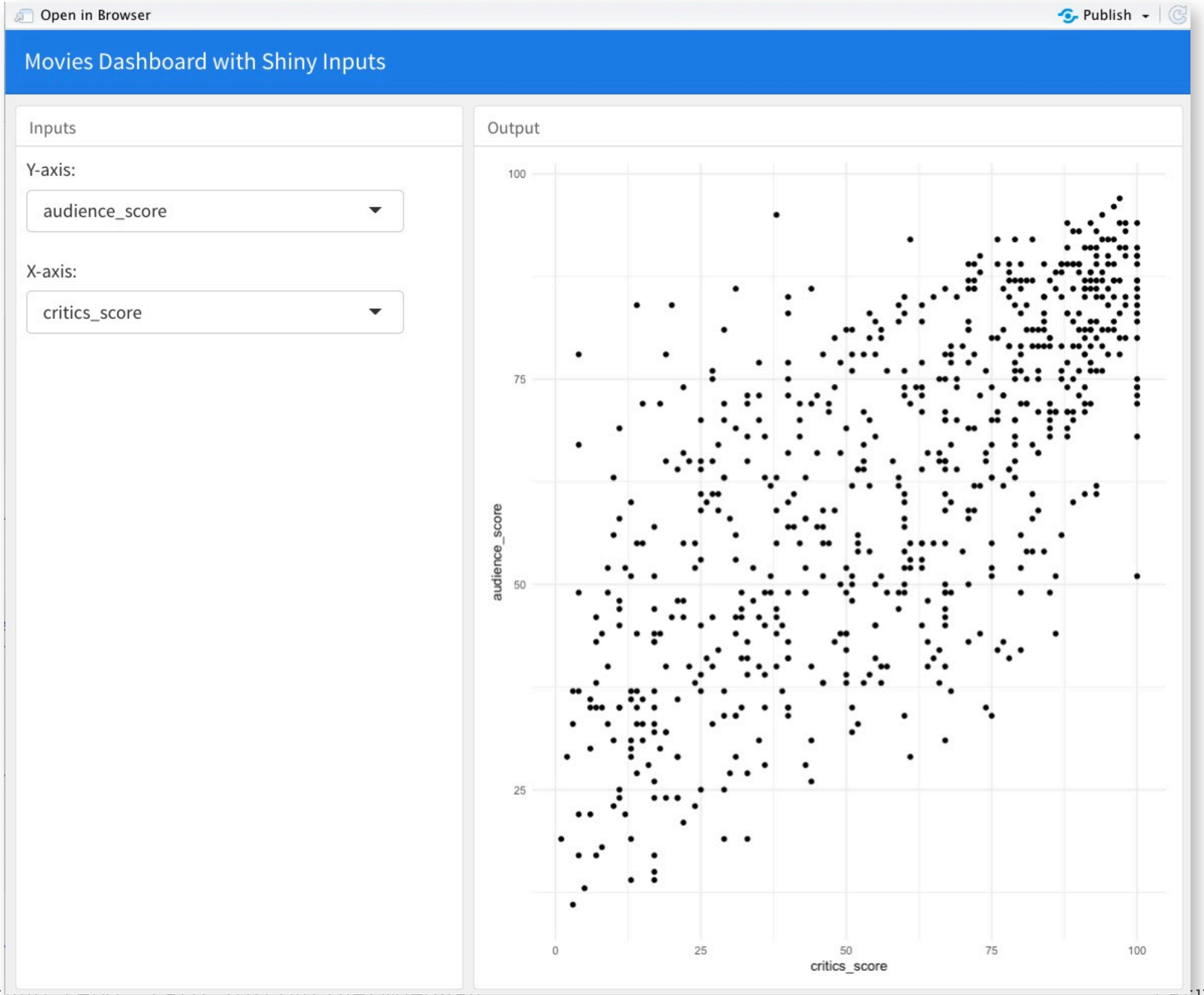
rstudio.cloud workspace: rstd.io/RMAID

Exercise 51

rstudio::conf

Build A Movie Brower

1.Open the project **05-RMAID-Shiny-Dashboards**
2. Click on **`51-movies1.Rmd`** in the Files pane to open that file
3. Add in a second **`selectInput`** function to set the variable **`y`**
4. Click on *Run App*. Note that *Knit* isn't available.



GitHub repo: rstd.io/conf20-rma-dash

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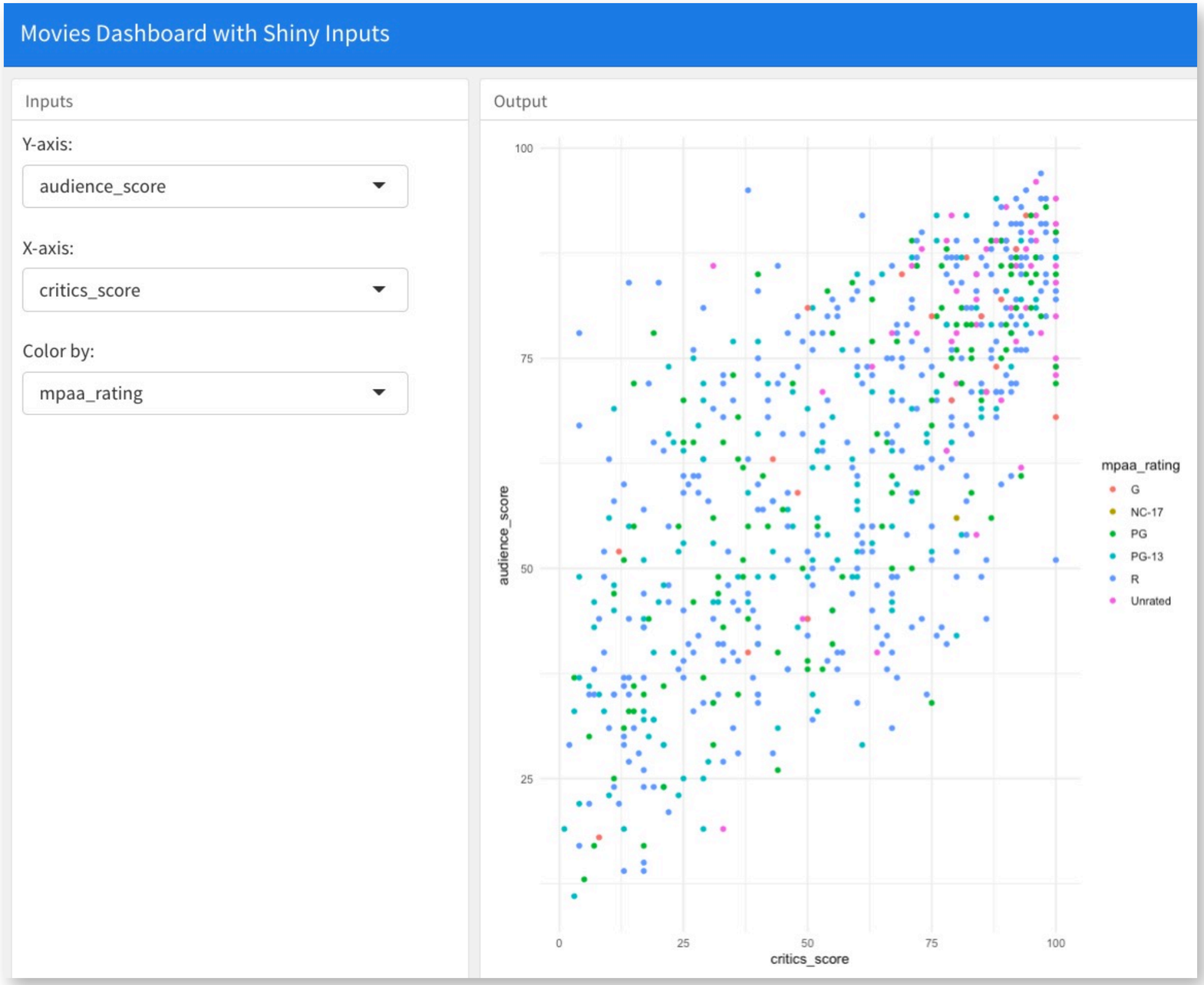
Exercise 52

rstudio::conf

Add Color

1. Using the same file, now add a **`selectInput`** function to set the variable **`z`**.
2. Make the choices for z be **`c("title_type", "genre", "mpaa_rating", "critics_rating", "audience_rating")`**
3. Modify the ggplot routine to add an aesthetic value **`color=z`**.
4. Run your app.



Github repo: rstd.io/conf20-rmd-dash

rstudio.cloud workspace: rstd.io/RMAID

Exercise 53

rstudio::conf

Add Transparency

1. Using the same file, now add a **`sliderInput`** function to set the variable **`alpha`**.
2. Modify the ggplot chunk to add an aesthetic value **`alpha=alpha`**.
3. Run your app.

5m 00s

Movies Dashboard with Shiny Inputs

Inputs

Y-axis:

audience_score

X-axis:

critics_score

Color by:

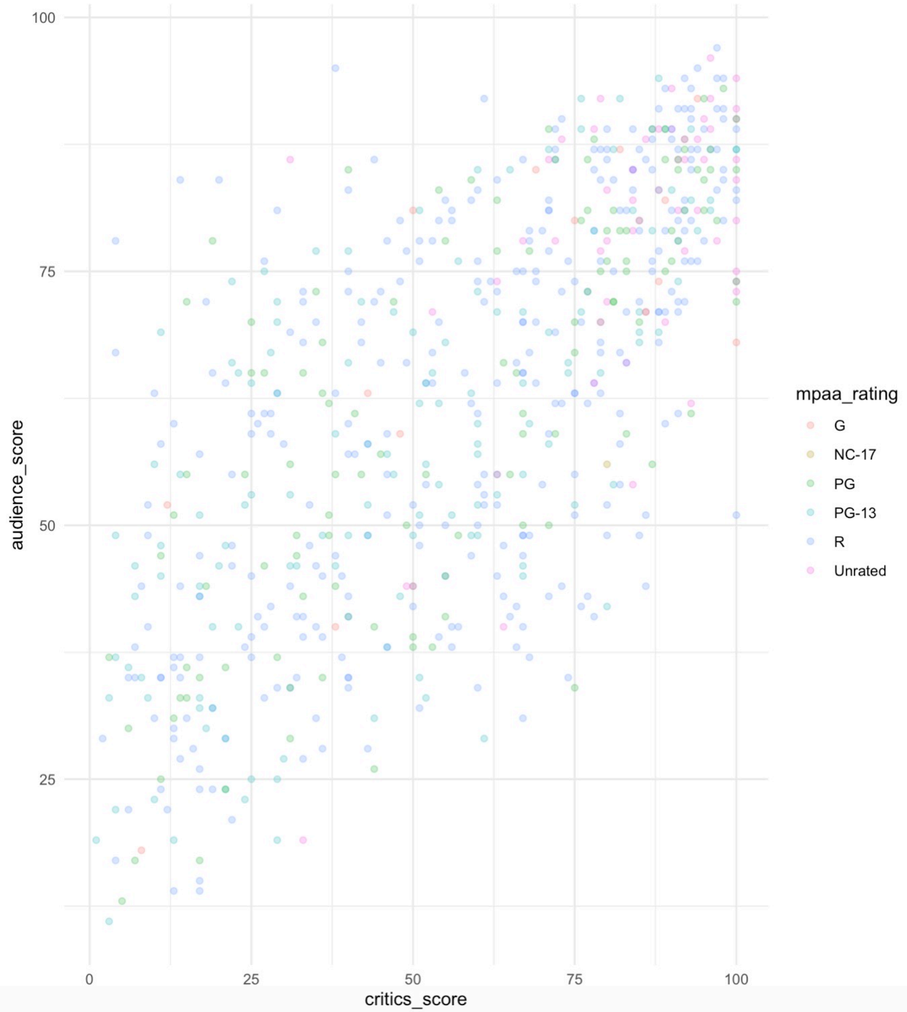
mpaa_rating

Alpha:

0 0.25 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Output



Github repo: rstd.io/conf20-rmd-dash

rstudio.cloud workspace: rstd.io/RMAID

Exercise 54

rstudio::conf

Add DataTable Output

1. Open file **`54-movies-4.Rmd`**
2. Add another RMarkdown pane below the plot using a level 3 header (### something)
3. Within that pane, add a renderDataTable for movies using the following code:

```
DT::renderDataTable({
    DT::datatable(data = movies %>% select(selected_columns),
                  options = list(pageLength = 10,
                                 rownames = FALSE))
})
```

4. Run your app.

Movies Dashboard with Shiny Inputs

Inputs

Y-axis:

audience_score

X-axis:

critics_score

Color by:

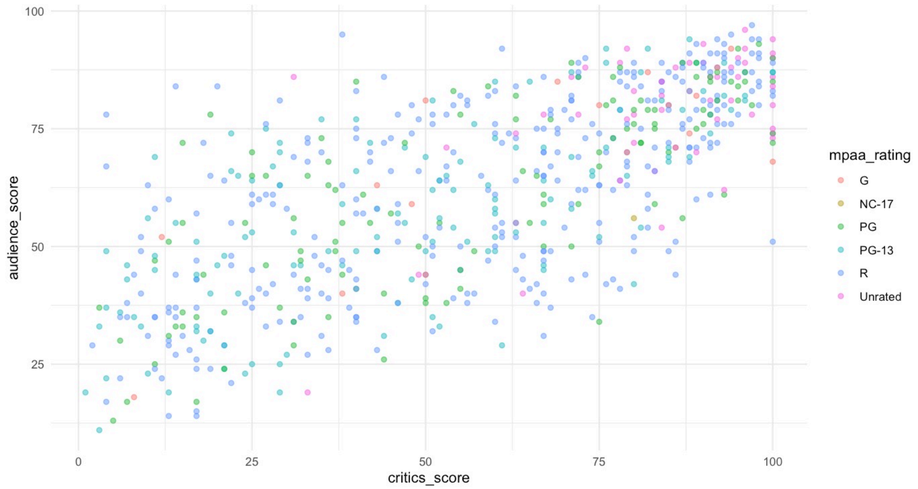
mpaa_rating

Alpha:

0 0.5 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Output Plot



Output Data Table

Show 10 entries Search:

	imdb_rating	critics_score	audience_score	runtime	title_type	genre
1	5.5	45	73	80	Feature Film	Drama
2	7.3	96	81	101	Feature Film	Drama
3	7.6	91	91	84	Feature Film	Comedy
4	7.2	80	76	139	Feature Film	Drama
5	5.1	33	27	90	Feature Film	Horror
6	7.8	91	86	78	Documentary	Documentar
7	7.2	57	76	142	Feature Film	Drama
8	5.5	17	47	93	Feature Film	Drama

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Exercise 55

rstudio::conf

Filtering Results

1. Open file **`55-movies5-doesnt-work.Rmd`**
2. Examine the code we added below ### $$$.
3. Run the app and see what happens.

What is

```
Error in .getReactiveEnvironment()
$currentContext: Operation not allowed
without an active reactive context. (You
tried to do something that can only be
done from inside a reactive expression or
observer.)?
```

Shiny inputs drive outputs through ***reactivity***

This Code Doesn't Work Because....

```
# Select genre for filtering
      selectInput(inputId = "genre_selection",
                  label = "Filter by genre:",
                  choices = movies %>% select(genre) %>% unique(),
                  selected = "mpaa_rating")

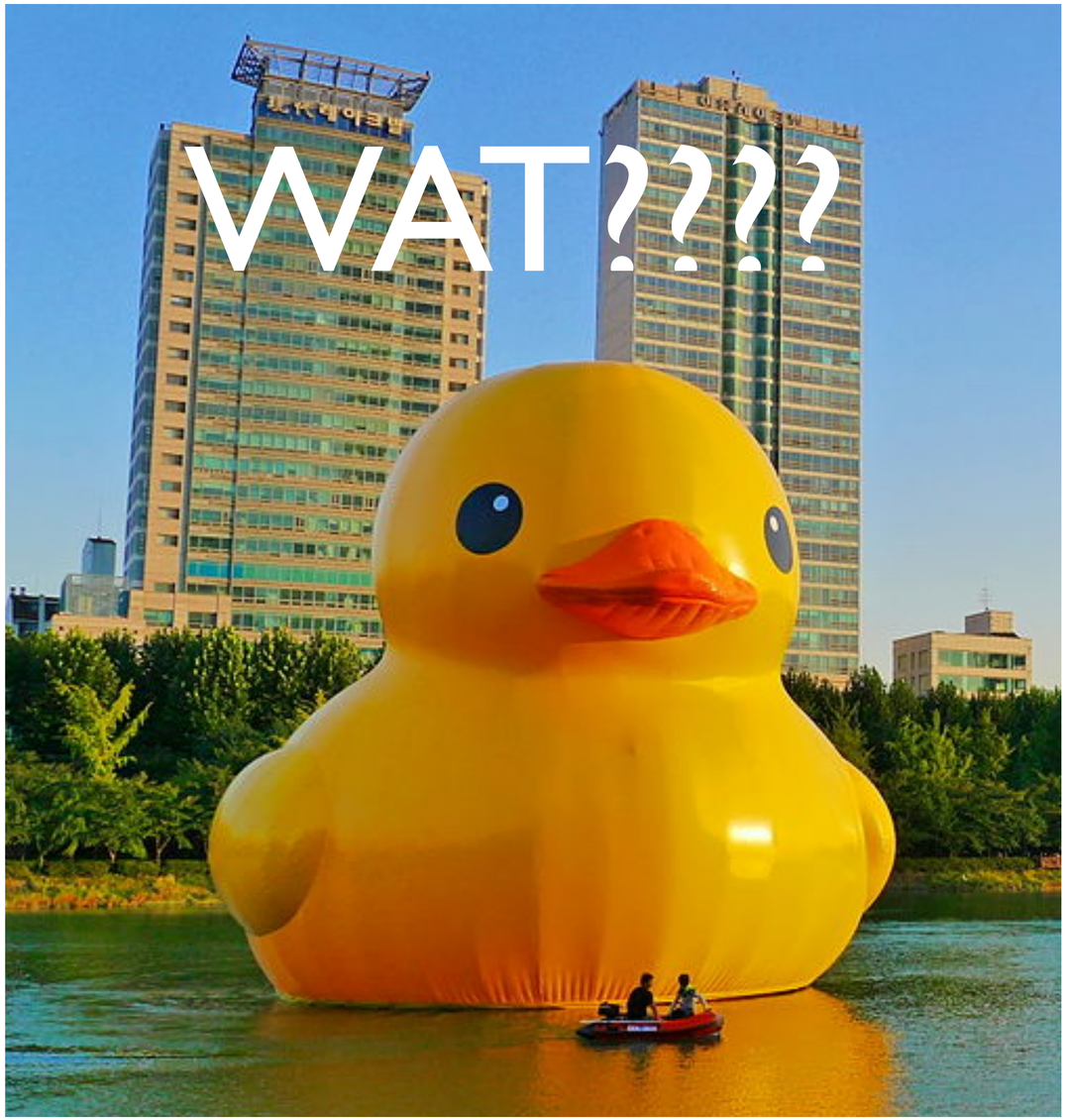

filtered_movies <- movies %>%
  filter(genre == input$genre_selection)
```

`input$genre_selection` isn't an ordinary variable

it's a reactive input that can change value with time

Reactivity

- Shiny input results of the form `input$variable` are reactive variables
- `input` variables can be used directly inside `render` expressions
- Any other uses of `input` variables must be inside a `reactive({})` expression
- Reactive expressions yield functions that are reactive when called as functions.



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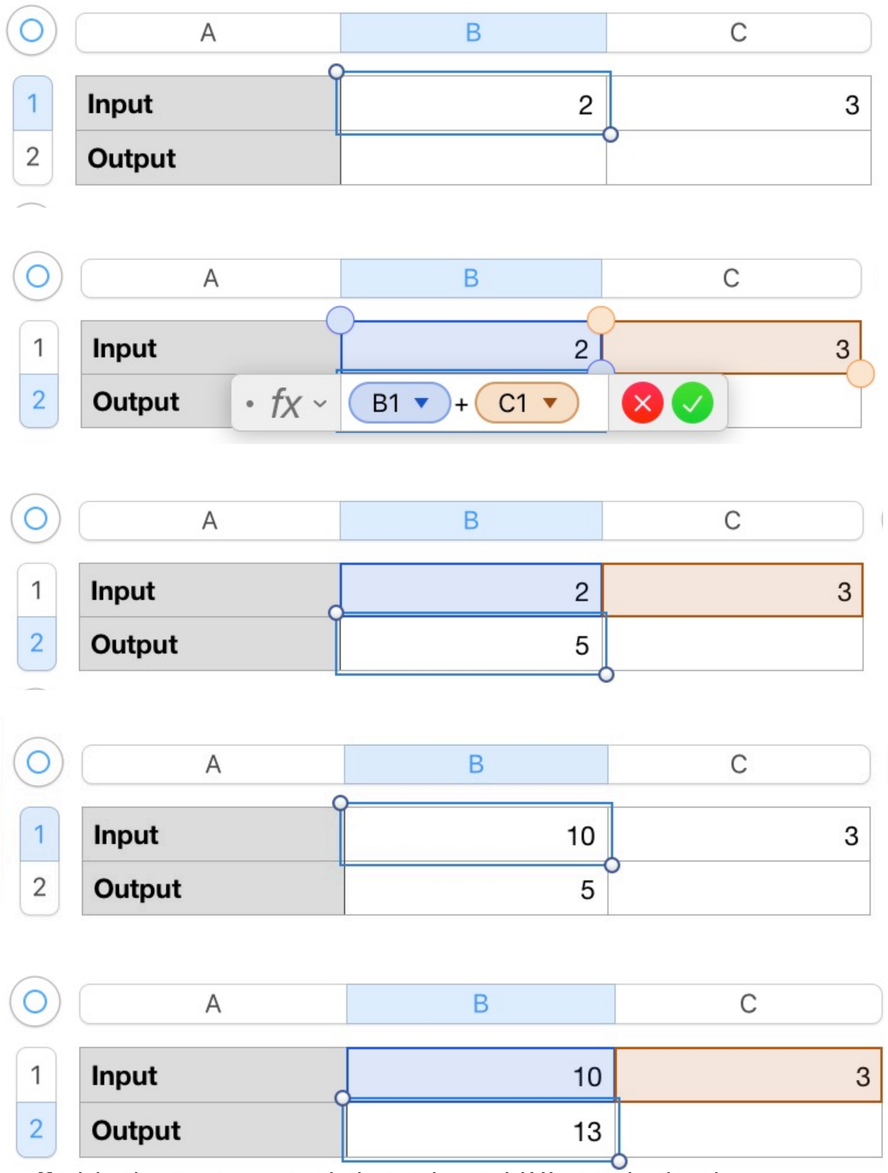
Think Of A Spreadsheet



- The value 13 was computed by reacting to B1 changing from 2 to 10
- All cells in spreadsheets are reactive by default
- In Shiny, only input variables created by Shiny input functions are reactive by default

Github repo: rstd.io/conf20-rmd-dash

rstudio.cloud workspace: rstd.io/RMAID

We Tell Shiny About Reactivity With The `reactive` Function

We have to change this:

```
filtered_movies <- movies %>%
  filter(genre == input$genre_selection)
```

To this:

```
reactive_movies <- reactive({ movies %>%
  filter(genre == input$genre_selection)
    })
```

And when we want the value of reactive_movies, we have to invoke a function instead of just referencing it:

```
  ggplot(data = reactive_movies(), ...
```

Exercise 55B

rstudio::conf

Filtering Results

1. Open file **`55-movies5.Rmd`**
2. Change **`filtered_movies`** to a new reactive expression, **`reactive_movies`** where $$$ appears
3. Also change references to **`filtered_movies`** to **`reactive_movies()`**
4. Run the app and see what happens.

Movies Dashboard with Shiny Inputs

Inputs

Y-axis:

audience_score

X-axis:

critics_score

Color by:

title_type

Alpha:

0 0.71 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Size:

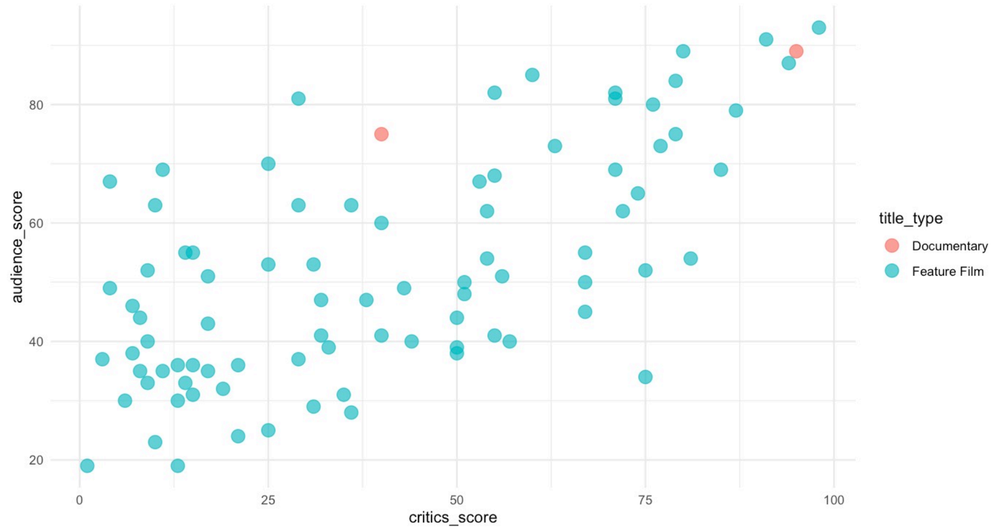
1 4 10

1 2 3 4 5 6 7 8 9 10

Filter by genre:

Comedy

Output Plot



Output Data Table

Show 10 entries Search:

	title	title_type	genre	runtime	mpaa_rating	studio	thtr_rel_
1	Waiting for Guffman	Feature Film	Comedy	84	R	Sony Pictures Classics	
2	The Royal Tenenbaums	Feature Film	Comedy	110	R	Buena Vista Distribution Compa	
3	School for Scoundrels	Feature Film	Comedy	100	PG-13	MGM	
4	Rhinestone	Feature Film	Comedy	111	PG	20th Century Fox	

Github d workspace: rstd.io/RMAID

Publishing Shiny apps requires a server that runs R. shinyapps.io and RStudio Connect are two easy options

Publishing Shiny Apps

- Unlike HTML widgets that just rely on HTML and Javascript, Shiny apps must be published to a server that can run R.
- RStudio runs a public server called shinyapps.io that you can publish Shiny apps to.
- To publish your app so others can use it, hit the *Publish* button in the IDE.
- Create an account on shinyapps.io when asked and publish your app there.
- Note that shinyapps.io will only allow you to run 5 apps without paying, so be sure to kill of apps when you no longer want them.

Exercise 55C

rstudio::conf

Publish your app to Connect

1. If you currently have a working app, click the Publish button
2. Select RStudio Connect as your publishing destination
3. Go check out your Shiny app on Connect to see what it looks like there

5m 00s

Shiny Tips and Tricks

- Debugging Shiny apps can be VERY challenging because of their real-time nature

  1. Start by writing a static plotting application without Shiny
  2. Build out your UI in R Markdown without Shiny
  3. Encapsulate your application and UI within Shiny functions

You can use HTML Widgets in your Shiny app by modifying your render functions

Render Functions For 2 HTML Widgets

If you want to use...	render using...	Instead of....
Plotly plots	renderPlotly	renderPlot
Leaflet maps	renderLeaflet	making your own maps

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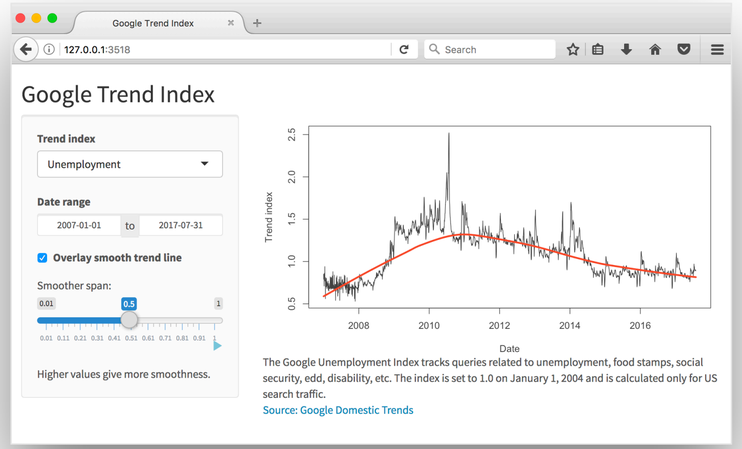
Exercise 56

rstudio::conf

Pull It All Together

1. Open file **`56-movies-and-earthquakes.Rmd`**
2. Modify the existing plots to use **`plotly`**
3. Collect the existing materials into a single first level header **`# Movies`**
4. Create a new first level header page titled **`# Earthquakes`** that plots recent earthquakes using **`leaflet`** and **`renderLeaflet`**. You can find the leaflet code in the dashboard **`01-my-first-dashboard.Rmd`** in the **`01-Introduction`** directory; you will, however, want to remove the layer with temperatures and the grouping legend code.
5. Extra credit: add a datatable below your leaflet map with the most recent earthquakes



Program logic

R code

Layout

R Markdown

Github repo: rstd.io/conf20-rmd-dash

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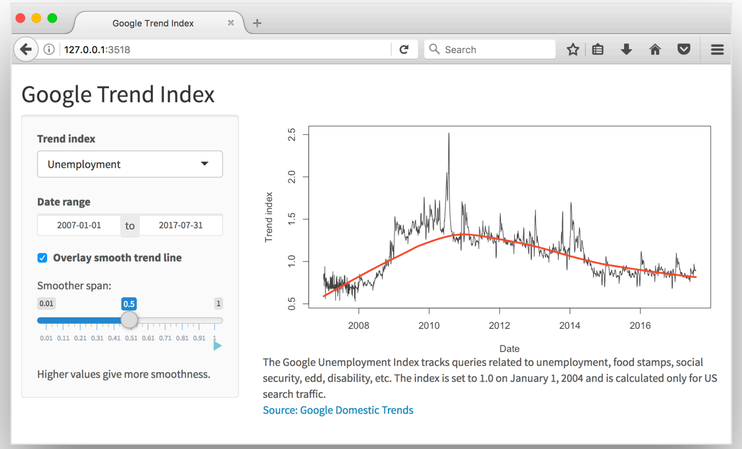
But what about using pure Shiny?

Now that you know Shiny, you may can skip R Markdown altogether.

Instead of .Rmd files, we'll just create .R scripts in two pieces



Server instructions

server.R

User interface

ui.R

Github repo: rstd.io/conf20-rmd-dash

rstudio.cloud workspace: rstd.io/RMAID

Exercise 57

rstudio::conf

Explore pure Shiny versions of the movies browser

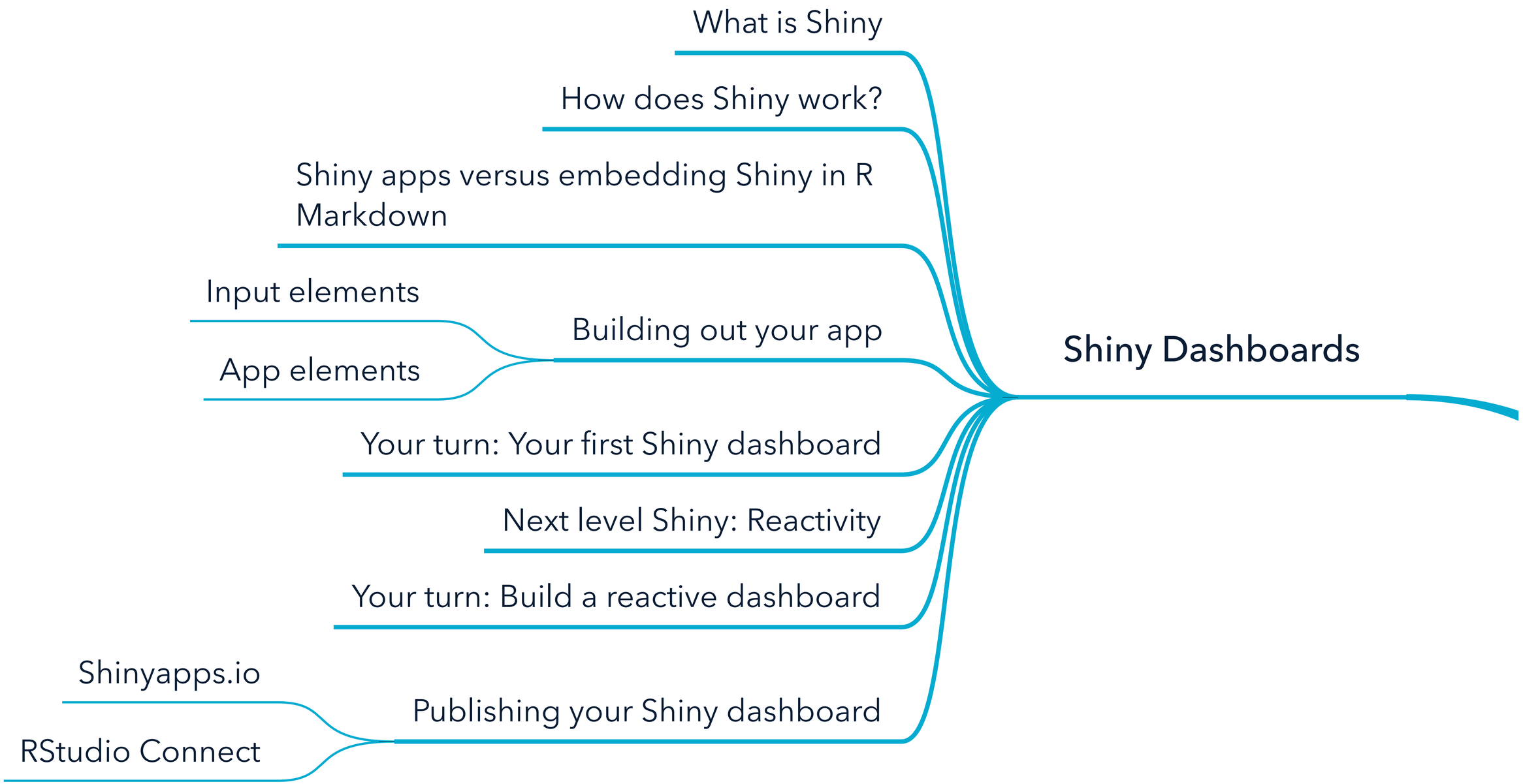
1. Open file **`57-movies-no-markdown.R`**
2. Compare the code here with **`52-movies2.Rmd`**
3. Notice that the pure Shiny version now adds functions devoted to layout
4. Also notice that we click *Run App* instead of *Run Document.*
5. Run the app and observe the differences in layout
6. Load and run **`58-movies-color.R`** to observe how color was added, just as was done in **`53-movies3.Rmd`**

Summary

- Shiny is an R package that makes it easy to build interactive web apps from R
- Shiny offers user interface and rendering functions for input and output controls
- Shiny inputs drive outputs through reactivity
- Publishing Shiny apps requires a server that runs R. shinyapps.io and RStudio Connect are two easy options
- You can use HTML Widgets in your Shiny app by modifying your render functions
- You can build dashboards using pure Shiny and no R Markdown

Github repo: rstd.io/conf20-rmd-dash

rstudio.cloud workspace: rstd.io/RMAID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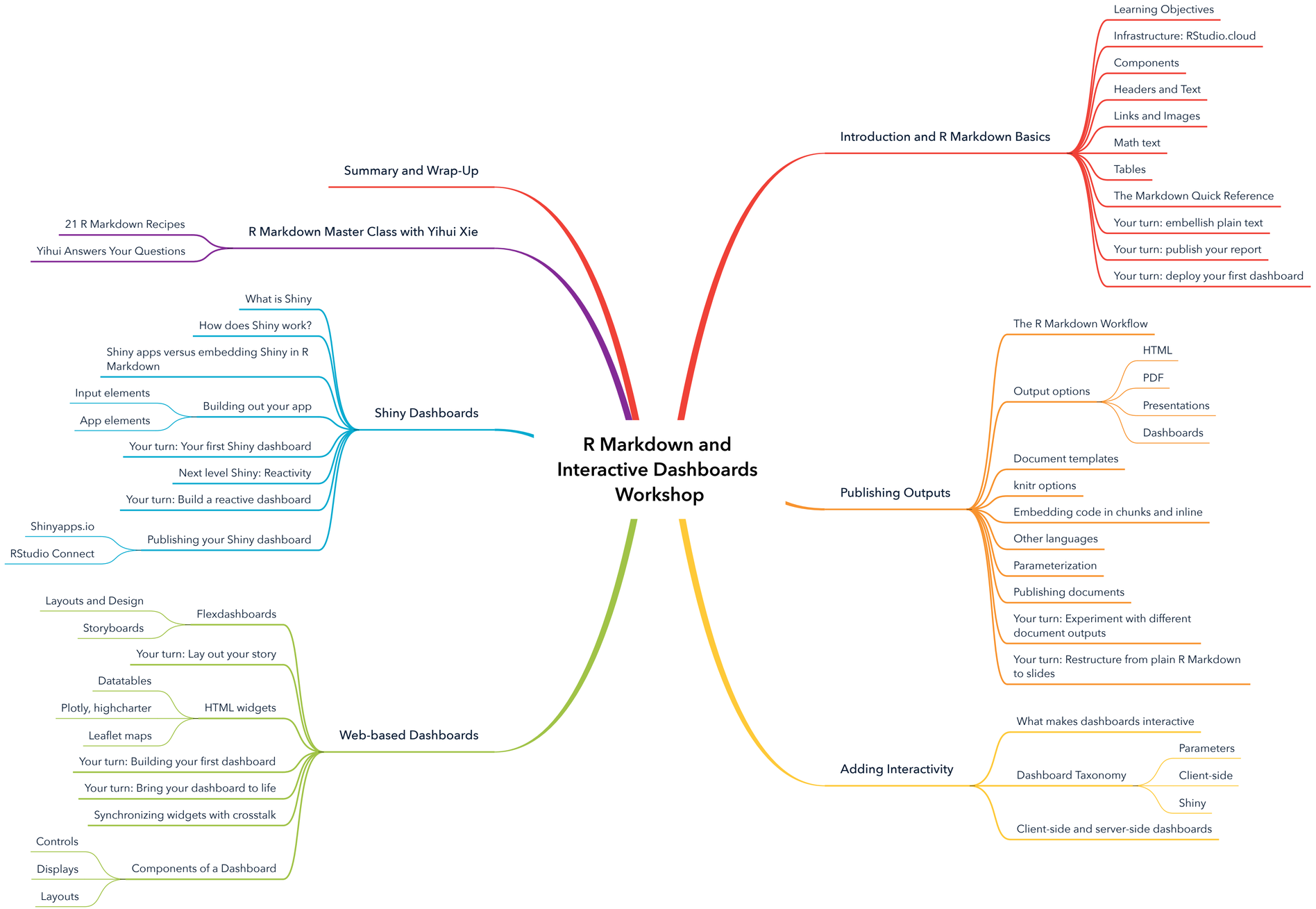
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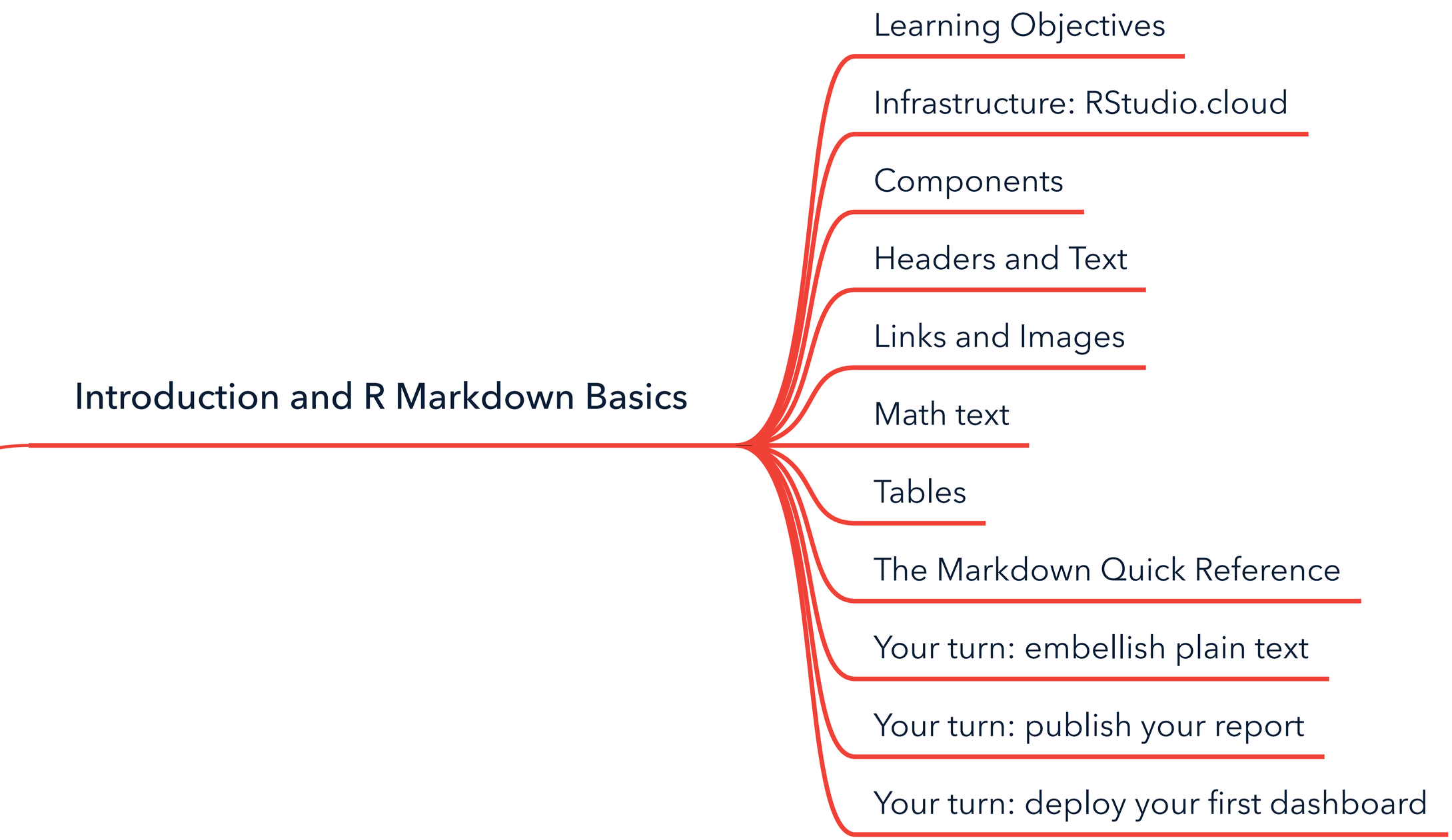
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R Markdown is a language for creating ***computational documents****

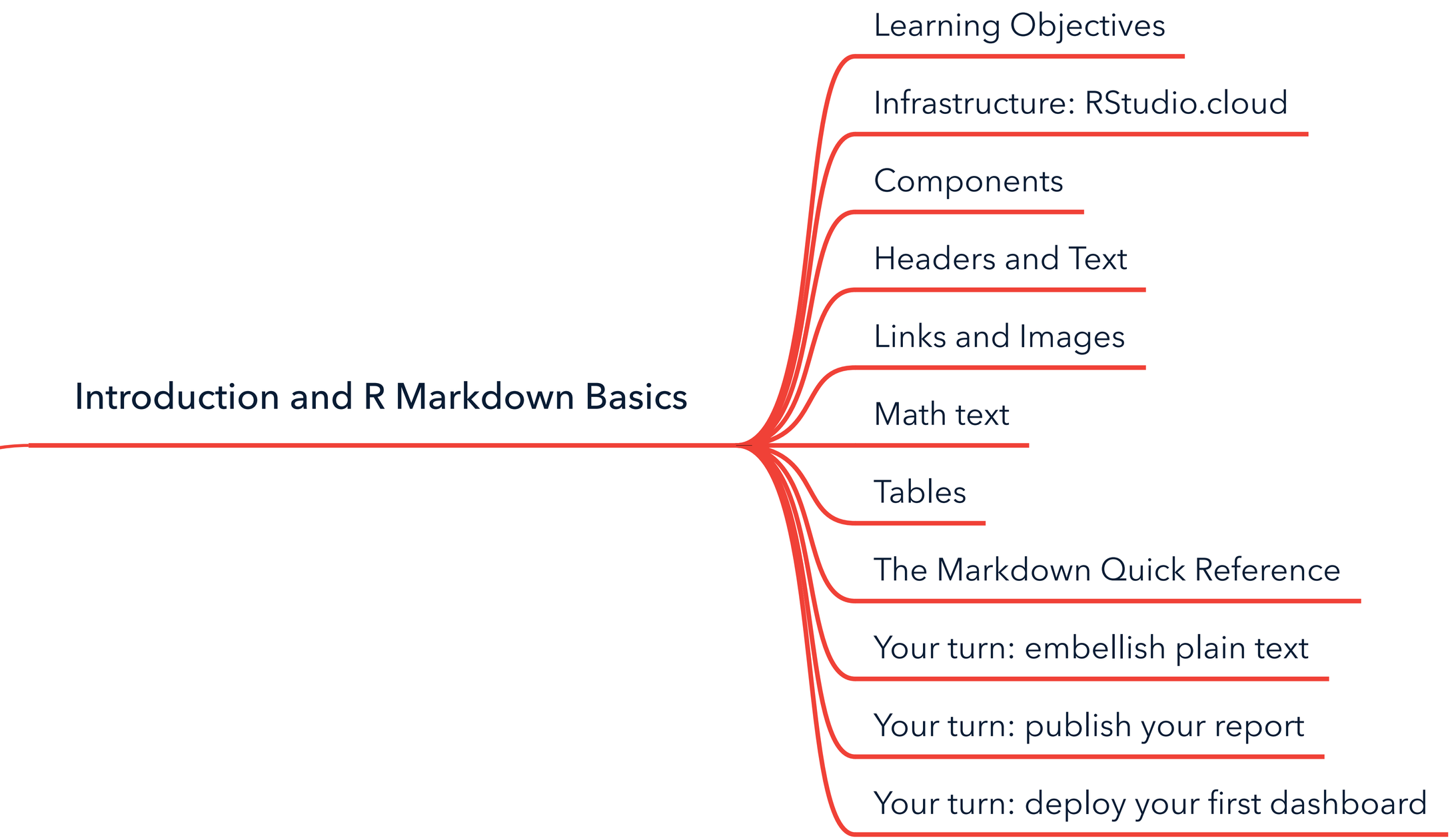
Donald Knuth's name for computational documents was *Literate Programming*, which he defined in a book of the same name. I prefer computation documents because it is more intuitively descriptive.

Metadata for an R Markdown document is written at the top of the document in YAML

R Markdown flags structural elements of our text for special treatment

Code chunks delimited by ``` glyphs allow us to add computation to our document.

R Markdown code chunks support many languages.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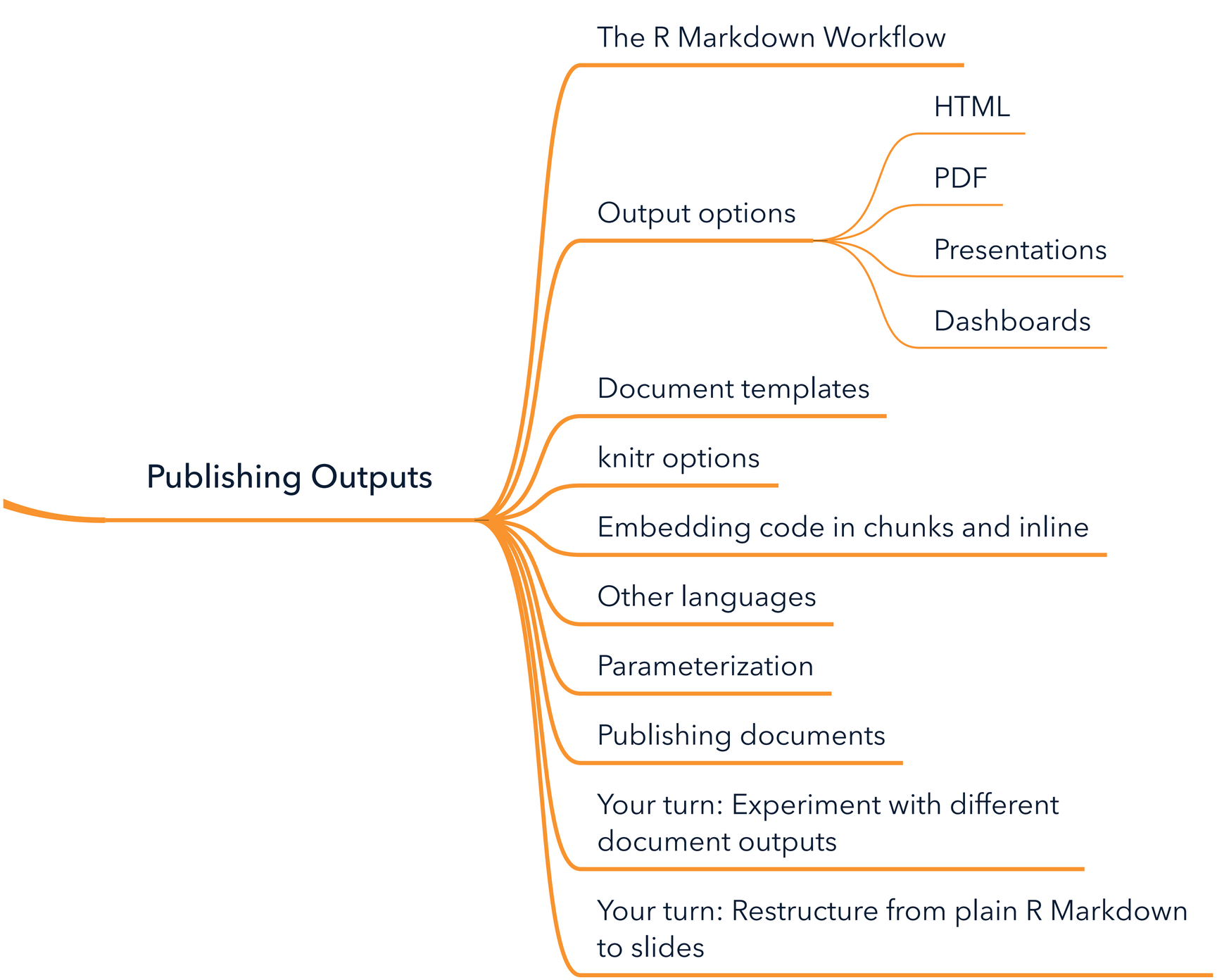
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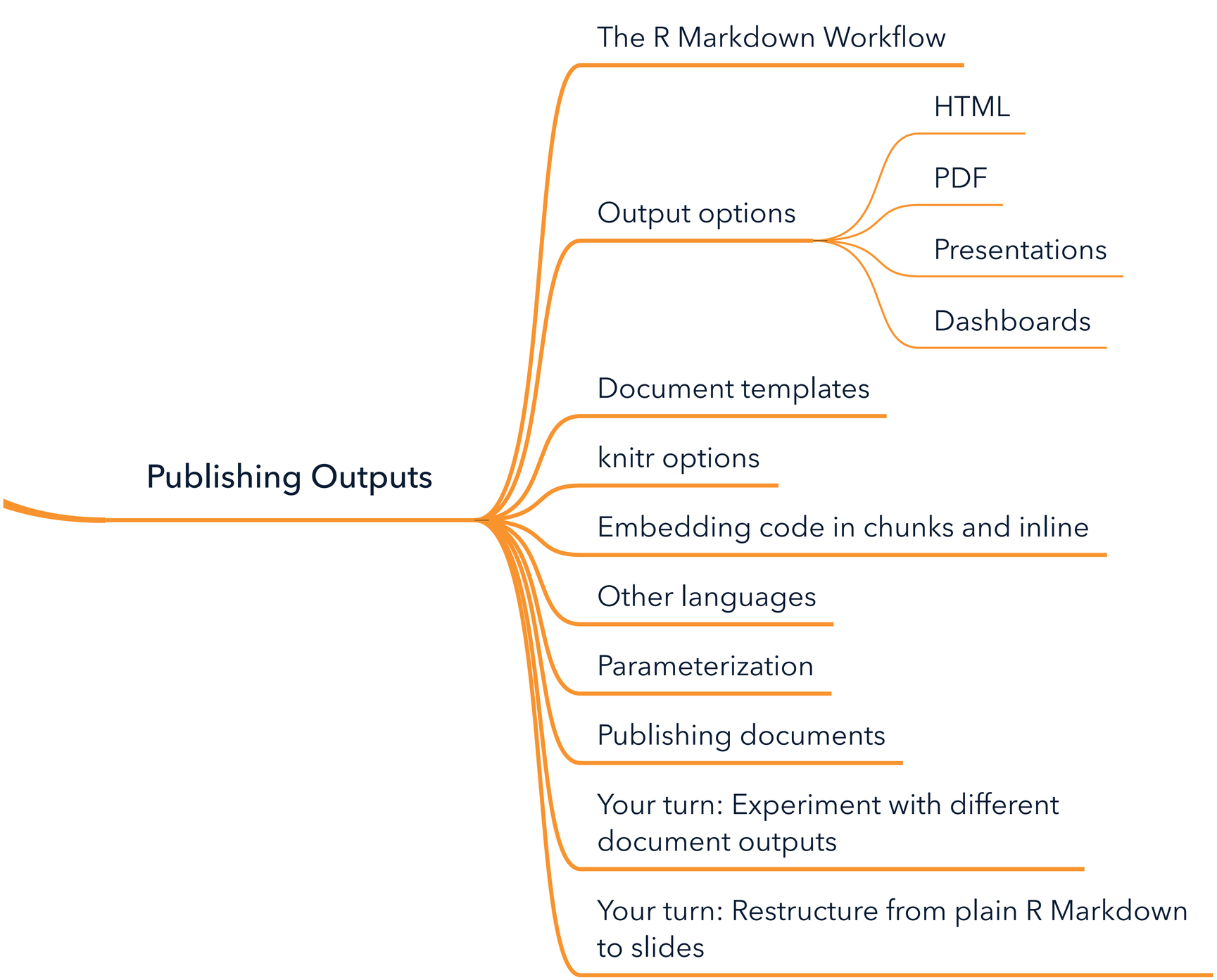
R Markdown is a system for creating **structured** *computational documents*

R Markdown can knit to many document types

HTML-based R Markdown documents can be shared using the **`publish`** *button in the RStudio IDE*

R Markdown similar to that for reports and slides can also generate dashboards.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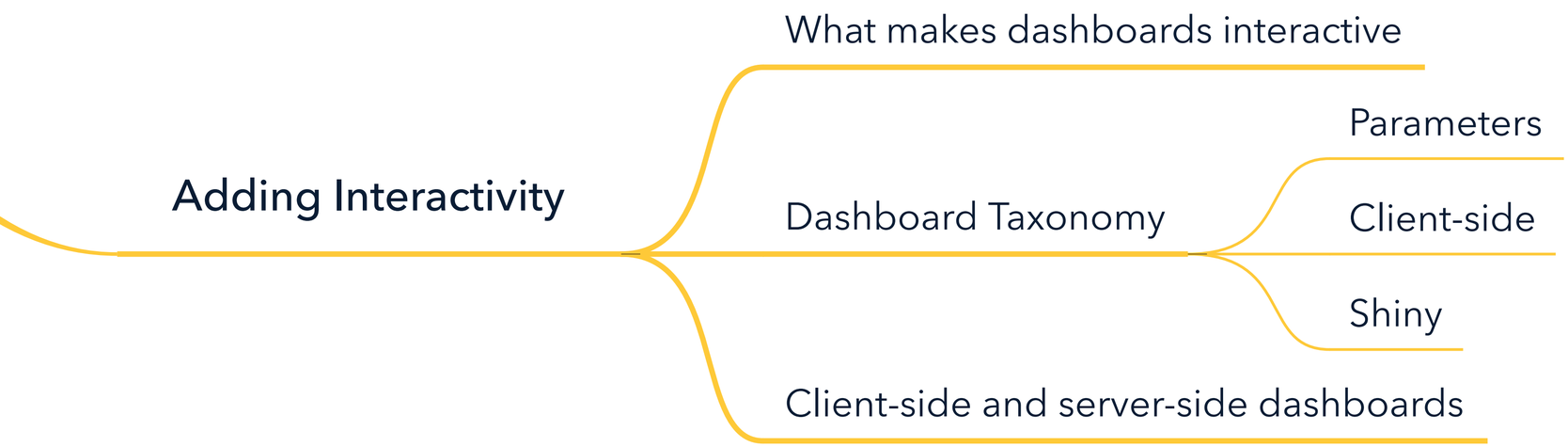
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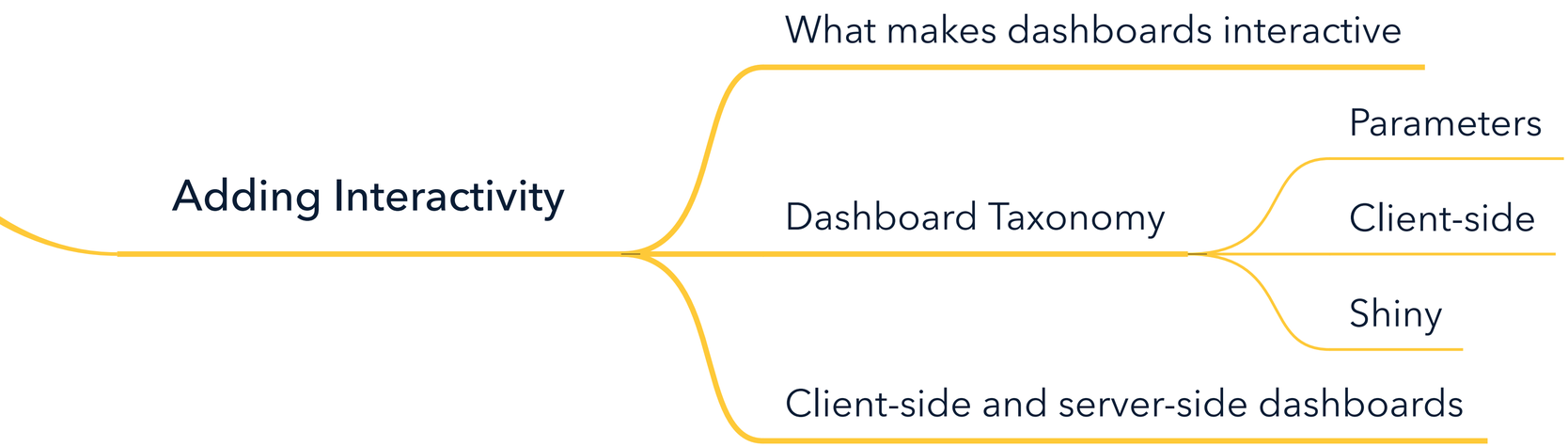
Interactivity is the gateway drug that hooks users on your content

R Markdown supports three different types of interactivity: one-time, web-based, and server-side

Tailor your interactivity plan to your data and user goals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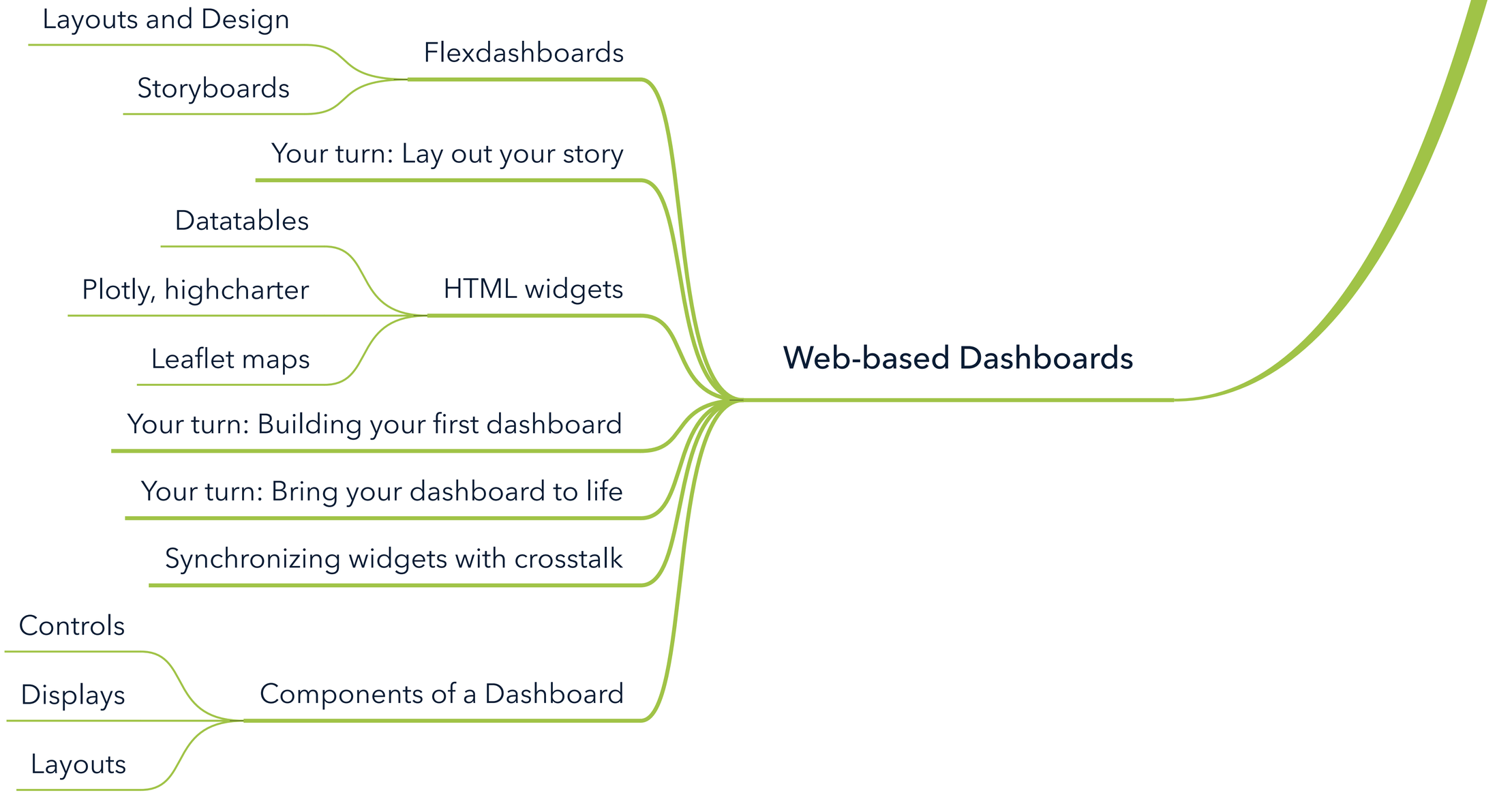
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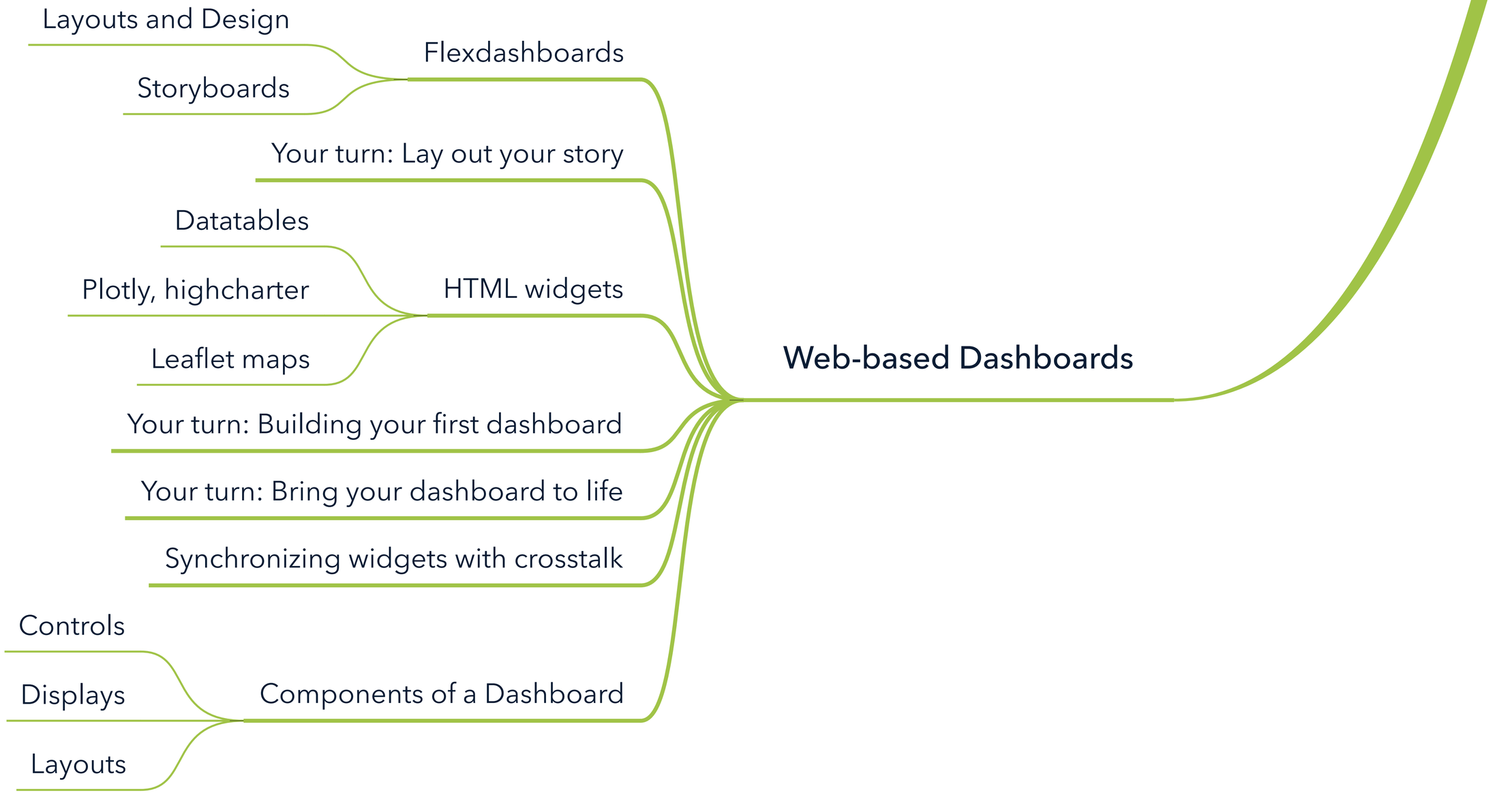
Dashboards have three building blocks:

1. Controls
2. Displays
3. Layouts

R Markdown layouts use header information to mark rows and columns on pages

HTML widgets create display interactivity using the user's browser

We build interactive controls using either kniting with parameters or using Shiny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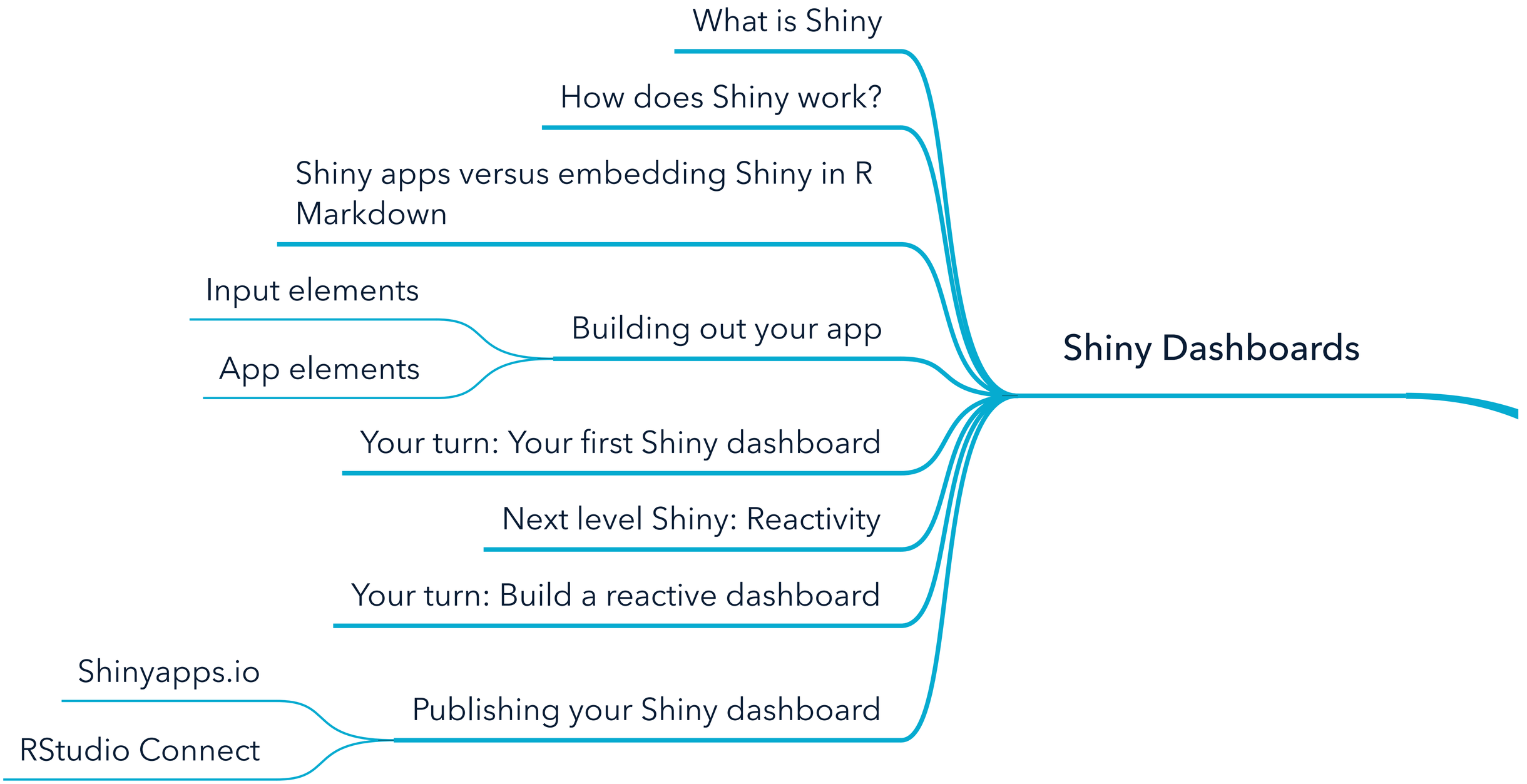
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shiny.rstudio.com

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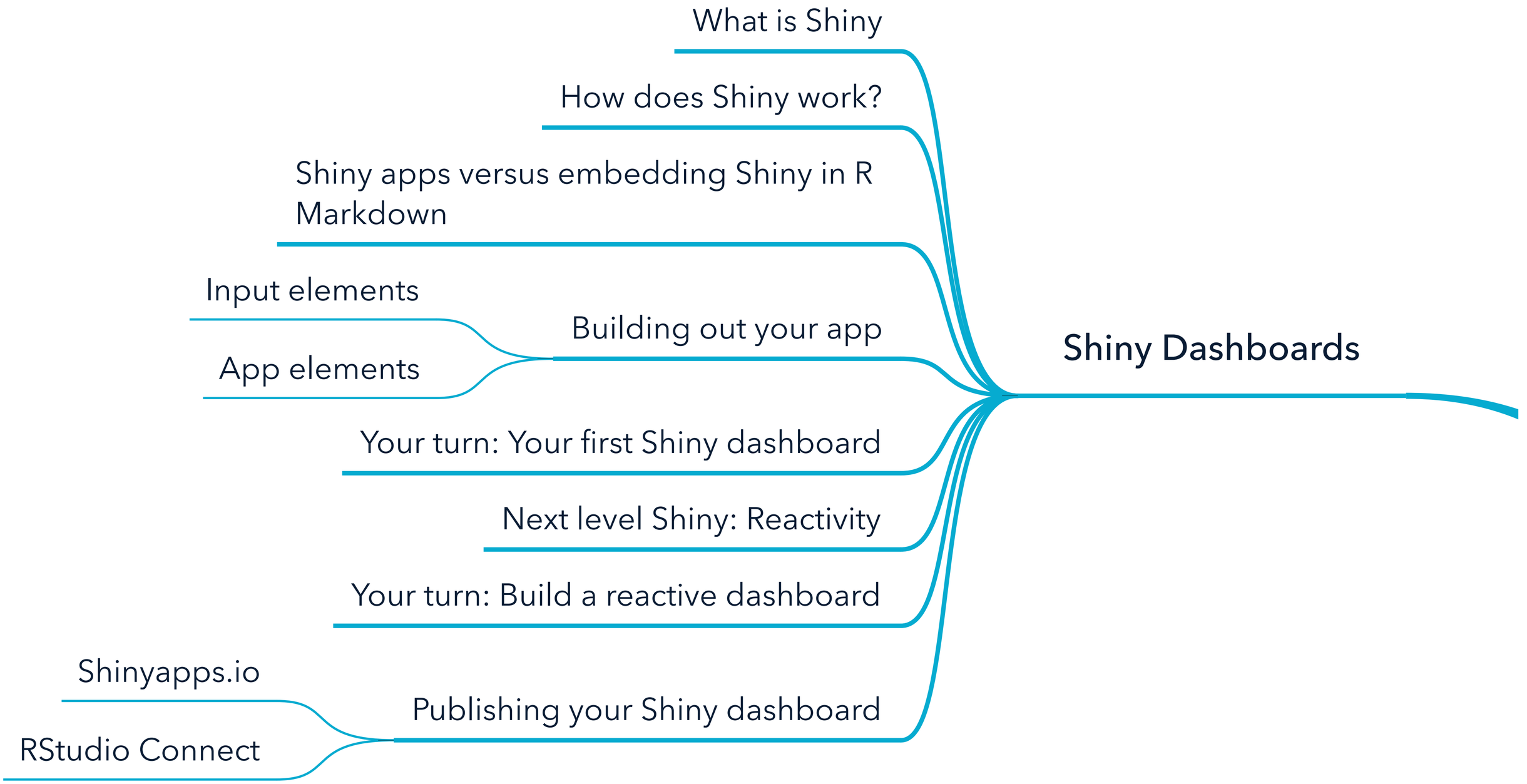
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Carl Howe
Yihui Xie

Hadrien Dykiel
Melanie Mayer
Jiena McLellan
Adi Sarid

https://rstd.io/ws-survey


Thank you for your participation!
Please help us improve our workshops by filling out our survey at:
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