




# UNDERSTANDING UI

- ▶ Web application UI is ultimately HTML/CSS/JavaScript
- ▶ Let R users write user interfaces using a simple, familiar-looking API...
- ▶ ...but no limits for advanced users

# **Ladder of progression**

# LADDER OF UI PROGRESSION

- ▶ Step 1. Shiny built-in inputs/outputs and layouts (sidebarLayout, navbarPage, tabsetPanel)
- ▶ Step 2. Use functions from external packages (shinythemes, shinydashboard, shinybs)
- ▶ Step 3. Use tag objects, write UI functions  **Our focus today**
- ▶ Step 4. Author HTML templates
- ▶ Step 5. Create custom inputs/outputs, wrap existing CSS/JS libraries and frameworks

# High level

# view



# MULTIPLE LEVELS OF ABSTRACTION

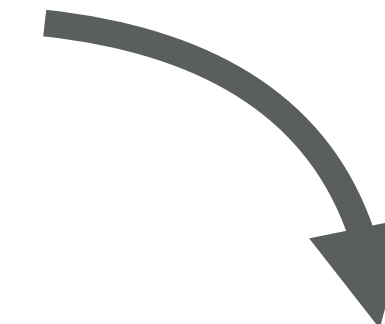
**High-level funcs**

`fluidRow(...)`



**htmltools tags**

`div(class="row", ...)`



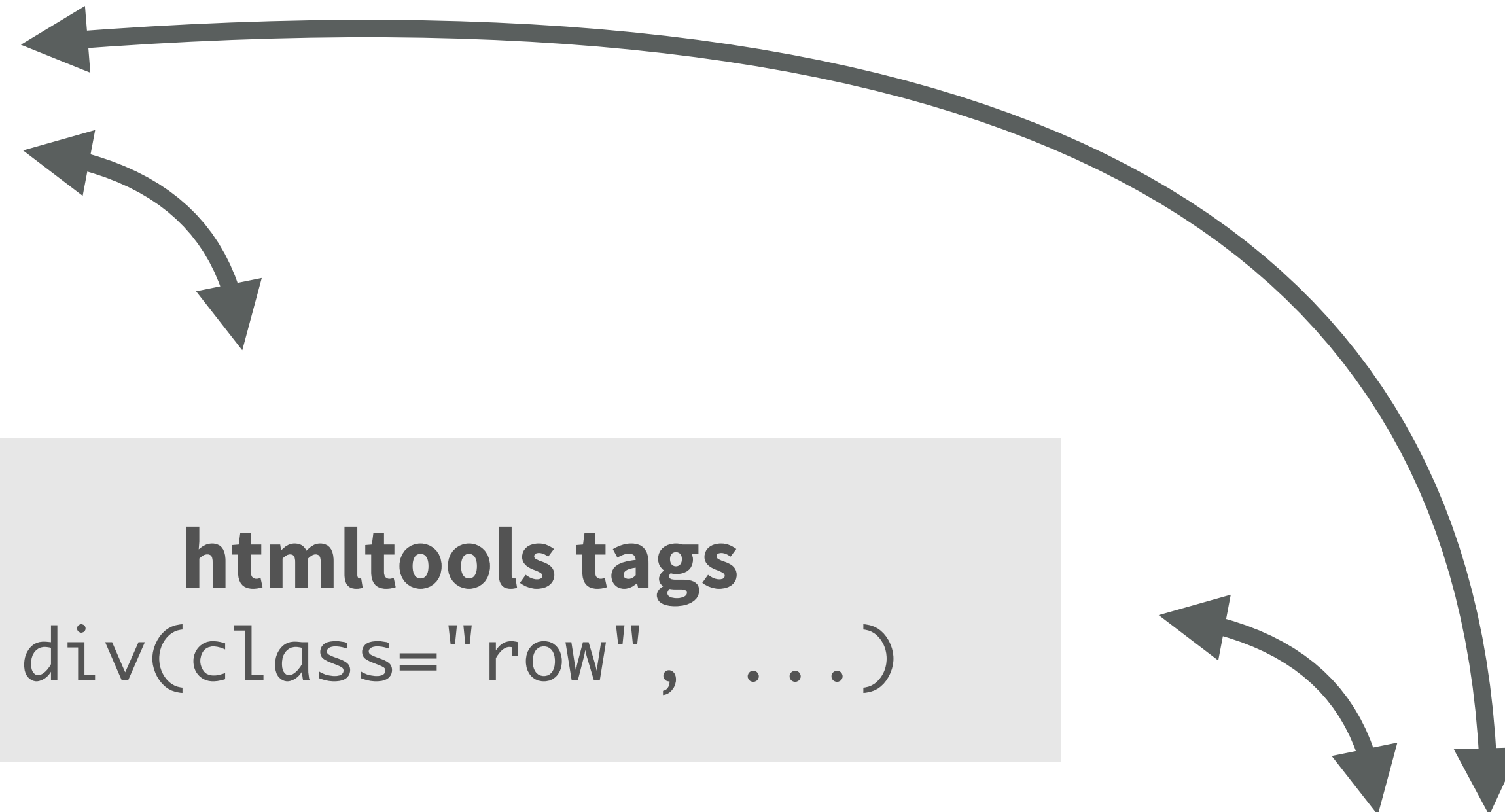
**Raw HTML markup**

`<div class="row">...</div>`

# MIX AND MATCH FREELY

## High-level funcs

`fluidRow(...)`



**htmltools tags**  
`div(class="row", ...)`

## Raw HTML markup

`<div class="row">...</div>`

# RAW HTML

- ▶ Pros
  - ▶ Can do anything that's possible in a web page
  - ▶ Comfortable for designers, web developers
- ▶ Cons
  - ▶ Unfamiliar for many R users
  - ▶ Potentially lots of HTML needed for conceptually simple tasks
  - ▶ CSS/JavaScript dependencies must be handled manually

```
<nav class="navbar navbar-default navbar-static-top" role="navigation">
  <div class="container">
    <div class="navbar-header">
      <span class="navbar-brand">Superzip</span>
    </div>
    <ul class="nav navbar-nav shiny-tab-input" id="nav">
      <li class="active">
        <a href="#tab-5158-1" data-toggle="tab" data-value="1">Interactive</a>
      </li>
      <li>
        <a href="#tab-5158-2" data-toggle="tab" data-value="2">Map</a>
      </li>
      <li>
        <a href="#tab-5158-3" data-toggle="tab" data-value="3">About</a>
      </li>
    </ul>
  </div>
</nav>
<div class="container-fluid">
  <div class="tab-content">
    <div class="tab-pane active" data-value="Interactive">
      <div class="outer">
        <div id="map" style="width:100%; height:100%; border: 1px solid black;">
          <div class="panel panel-default draggable" id="map">
            <div class="panel-body">
              <div class="map">
                <img alt="Map of the world" data-bbox="100 100 900 900"/>
              </div>
            </div>
          </div>
        </div>
      </div>
    </div>
  </div>
</div>
```



# HTMLTOOLS OBJECTS

- ▶ HTML-generating R functions
- ▶ Pros
  - ▶ All the power of HTML, but looks like R
  - ▶ Automated CSS/JS dependency handling
  - ▶ More composable, programmable than HTML
- ▶ Cons
  - ▶ Easy to misplace commas
  - ▶ Almost as verbose as raw HTML

```
nav(class="navbar navbar-default navbar-static-top", rol
  div(class="container",
    div(class="navbar-header",
      span(class="navbar-brand", "Superzip")
    ),
    ul(class="nav navbar-nav shiny-tab-input", id="nav",
      li(class="active",
        a(href="#tab-5158-1", `data-toggle`="tab", `data
      ),
      li(
        a(href="#tab-5158-2", `data-toggle`="tab", `data
      ),
      li(
        a(href="#tab-5158-3", `data-toggle`="tab")
      )
    )
  )
)
```

# HIGH LEVEL FUNCTIONS

- ▶ Functions that return htmltools objects
- ▶ Pros
  - ▶ Less code, clearer intent
  - ▶ Anyone can make their own
- ▶ Cons
  - ▶ Less flexible

```
navbarPage("Superzip", id="nav",  
  tabPanel("Interactive map", ...),  
  tabPanel("Data explorer", ...)  
)
```

# Using Shiny

## built-ins

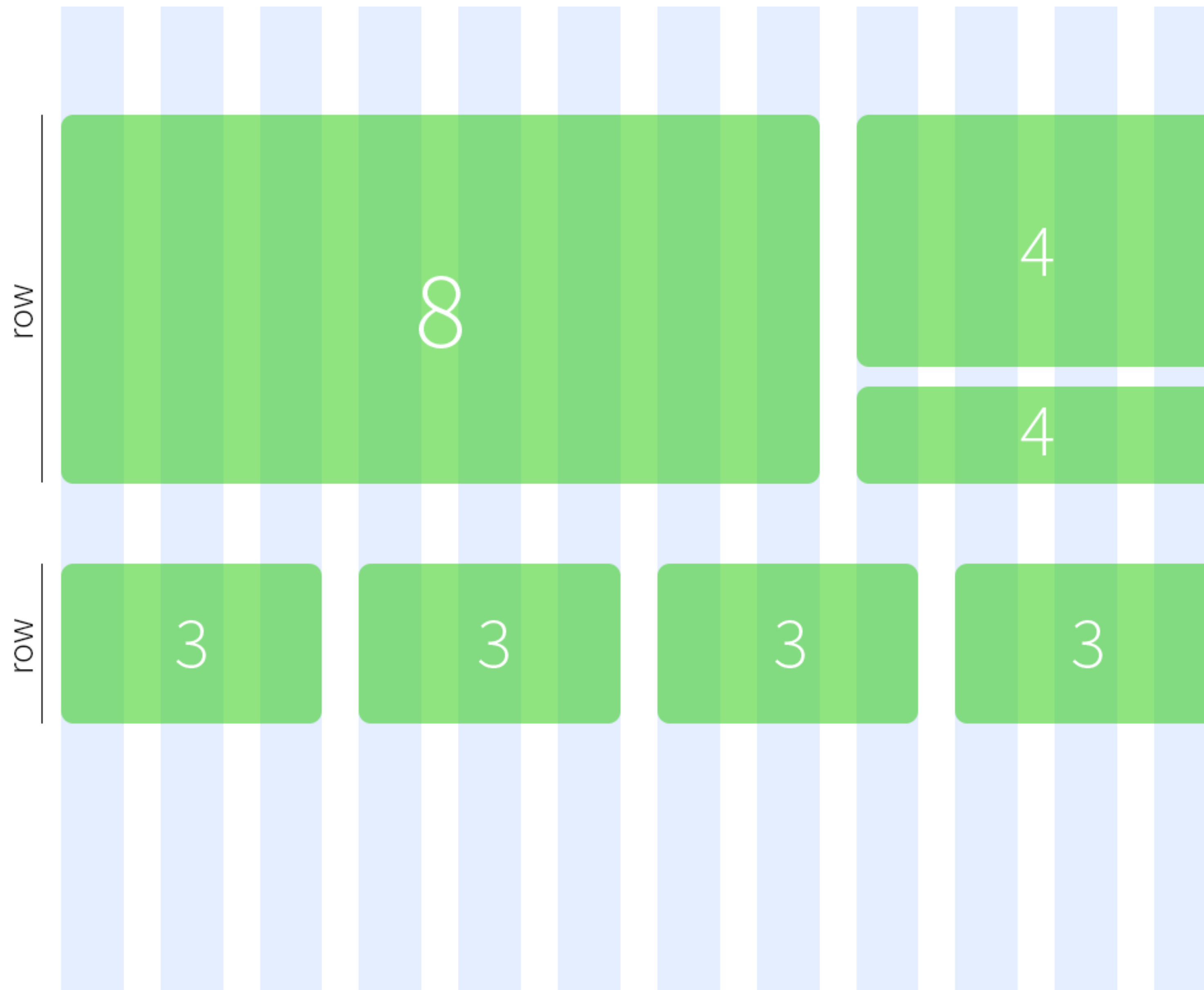
# SHINY UI BUILT-INS

- ▶ **Bootstrap grid framework** – fluidPage, fixedPage, fluidRow, column
- ▶ **Containers** – wellPanel, absolutePanel, fixedPanel
- ▶ **Navigation panels** – tabsetPanel, navlistPanel, navbarPage
- ▶ **Fill layouts** (Shiny 0.13+) – fillPage, fillRow, fillCol
- ▶ **Modals and notifications** (Shiny 0.14+) – showModal, modalDialog

# BOOTSTRAP GRID FRAMEWORK

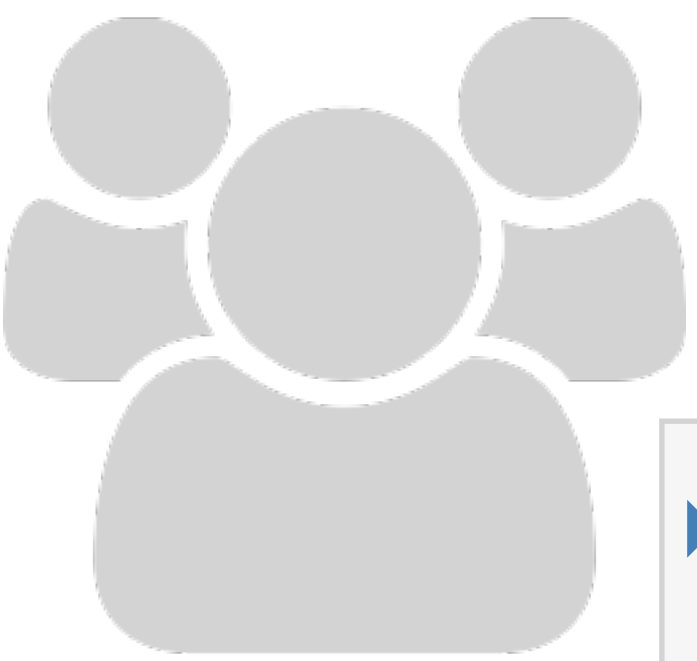
- ▶ Every page has 12 invisible columns
- ▶ Each column of content must span an integral number of columns
- ▶ Simple R API for implementing Bootstrap grid
  - ▶ `fluidPage(...)` wraps the entire page
  - ▶ `fluidRow(...)` wraps each row's column
  - ▶ `column(width, ...)` wraps each column's content





```
ui <- fluidPage(  
  fluidRow(  
    column(8, item1),  
    column(4, item2, item3),  
  ),  
  fluidRow(  
    column(3, item4),  
    column(3, item5),  
    column(3, item6),  
    column(3, item7)  
  )  
)
```

# EXERCISE



- ▶ Modify **ui\_01.R** to display the two outputs next to each other (instead of above and below)
- ▶ Assign the left output to be 5 columns wide, and the right output to be 7 columns wide
- ▶ See what happens as you change the width of the browser window

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# SOLUTION

Solution to the previous exercise

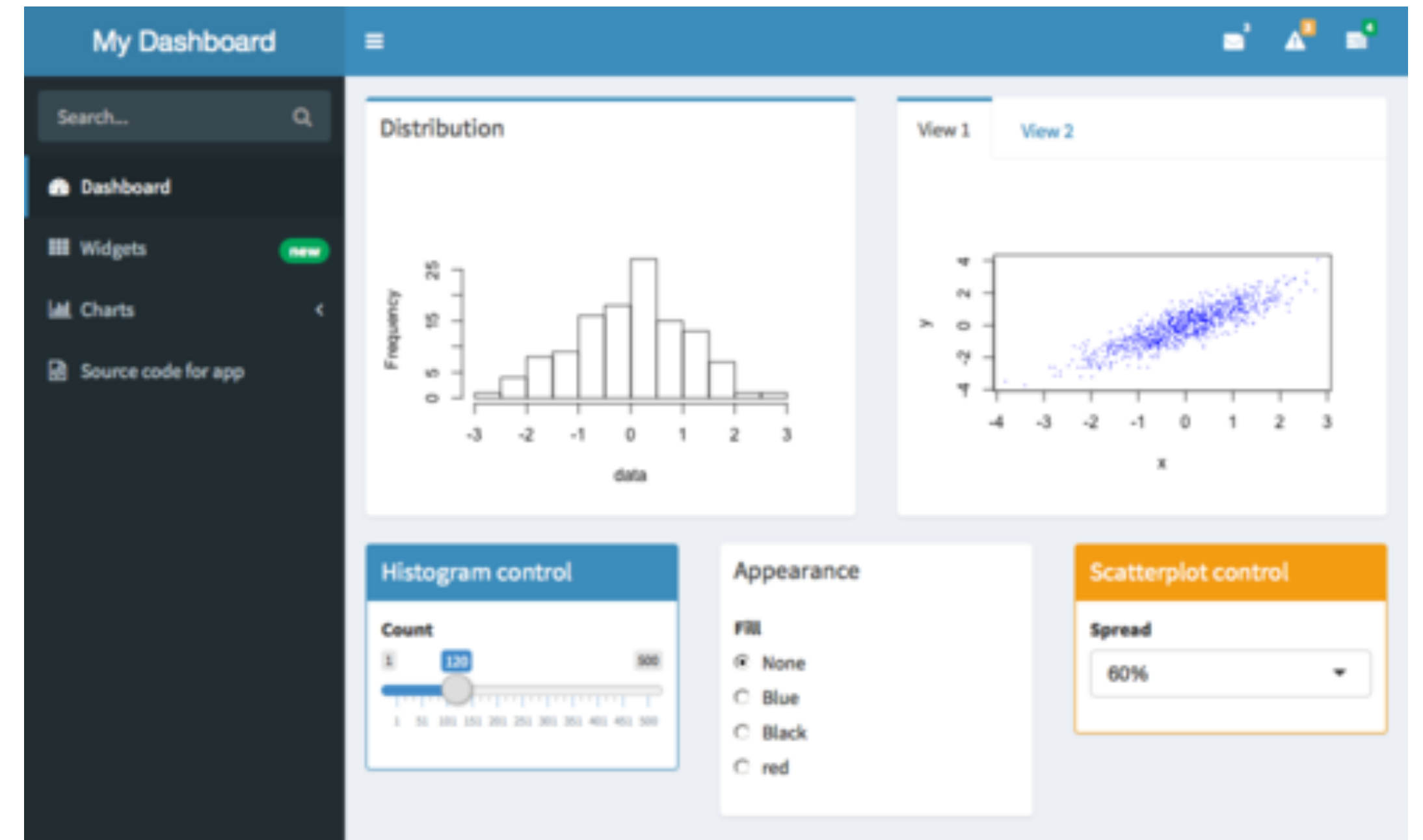
`ui_02.R`

# Using external packages



# EXTERNAL PACKAGES

## ► shinydashboard



# EXTERNAL PACKAGES

- ▶ shinydashboard
- ▶ shinythemes

The image displays a collage of Shiny dashboard examples created using external packages like `shinydashboard` and `shinythemes`. The examples are arranged in a layered, overlapping fashion, showcasing different themes and UI components.

**Themes shown:**

- Darkly:** A dark-themed dashboard with a sidebar and main content area.
- United:** A dashboard with a prominent orange header bar.
- Flatly:** A clean, light-themed dashboard.
- Navbar 1:** A dashboard with a dark blue header bar.
- Plot:** A dashboard with a dark blue header bar.
- Table:** A dashboard with a dark blue header bar.

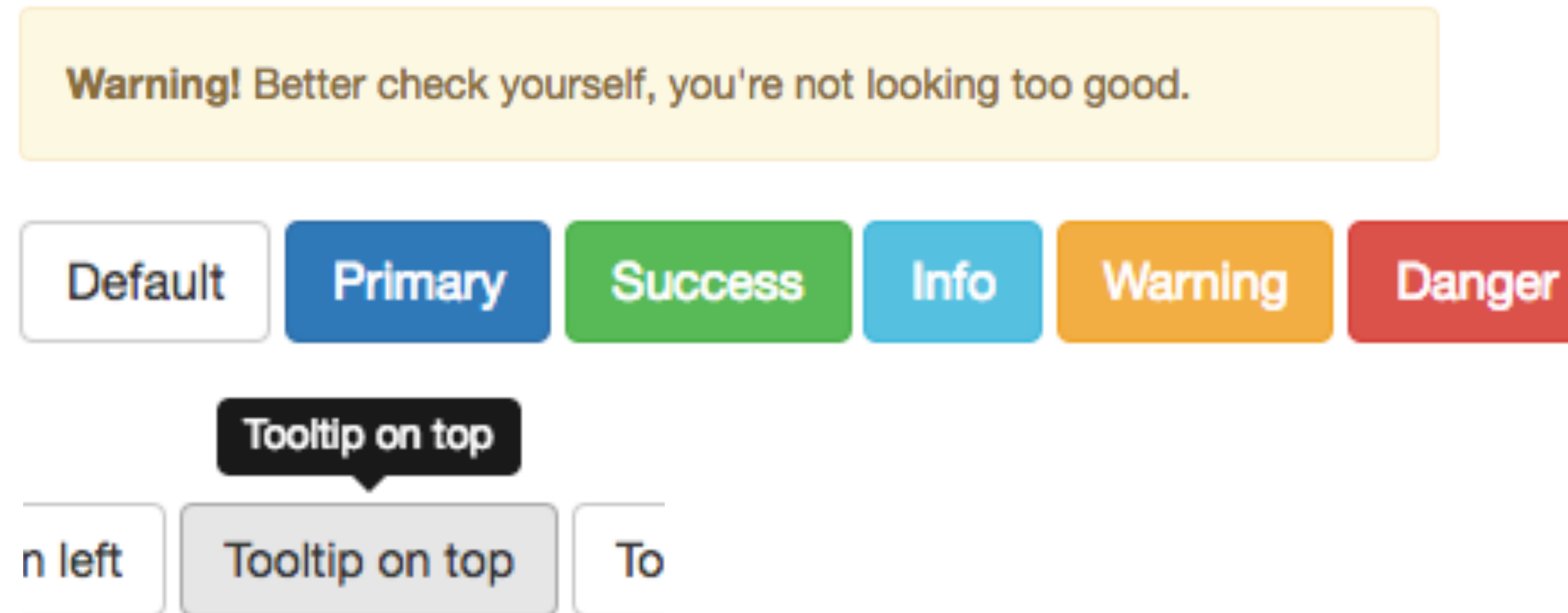
**UI Components shown:**

- File input:** A file input field with a "Browse..." button.
- Text input:** A text input field with the value "general".
- Slider input:** A slider input field with a range from 1 to 100 and a current value of 30.
- Default action button:** A button labeled "Search".
- ActionButton with CSS class:** A button labeled "Action button".
- Table:** A table with columns "speed" and "dist".

speed	dist
4.00	2.00
4.00	10.00
7.00	4.00
7.00	22.00
- Verbatim text output:** A text output field displaying "general, 30, NULL".
- Header 1, Header 2, Header 3, Header 4, Header 5:** Various header elements used for layout organization.

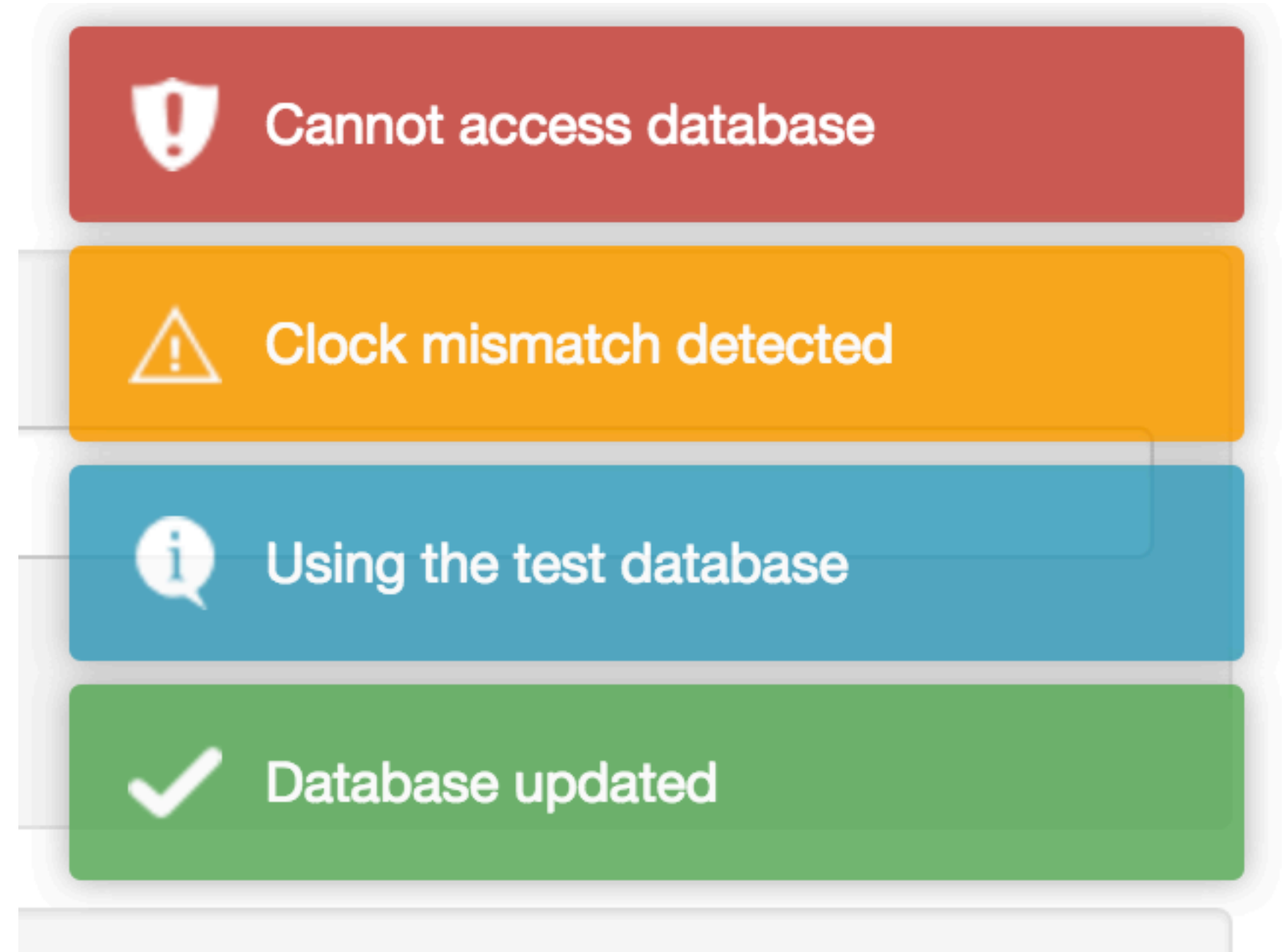
# EXTERNAL PACKAGES

- ▶ shinydashboard
- ▶ shinythemes
- ▶ shinyBS (@ebailey78)



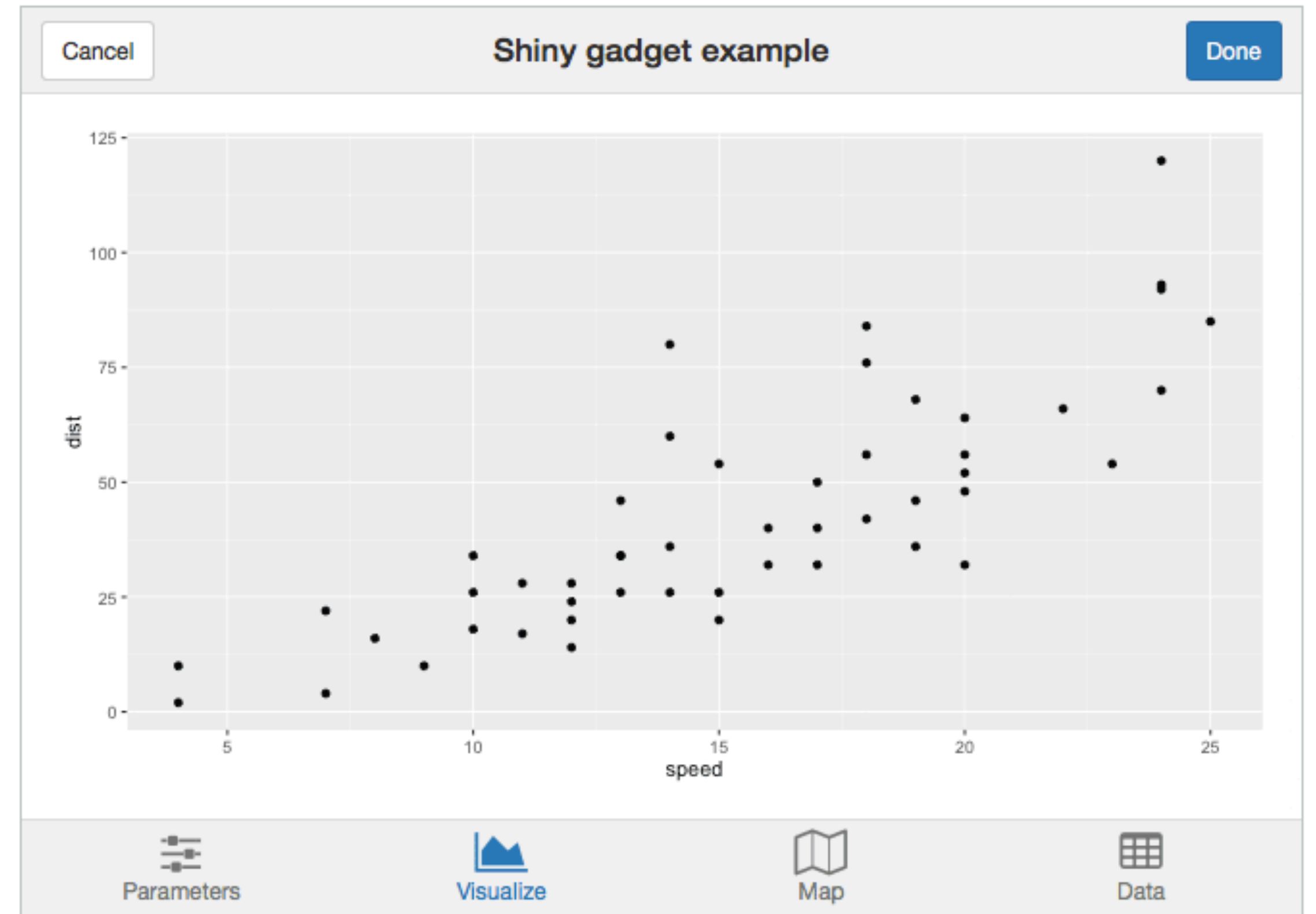
# EXTERNAL PACKAGES

- ▶ shinydashboard
- ▶ shinythemes
- ▶ shinyBS (@ebailey78)
- ▶ shinytoastr (@gaborcsardi)



# EXTERNAL PACKAGES

- ▶ shinydashboard
- ▶ shinythemes
- ▶ shinyBS (@ebailey78)
- ▶ shinytoastr (@gaborcsardi)
- ▶ miniUI (for mobile devices or Shiny Gadgets)



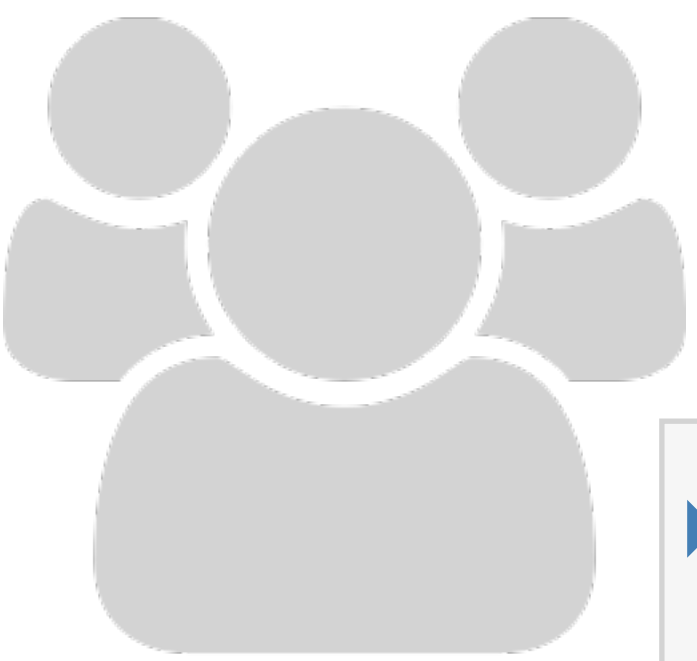


# EXTERNAL PACKAGES

- ▶ shinyjs (@daattali)
  - ▶ Perform many UI-related JavaScript operations from R

Function	Description
<code>show / hide / toggle</code>	Display or hide an element (optionally with an animation).
<code>hidden</code>	Initialize a Shiny tag as invisible (can be shown later).
<code>enable / disable / toggleState</code>	Enable or disable an input element, such as a button or text input.
<code>disabled</code>	Initialize a Shiny input as disabled.
<code>reset</code>	Reset a Shiny input widget back to its original state.
<code>delay</code>	Execute R code (including any <code>shinyjs</code> functions) after a specified amount of time.
<code>alert</code>	Show a message to the user.
<code>html</code>	Change the text/HTML of an element.
<code>onclick</code>	Run R code when a specific element is clicked, with the sole purpose of running a <code>shinyjs</code> function. The function must be named <code>onclick</code> , though any R code can be used.
<code>onevent</code>	Similar to <code>onclick</code> , but can be used with many events (for example, listen for a key press, mouse hover, etc.).
<code>addClass / removeClass / toggleClass</code>	add or remove a CSS class from an element.
<code>runjs</code>	Run arbitrary JavaScript code.
<code>extendShinyjs</code>	Allows you to write your own JavaScript functions and use them as if they were regular R code. More info: <a href="#">shinyjs::extendShinyjs</a>


# EXERCISE



- ▶ Modify **movies\_12.R** to use a Bootstrap theme
  - ▶ Use the "Live theme selector" feature in shinythemes in your own app
  - ▶ Once you've decided on a theme, remove the theme selector and apply your chosen theme permanently
- ▶ See shinythemes instructions at:  
<https://rstudio.github.io/shinythemes/>

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# SOLUTION



```
# Use theme selector
ui <- fluidPage(
  shinythemes::themeSelector(),
  ...

# Apply theme
ui <- fluidPage(
  theme = shinythemes::shinytheme("united"),
  ...
```

**Using htmltools**  
**tag objects**

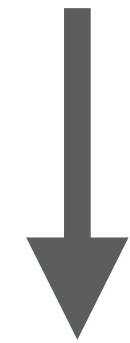
# AN API FOR COMPOSING HTML

- ▶ When Shiny was born, it came with a sub-package for composing HTML
- ▶ These functions were so useful, we extracted them out into a separate package: `htmltools`
- ▶ Now used by R Markdown and `htmlwidgets` as well



# HTML BASICS

```
<a href="https://www.rstudio.com">RStudio</a>
```



RStudio

# HTML BASICS

```
<a href="https://www.rstudio.com">RStudio</a>
```

End tag

Start tag

Child content

# ANATOMY OF A TAG

Attribute name

```
<a href="https://www.rstudio.com">RStudio</a>
```

Tag name

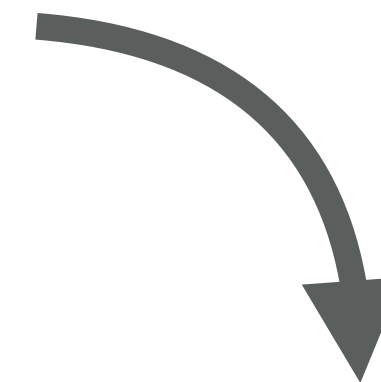
Attribute value

Creates an **anchor** whose  
**hyperlink reference** is the URL  
`https://www.rstudio.com`

# ANATOMY OF A TAG

- ▶ Text can contain tags
- ▶ Tags can optionally contain text and/or other tags
- ▶ Each start tag can have zero or more attributes

```
<div class="panel panel-default">
  <div class="panel-heading">
    <h3 class="panel-title">Panel title</h3>
  </div>
  <div class="panel-body">
    Panel content
  </div>
</div>
```



**Panel title**

Panel content

# LOOKS LIKE R, MEANS HTML

```
<div class="panel panel-default">  
  <div class="panel-heading">  
    <h3 class="panel-title">  
      Panel title  
    </h3>  
  </div>  
  <div class="panel-body">  
    Panel content  
  </div>  
</div>
```

```
div(class="panel panel-default",  
  div(class="panel-heading",  
    h3(class="panel-title",  
      "Panel title",  
    )  
  ),  
  div(class="panel-body",  
    "Panel content"  
  )  
)
```

# USING TAG FUNCTIONS

- ▶ Many common tags are exported as functions by `htmltools` and `shiny` (`p`, `h1-h6`, `a`, `br`, `div`, `span`, `img`)
- ▶ All other tags can be accessed via the **tags** object. E.g., `<li>Item 1</li>` → `tags$li("Item 1")`
- ▶ If you have lots of HTML to write, you can use the **withTags** function—it makes the **tags\$** prefix optional.

```
withTags(  
  ul(  
    li("Item 1"), li("Item 2")  
  )  
)
```



# USING TAG FUNCTIONS

- ▶ All tag functions behave the same way
  - ▶ Call the function to create a tag object
  - ▶ *Named* arguments become attributes
  - ▶ *Unnamed* arguments become children

# Demo

# TAG ATTRIBUTES

- ▶ Any valid HTML attribute name can be used (use quotes if the name has dashes, e.g. **"data-toggle"="dropdown"**)
- ▶ Valid tag attribute values are:
  - ▶ **NULL** (omit the attribute)
  - ▶ **NA** (the attribute should be included with no value)
  - ▶ Single-element character vector (or something to be coerced to character)

```
tags$input(type = "checkbox",  
  disabled = if (disabled) NA # else NULL  
)
```

# TAG CHILDREN

- ▶ Valid tag children are:
  - ▶ Tag objects
  - ▶ Single-element character vectors (treated as text)
  - ▶ **NULL** (silently ignored)
  - ▶ Raw HTML (see **?htmltools::HTML**)
  - ▶ Lists of valid tag children (recursive!)

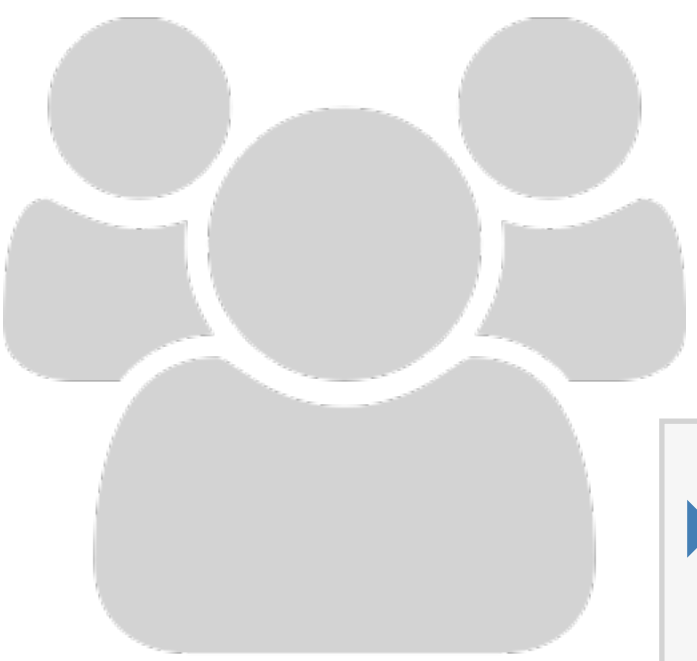
# USING TAGS

- ▶ Tags are made using normal R functions that take normal parameters and return normal values! You can do R-like things to them:

```
tags$ul(lapply(1:10, tags$li))
```

- ▶ Print tag objects at the console to see their HTML source
  - ▶ Call **print(x, browse = TRUE)** to see their rendered view instead
  - ▶ Use **htmltools::browsable()** to make an object show its rendered view when printed, by default
  - ▶ If your top-level object is a list, you'll need to wrap in **tagList(...)** to get the right behavior at the console (or in an R Markdown doc)

# EXERCISE



- ▶ Open `ui_03.R`.
- ▶ Replace `includeHTML("youtube_thumbnail.html")` with the equivalent `htmltools` tag objects.
- ▶ If you get that working, take the next step and define an R function that takes a YouTube URL, a title, and a description, and returns a thumbnail frame like the one you created.

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# SOLUTION



Open `ui_04.R` and `ui_05.R`.

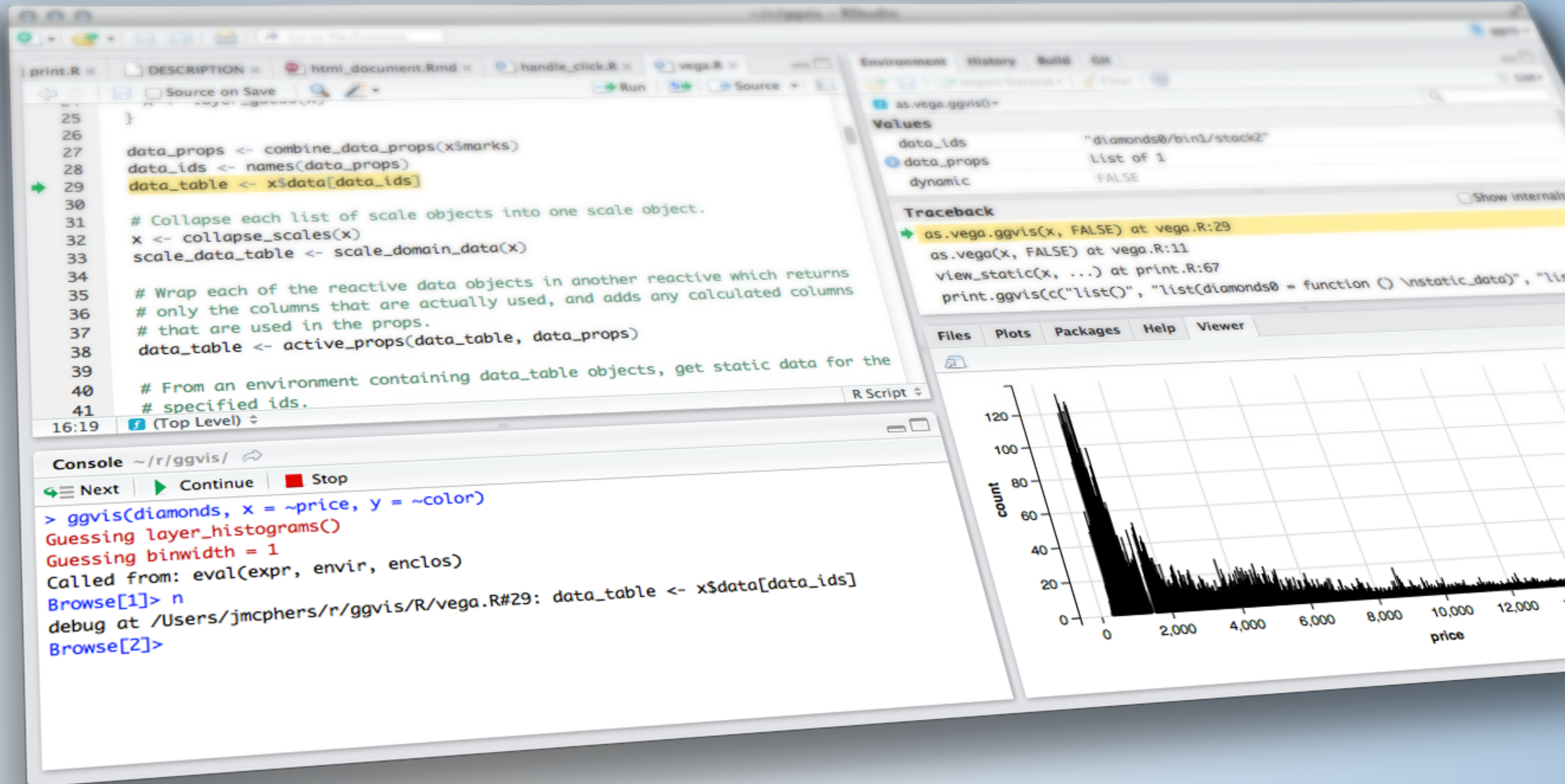


**Using**

**raw HTML**

# USING RAW HTML

- ▶ Incorporate tiny amounts of HTML using inline string literals wrapped in `HTML()`
  - ▶ `div(HTML("This is <strong>HTML</strong>"))`
- ▶ For chunks of HTML, use `includeHTML` (or similar `includeCSS`, `includeScript`)
  - ▶ `div(includeHTML("file.html"))`
- ▶ Or go the other way, with the HTML Templates feature: start with HTML, and embed R expressions that yield tag objects



# UNDERSTANDING UI

## TO SHINY

Shiny from  Studio™