Shiny Demonstration

West of Ireland Data Science

26th February 2015

shiny.rstudio.com

RStudio

- Makers of Shiny : RStudio (JJ Allaire, Hadley Wickham etc etc)
- RStudio? IDE for R. See `www.rstudio.org` for more.
- Shiny's Lead Developers : Winston Chang and Joe Cheng.

Overview of Demonstration

Overview of Demonstration

- Resources (i.e. Shiny Tutorial Page)
- Minimal Examples
- Widgets
- A bit about JavaScript
- Special Design Considerations
- Deploying Shiny

What is Shiny?

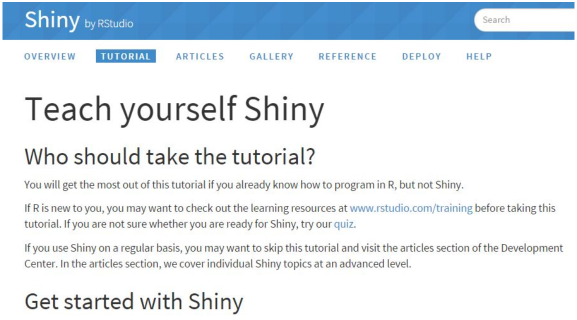
Easy web applications in R
(Source: Shiny's Website)

- **Shiny** makes it super simple for R users like you to turn analyses into interactive web applications that anyone can use.
- Let your users choose input parameters using friendly controls like sliders, drop-downs, and text fields.
- Easily incorporate any number of outputs like plots, tables, and summaries.

What is Shiny?

Easy web applications in R (contd.)
(Source: Shiny's Website)

- No **HTML** or **JavaScript** knowledge is necessary. If you have some experience with R, youre just minutes away from combining the statistical power of R with the simplicity of a web page.
- *(Remark: They do appear to be really handy - based on several examples available on the internet!)*



Teach yourself Shiny

Who should take the tutorial?

You will get the most out of this tutorial if you already know how to program in R, but not Shiny.

If R is new to you, you may want to check out the learning resources at www.rstudio.com/training before taking this tutorial. If you are not sure whether you are ready for Shiny, try our quiz.

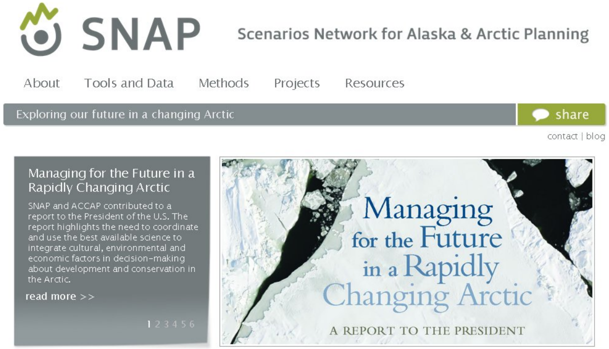
If you use Shiny on a regular basis, you may want to skip this tutorial and visit the articles section of the Development Center. In the articles section, we cover individual Shiny topics at an advanced level.

Get started with Shiny

Shiny Resources

Resources

- Shiny Tutorial - (`shiny.rstudio.com/tutorial/`)
- Chris Beeley's Book (Sample Chapter Available)
- Stack-Overflow and GitHub


SNAP Scenarios Network for Alaska & Arctic Planning

About Tools and Data Methods Projects Resources

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Managing for the Future in a Rapidly Changing Arctic

SNAP and ACCAP contributed to a report to the President of the U.S. The report highlights the need to coordinate and use the best available science to integrate cultural, environmental and economic factors in decision-making about development and conservation in the Arctic.

read more >>

1 2 3 4 5 6

Managing for the Future in a Rapidly Changing Arctic
A REPORT TO THE PRESIDENT

Matthew Leonawicz (SNAP - Uni. Alaska Fairbanks)

github.com/ua-snap/shiny-apps

twitter.com/leonawicz

github
SOCIAL CODING

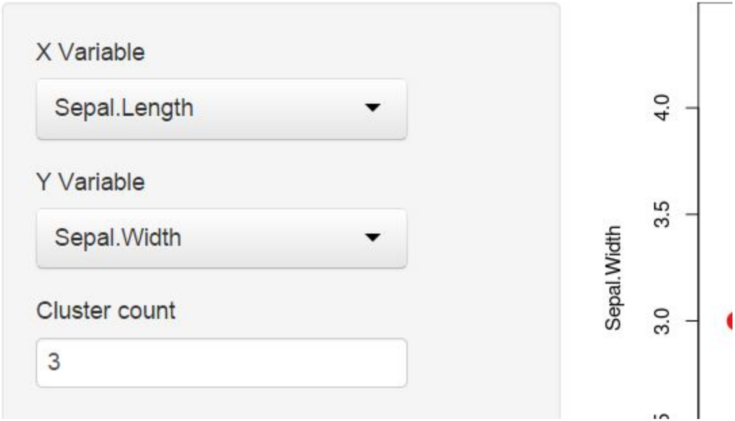
github - code sharing

Components of Shiny

Main Components of a Shiny Web App

- The shiny app is structurally a folder. The name of the app is the name of the folder.
- Shiny programs are the easiest to build and understand using two scripts, which are kept within this folder. They must be named `server.R` and `ui.R`.
- The input elements are defined in `ui.R` and processed by `server.R`, which then sends them back to `ui.R`
- Consideration: **Reactive Programming**

Iris k-means clustering



X Variable

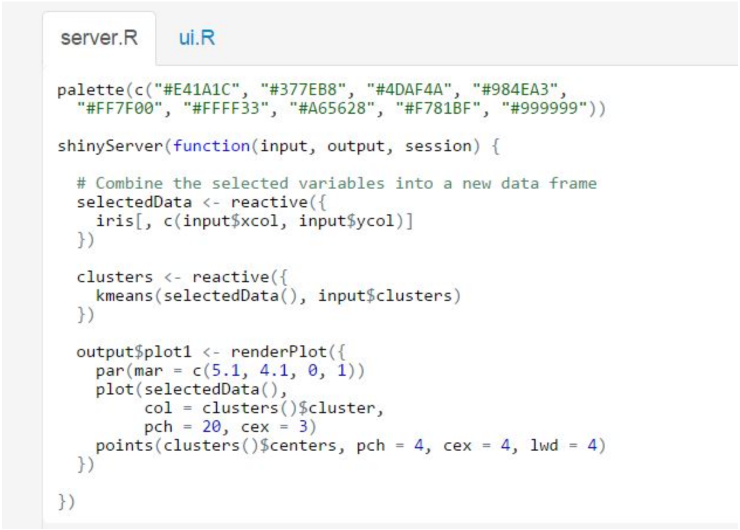
Sepal.Length

Y Variable

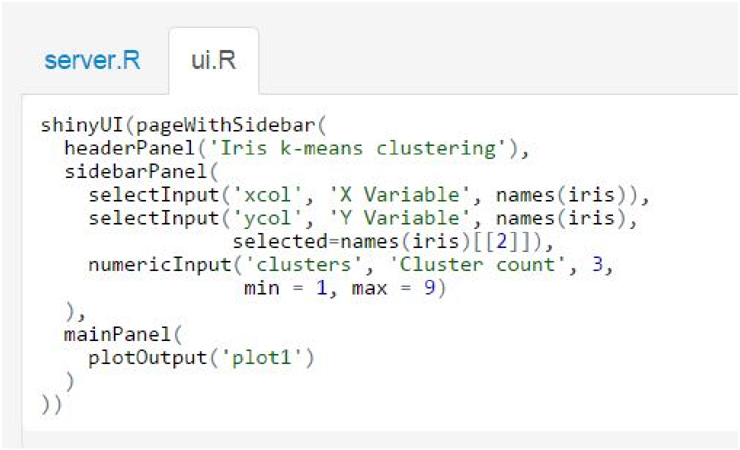
Sepal.Width

Cluster count

3

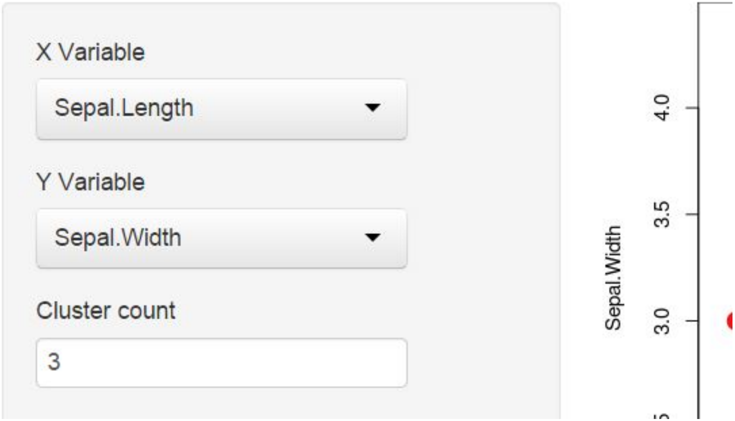


```r
palette(c("#E41A1C", "#377EB8", "#4DAF4A", "#984EA3",
  "#FF7F00", "#FFFF33", "#A65628", "#F781BF", "#999999"))

shinyServer(function(input, output, session) {

  # Combine the selected variables into a new data frame
  selectedData <- reactive({
    iris[, c(input$xcol, input$ycol)]
  })

  clusters <- reactive({
    kmeans(selectedData(), input$clusters)
  })

  output$plot1 <- renderPlot({
    par(mar = c(5.1, 4.1, 0, 1))
    plot(selectedData(),
         col = clusters()$cluster,
         pch = 20, cex = 3)
    points(clusters()$centers, pch = 4, cex = 4, lwd = 4)
  })

})
```



```
shinyUI(pageWithSidebar(
  headerPanel('Iris k-means clustering'),
  sidebarPanel(
    selectInput('xcol', 'X Variable', names(iris)),
    selectInput('ycol', 'Y Variable', names(iris),
                selected=names(iris)[[2]]),
    numericInput('clusters', 'Cluster count', 3,
                 min = 1, max = 9)
  ),
  mainPanel(
    plotOutput('plot1')
  )
))
```

Iris k-means clustering



X Variable

Sepal.Length

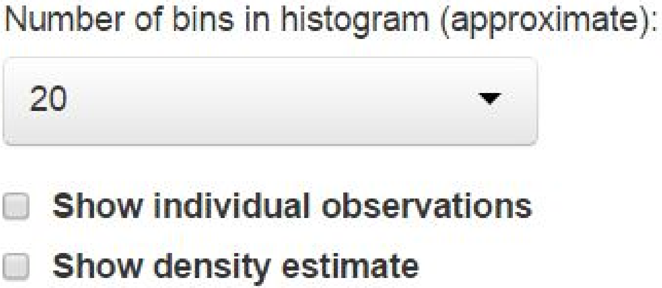
Y Variable

Sepal.Width

Cluster count

3

Figure:

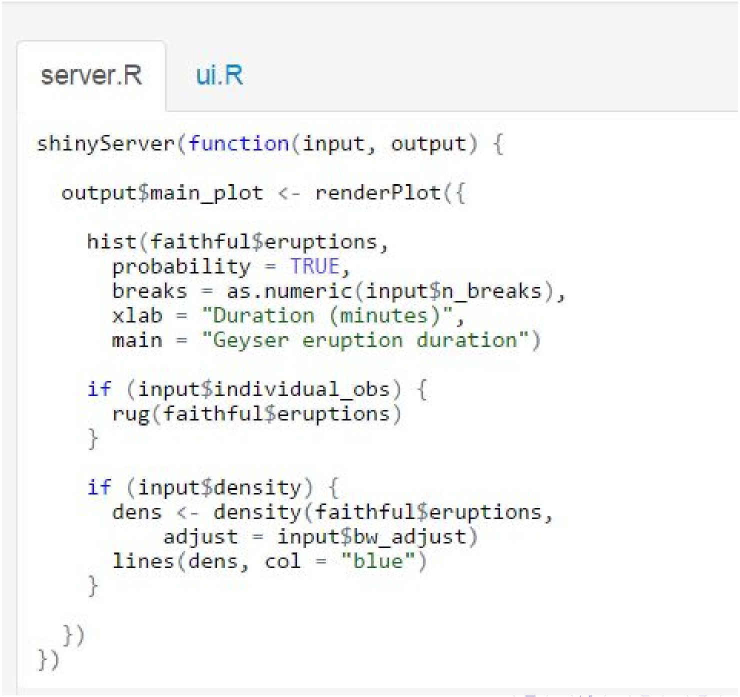


Number of bins in histogram (approximate):

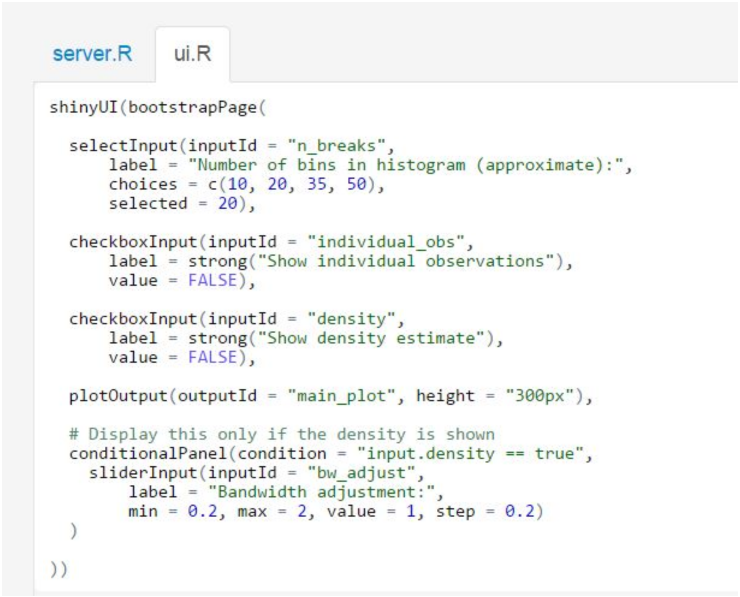
20

☐ Show individual observations

☐ Show density estimate


server.R ui.R

```
shinyServer(function(input, output) {

  output$main_plot <- renderPlot({

    hist(faithful$eruptions,
      probability = TRUE,
      breaks = as.numeric(input$n_breaks),
      xlab = "Duration (minutes)",
      main = "Geyser eruption duration")

    if (input$individual_obs) {
      rug(faithful$eruptions)
    }

    if (input$density) {
      dens <- density(faithful$eruptions,
          adjust = input$bw_adjust)
      lines(dens, col = "blue")
    }

  })
})
```



```r
shinyUI(bootstrapPage(

  selectInput(inputId = "n_breaks",
      label = "Number of bins in histogram (approximate):",
      choices = c(10, 20, 35, 50),
      selected = 20),

  checkboxInput(inputId = "individual_obs",
      label = strong("Show individual observations"),
      value = FALSE),

  checkboxInput(inputId = "density",
      label = strong("Show density estimate"),
      value = FALSE),

  plotOutput(outputId = "main_plot", height = "300px"),

  # Display this only if the density is shown
  conditionalPanel(condition = "input.density == true",
    sliderInput(inputId = "bw_adjust",
        label = "Bandwidth adjustment:",
        min = 0.2, max = 2, value = 1, step = 0.2)
  )

))
```

Reactive Programming

Simple R example re: reactivity

```
> A <- 5
> B <- A + 3
> A <-6          #Update A
>
> c(A,B,A+3)
[1] 6 8 9
>
```

Comapre this with Microsoft Excel Spreadsheets

Shiny Basics

Basic structure of a Shiny program

- Selection of simple input widgets (checkboxes and radio buttons)
- Selection of simple output types (rendering plots and returning text)
- Selection of simple layout types (page with sidebar and tabbed output panel)
- Handling reactivity in Shiny

Running a Shiny App

To run a Shiny program on your local machine you just need to do the following:

1. Make sure that `server.R` and `ui.R` are in the application subfolder (`appName`).
2. Make the main folder `R`'s working directory (using the `setwd()` command, for example `setwd(" /shinyFiles")`).

   `>...\shinyFiles\appName`
3. Load the Shiny package (`library(shiny)`). You should always do that in both `server.R` and `ui.R` files.

runApp

- Type `runApp("appName")` at the console.
- If you are in the application folder, just type `runApp()`
- **Important** - Just remember that it is a directory and not a file that you need to point to.

ui.R

User Inferface

- The `ui.R` file is a description of the UI and is often the shortest and simplest part of a Shiny application.
- All of the UI elements are defined within this instruction.
- The standard shiny layout is a three panel layout, with a header panel, a sidepanel controls on the left, and the main panel on the right - with the output.
- This layout is called **pageWithSidebar**. There are other layouts too - such as **basicPage** and **threePage**.

Inputs

The arguments are pretty typical among most of the widgets and are as follows:

- inputId : This argument names the variable so it can be referred to in the `server.R` file
- label : This argument gives a label to attach to the input so users know what it does
- value : This argument gives the initial value to the widget when it is set up.
  All the widgets should have sensible defaults for this argument.

Main Panel

- The final function is `mainPanel()`, which sets up the output window.
- HTML helper functions - make a little title `h3("...")`. Knowledge of HTML is very useful!
- There are several of these functions designed to generate HTML to go straight on the page; e.g. type `?p` at the console for the complete list.

Main Panel

- The other element that goes in `mainPanel()` is an area for handling reactive text or plots generated within the `server.R` file
- For example - a call to `textOutput()` with the name of the output as defined in `server.R`, in the upcoming "minimal case" examples.

Layout of a Shiny Web Application

`fluidPage` - **updated**

- To create a display with a fluid, unbroken layout, Shiny `ui.R` scripts need the function `fluidPage`. Shiny knows where to put your apps elements when it reads them in the `fluidPage` function.
- The following `ui.R` script creates a user-interface that has a title panel, a sidebar panel, and a main panel.
- Note that these elements are placed within the `fluidPage()` function.

Layout of a Shiny Web Application

```
# ui.R

shinyUI(fluidPage(
titlePanel("title panel"),

sidebarLayout(
sidebarPanel( "sidebar panel"),
mainPanel("main panel")
)
))
```

Layout of a Shiny Web Application

- `titlePanel` and `sidebarLayout` are the two most popular elements to add to `fluidPage`. They create a basic Shiny app with a sidebar.
  - `sidebarLayout` always takes two arguments:
  - `sidebarPanel` function output
  - `mainPanel` function output
- These functions place content in either the sidebar or the main panels.
- By default the sidebar appears on the left side of your apps display. To move the sidebar to the right, in `sidebarLayout` set position to right.

Layout of a Shiny Web Application

```
# ui.R

shinyUI(fluidPage(
titlePanel("title panel"),

sidebarLayout(position = "right",   #<- HERE
sidebarPanel( "sidebar panel"),
mainPanel("main panel")
)
))
```

server.R

- `shinyServer(......)` defines the bit of Shiny that's going to handle all the data.
- On the whole, two types of things go in here.
- **Reactive objects** (for example, data) are defined, which are then passed around as needed (for example, to different output instructions),
- Outputs are defined, such as graphs.

Shiny - Special Topics

- Conditional Panels - Outside Document
- Formatted Text - Outside Document
- HTML - Outside Document
- MathsJax

Sliders Widgets and Tabs

Customizing Sliders

- Shiny slider controls are extremely capable and customizable.
- Features supported include:
  - The ability to input both single values and ranges
  - Custom formats for value display (e.g for currency)
  - The ability to animate the slider across a range of values
- Slider controls are created by calling the sliderInput function.

Widgets

Worked Example - ex10

```
sidebarPanel(
selectInput("dataset", "Choose a dataset:",
choices = c("rock", "pressure", "cars")),

numericInput("obs", "Number of observations to view:", 10)

helpText("Note: while the data view will show only the spec
"number of observations, the summary will still be based",
"on the full dataset."),

submitButton("Update View")
)
```

Tab Panels

- Tabsets are created by calling the `tabsetPanel` function with a list of tabs created by the `tabPanel` function.
- Each tab panel is provided a list of output elements which are rendered vertically within the tab.
- In this example we updated our Hello Shiny application to add a summary and table view of the data, each rendered on their own tab.

Widgets

Worked Example - ex11

```
mainPanel(
tabsetPanel(
tabPanel("Plot", plotOutput("plot")),
tabPanel("Summary", verbatimTextOutput("summary")),
tabPanel("Table", tableOutput("table"))
)
)
```

Deploying Shiny apps

- The Shiny package itself is designed to run Shiny applications locally.
- To share Shiny applications with other R users, you can send them your application source as a GitHub gist, R package, or zip file.

Deploying Shiny

Sharing Apps to Run Locally

- Once youve written your Shiny app, you can distribute it for others to run on their own computersthey can download and run Shiny apps with a single R command. All that this requires that they have R and Shiny installed on their computers.
- If you want your Shiny app to be accessible over the web, so that users only need a web browser, see Deploying Shiny Apps over the Web.

Deploying Shiny

Gist

- One easy way is to put your code on gist.github.com, a code pasteboard service from **GitHub**.
- Both `server.R` and `ui.R` must be included in the same gist, and you must use their proper filenames.
- See *http://gist.github.com/3239667* for an example.

- Your recipient must have R and the Shiny package installed, and then running the app is as easy as entering the following command:

```
shiny::runGist('3239667')
```

- In place of '**3239667**' you will use your gists ID; or, you can use the entire URL of the gist (e.g. '*https://gist.github.com/3239667*').

Deploying Shiny

Advantages of using Gist

- Source code is easily visible by recipient (if desired)
- Easy to run (for `R` users)
- Easy to post and update

Cons

- Code is published to a third-party server

GitHub repository

- If your project is stored in a git repository on GitHub, then others can download and run your app directly. An example repository is at **http://github.com/rstudio**
- The following command will download and run the application:

```
shiny::runGitHub('shiny_example', 'rstudio')
```

In this example, the GitHub account is 'rstudio' and the repository is 'shiny example'; you will need to replace them with your account and repository name.

Github: Advantages

- Source code is easily visible by recipient (if desired)
- Easy to run (for R users)
- Very easy to update if you already use GitHub for your project
- Git-savvy users can clone and fork your repository

Disadvantages

- Developer must know how to use git and GitHub.
- Code is hosted by a third-party server.

Deploying Shiny

Making it into a Package

- If your Shiny app is useful to a broader audience, it might be worth the effort to turn it into an `R` package. Put your Shiny application directory under the packages inst directory, then create and export a function that contains something like this:

```
shiny::runApp(system.file('appdir',
package='packagename'))
```

where `appdir` is the name of your apps subdirectory in inst, and **packagename** is the name of your package.

Deploying Shiny

Making it into a Package:

Advantages

- Publishable on CRAN
- Easy to run (for `R` users)

Disadvantages

- More work to set up
- Source code is visible by recipient (if not desired)

Deploying Shiny apps

Deployment over the Web

- You can also deploy Shiny applications over the web, so that users need only a web browser and your applications URL.
- For this, youll need a Linux server and our Shiny Server software.
- Shiny Server is free and open source, though in the future RStudio will offer a commercially licensed edition with additional features for larger organizations.
- RStudio also working on a subscription-based hosting service for Shiny.

Deploying Shiny apps : Shiny Server

Shiny Server

- Shiny Server is if you want to use your own server instead of hosting it on Rstudio's server (i.e. **glimmer**).
- This is really important for those who can't let their code or data out of their organization, or want more computational/storage resources than glimmer can offer, or need their apps to access their internal network.