BUILDING INTERACTIVE, R-POWERED WEB APPLICATIONS WITH SHINY

2/9/2013  Jeff Allen, Dallas R Users Group
About Me

- MS Computer Science, SMU

By day…
- Computational Biologist at UT Southwestern
  - Use R to analyze biomedical data
  - Develop Java-based web application

By night…
- Freelance consultant as Trestle Technology
  - Web development
  - Data analysis
  - IT consulting
Overview

- Motivation
- Shiny
- Reactive Programming
- Code Walkthroughs
  - Simple histogram
  - Advanced histogram
  - Reactive histogram
  - Custom outputs
- Hosting
Motivation

“R is great!”

“The Internet is great!”
Motivation

- Want to get R into web browsers
- Previous approaches
  - rApache
  - Rserve (Java, C++, C#, Python, Ruby, .NET)
  - deployR
  - Custom hacks
- Just make R accessible to server-side programming languages (PHP, Ruby, Java, etc.)
Shiny

- Open-Sourced by RStudio 11/2012 on CRAN
- New model for web-accessible R code
- Able to generate basic web UIs
- Uses web sockets
  - “The new HTTP”
- Built on a “Reactive Programming” model
- Entirely extensible
  - Custom inputs and outputs
Reactive Programming

\( a \leftarrow 3 \)
\( b \leftarrow a + 2 \)
\( a \leftarrow 7 \)
\( b \equiv ? \)

Imperative: \( b = 5 \)
Reactive: \( b = 9 \)
Reactive Programming Example

<table>
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<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</tbody>
</table>
Basic Shiny Example

Basic Shiny UI and Server

http://trestletechnology.net:3838/simpleGeyeser/

https://github.com/trestletech/shiny-sandbox/tree/master/simpleGeyeser
ui.R

shinyUI(

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

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

)
ui.R

shinyUI(bootstrapPage(


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

  plotOutput(outputId = "main_plot", height = "300px")
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```
ui.R

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               choices = c(10, 20, 35, 50),
               selected = 20),

  plotOutput(outputId = "main_plot", height = "300px")
))
server.R

shinyServer(

)
shinyServer(function(input, output) {
  output$main_plot <- reactivePlot(
    function()
      hist(faithful$eruptions,
        probability = TRUE,
        breaks = as.numeric(input$n_breaks),
        xlab = "Duration (minutes)",
        main = "Geyser eruption duration")
  )
})
```r
shinyServer(function(input, output) {
  output$main_plot <- reactivePlot(
    function(){
      hist(faithful$eruptions,
        probability = TRUE,
        breaks = as.numeric(input$n_breaks),
        xlab = "Duration (minutes)",
        main = "Geyser eruption duration")
  }
})
})
```
server.R

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        probability = TRUE,
        breaks = as.numeric(input$n_breaks),
        xlab = "Duration (minutes)",
        main = "Geyser eruption duration")
    })
})
Dependency Graph – Simple

- shinyServer
  - `main_plot`
    - `$n_breaks`

Key:
- Reactive Function
- Input
Intermediate Shiny Example

Additional UI Features

http://trestletechnology.net:3838/naiveGeyeser/
https://github.com/trestletech/shiny-sandbox/tree/master/naiveGeyeser/
Dependency Graph – Naïve

shinyServer

main_plot
(Get data, get name, plot)

$dataset

$n_breaks

$individual_obs

$bw_adjust

$density

Key
Reactive Function
Input

(1) Reactive Function
Input

(2) $dataset

(3) $n_breaks

(4) $individual_obs

(5) $bw_adjust

(6) $density

(7) main_plot

(8) shinyServer
"Data Flow"—Naïve

shinyServer

main_plot
(Get data, get name, plot)

utoset

$n\_breaks$

$individual\_obs$

$bw\_adjust$

$density$

Key

Reactive Function

Input
Reactive Shiny Example

Optimized Reactive Server

http://trestletechnology.net:3838/reactiveGeyeser/
https://github.com/trestletech/shiny-sandbox/tree/master/reactiveGeyeser/
Dependency Graph – Reactive

shinyServer

main_plot

$dataset

dataName

getData

$n_breaks

$individual_obs

$bw_adjust

$density

Key

Reactive Function

Input
“Data Flow” – Reactive

Key
- Reactive Function
- Input

Diagram:
- shinyServer
- getData
- dataName
- $dataset

Variables:
- $n_breaks
- $bw_adjust
- $individual_obs
- $density
- main_plot

Function:
- getData
D3.JS Shiny Example

http://trestletechnology.net:3838/grn/
https://github.com/trestletech/shiny-sandbox/tree/master/grn
RGL Shiny Example

http://trestletechnology.net:3838/rgl/
https://github.com/trestletech/shiny-sandbox/tree/master/rgl
Hosting

- RStudio offers “Glimmer”
  - Free (for now) managed hosting platform for Shiny
- RStudio’s Shiny-Server
  - Open sourced 1/22/2013
  - Written in Node.js
  - Same software that powers Glimmer
  - “Some assembly required”
  - Hacks to support older IEs
- Amazon Machine Image on EC2
Questions?

- Code at
  - [http://github.com/trestletech/shiny-sandbox](http://github.com/trestletech/shiny-sandbox)

- Slides at
  - [http://trestletechnology.net/blog/](http://trestletechnology.net/blog/)

Find me on: