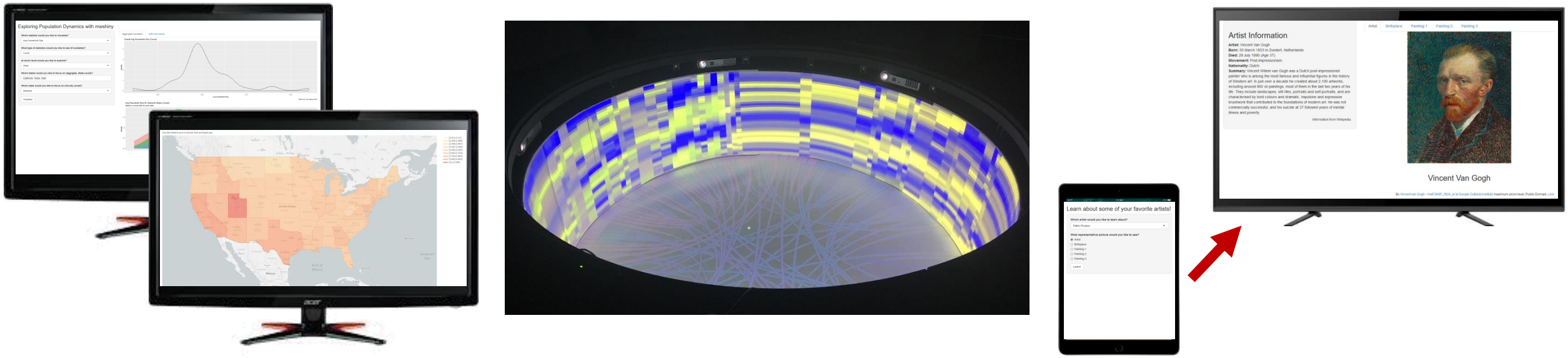


mwshiny: Connecting Shiny Across Multiple Windows

By **Hannah De los Santos**, John Erickson, Kristin P. Bennett

Rensselaer Polytechnic Institute

What is Shiny?

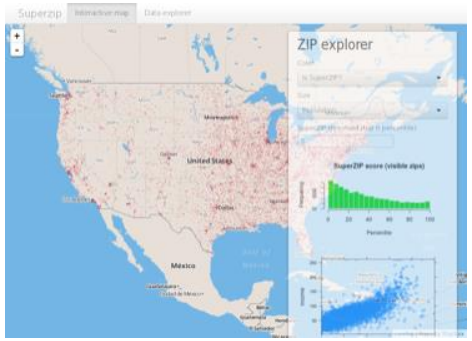
- Shiny lets users develop interactive web applications (apps) with only R

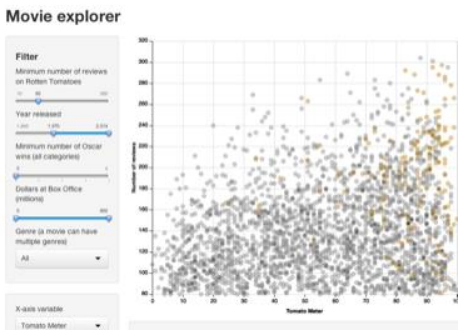
app.R

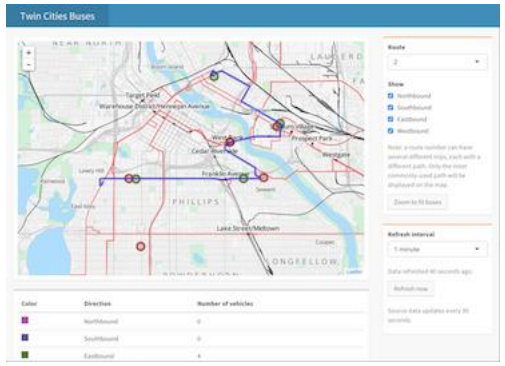
ui

server(input, output, session)

shinyApp(ui, server)



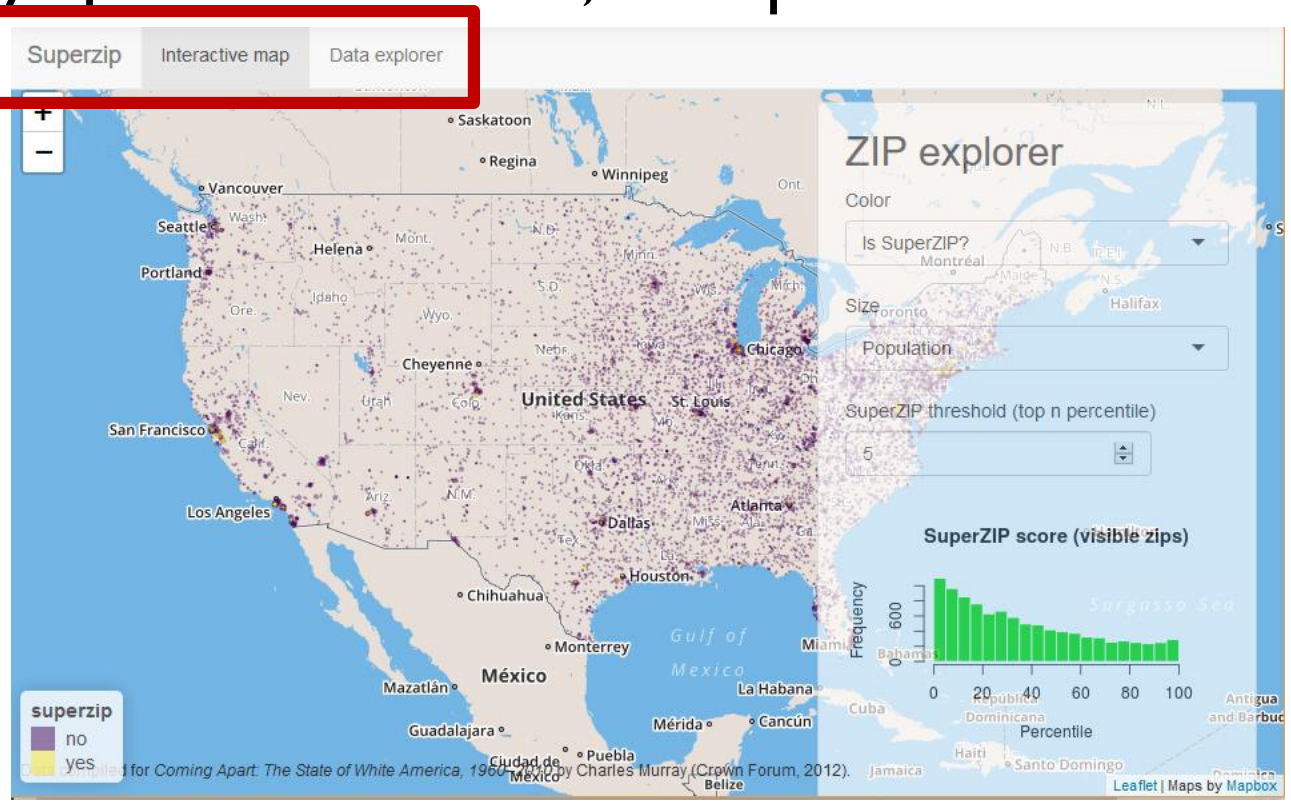




- Examples from RStudio Shiny Gallery: https://shiny.rstudio.com/gallery/

A Problem: Shiny apps have only one window!

- Shiny apps only span one window, and space is limited



- You can alleviate this problem by adding separate tabs, but it's difficult to compare outputs

Examples from RStudio Shiny Gallery: https://shiny.rstudio.com/gallery/

We Live In a Multi-Monitor World

Multiple Monitors at a Workstation

Controller Driving External Monitor

mwshiny: Multi-Window Shiny

- mwshiny extends Shiny across multiple separate windows
- Uses Shiny's syntax and conventions, so not much additionally to learn

- mwshiny does this by breaking app development into an easy workflow:

User Interface Development → **Server Computation** → **Server Output**

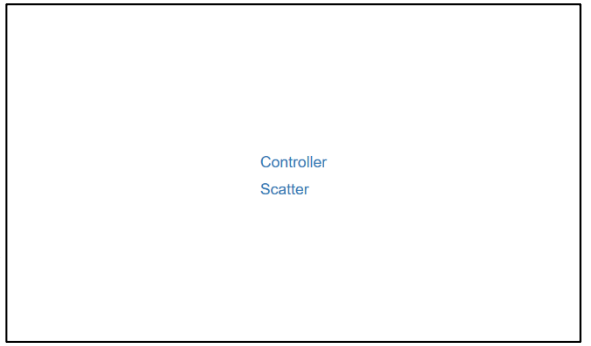
- On CRAN as: **mwshiny**

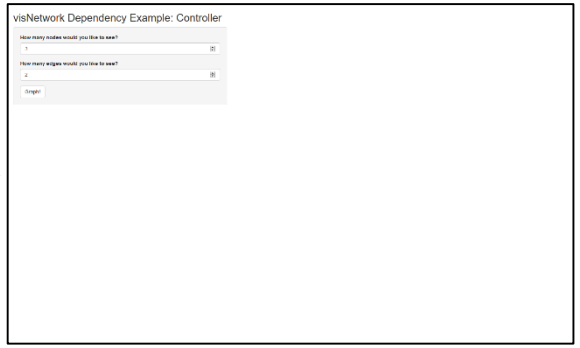
Mwshiny: User Interface Development

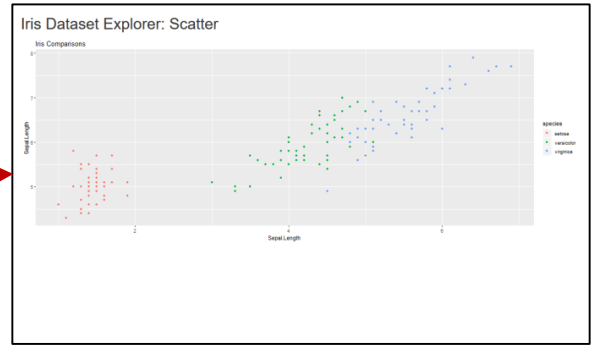
- Specify each window with user interface arguments:
  - Window titles (**win_titles**): a vector of strings
  - User interfaces (**ui_win**): a list of traditional Shiny UIs corresponding to each title

Example:

```
win_titles <- c("Controller","Scatter")

ui_win <- list()
ui_win[[1]] <- fluidPage(…) # controller
ui_win[[2]] <- fluidPage(…) # scatter
```







mwshiny: Server Calculations

- Observe events and create variables for output to be rendered:
  - Server calculations (serv_calc): a list of functions of the form function(calc, sess), where:
    - calc: reactive variable that contains Shiny input variables, as well as a place to put calculated variables
    - sess: traditional Shiny server session variable

Example:

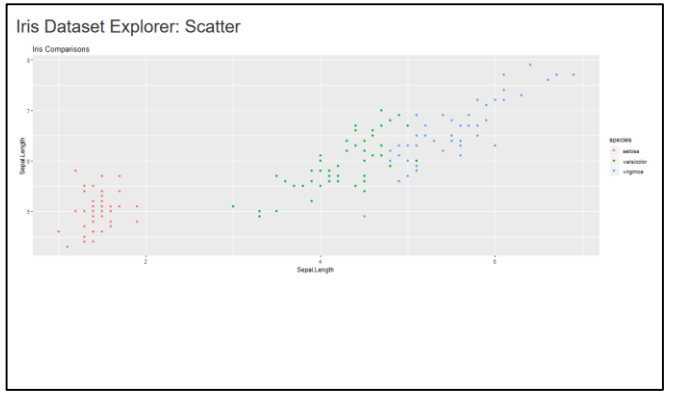
```
serv_calc <- list()

serv_calc[[1]] <- function(calc, sess){
  observeEvent(calc$go, {
    calc[["sub.df"]] <- data.frame(calc$go)
  })
}
```

mwshiny: Server Output

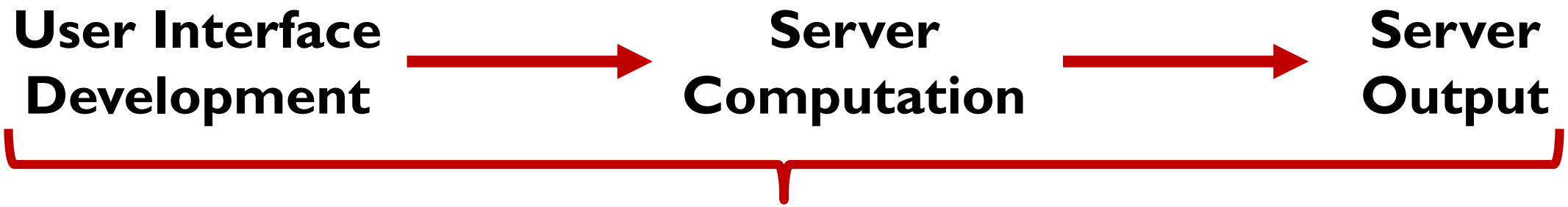
- Render output based on input and calculated variables:
  - Server output (serv_out): a named list of functions of the form function(calc, sess), which returns a render() result, and is named corresponding to the output ID

Example:

```
serv_out <- list()

serv_out[["iris_scatter"]] <- function(calc, sess){
  renderPlot({
    if (!is.null(calc$sub.df)){
      ggplot(calc$sub.df)…
    }
  })
}
```



mwshiny: Breaking Down the Workflow




```
mwsApp(win_titles, ui_win, serv_calc, serv_out, depend)
```

- Separating server into computation and output clarifies workflow
- Enhanced by list and function structure of mwsApp() variables

Examining mwshiny's Workflow Through Three Case Studies

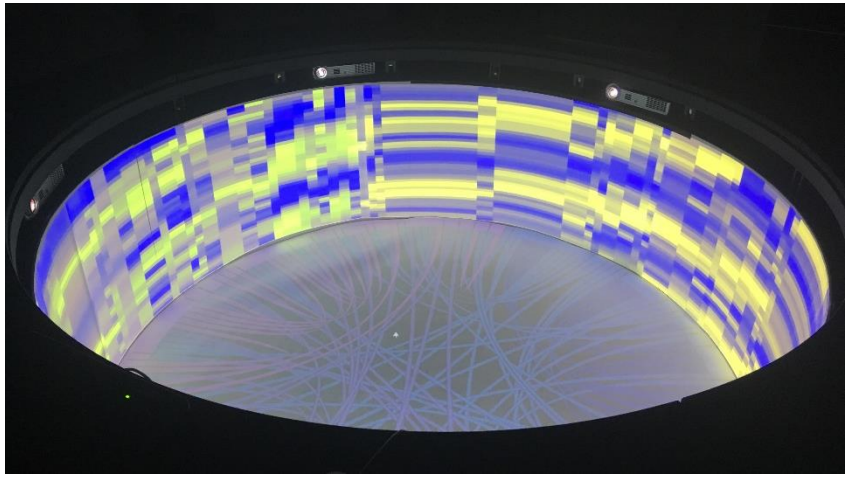
Case 1:

Multiple Monitors at a Workstation

Case 2:

Controller Driving External Monitor

Case 3:



Alternative Visualization Structures

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 1: Examining Population Dynamics Using Two Monitors

- Use 2010 US Census to examine population statistics at state and county levels
- Begin by defining our user interfaces for each window:

```
win_titles <- c("Controller", "Map")
ui_list <- list()
```

```
ui_list[["Controller"]] <- fluidPage(…
  sidebarLayout(
    sidebarPanel(
      selectInput("stat", "Which statistic would
you like to visualize?", choices = stat_choi),…
      actionButton("go", "Visualize!")),
    mainPanel(
      tabsetPanel(
        tabPanel("Aggregate Dynamics",
             plotOutput("overall_dens"), …
             ),…))))
```

```
ui_list[["Map"]] <- fluidPage(
  …
  plotlyOutput("map", height =
"1000px"),
  …
)
```

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 1: Server Calculations

- We then calculate variables based on which states or counties we've chosen that are required for visualizations:

```
serv_calc <- list()

serv_calc[[1]] <- function(calc, sess){
  observeEvent(calc$go, {
    …
    calc[["over_df"]] <- …
    calc[["state_df"]] <- …
    calc[["merge_pop"]] <- …
    …
  })
}
```

- These will be used in rendering our plots

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 1: Server Output

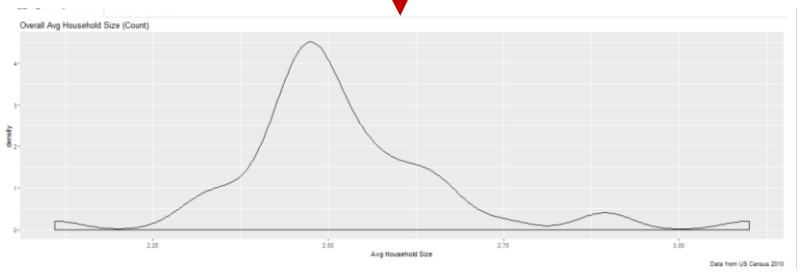
- In this case, we have our three outputs based on these calculations:

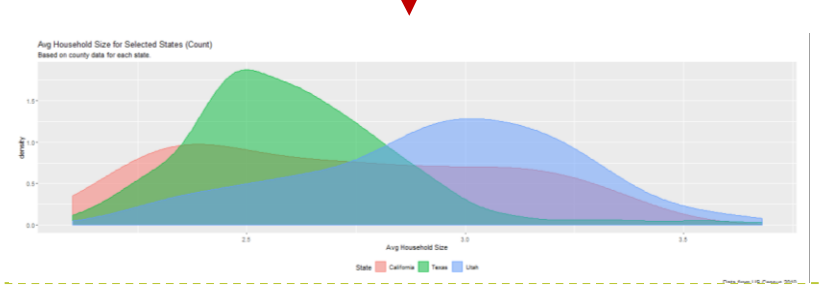
```
serv_out <- list()
```

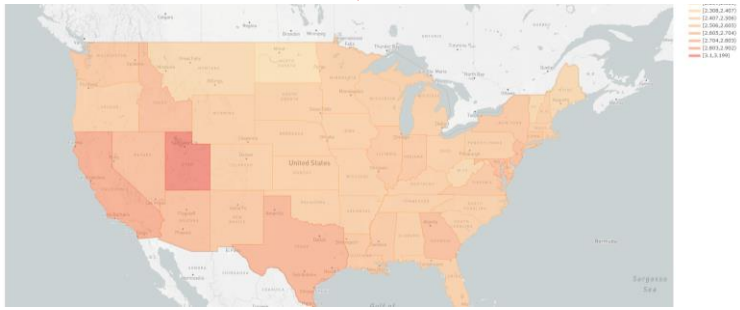
```
serv_out[["overall_dens"]]
<- function(calc, sess){
  renderPlot({
    ggplot(calc$over_df,…)+
      ...
  })
}
```

```
serv_out[[“state_dens"]] <-
function(calc, sess){
  renderPlot({
   ggplot(calc$state_df,…)+
      ...
  })
}
```

```
serv_out[["map"]] <-
function(calc, sess){
  renderPlotly({
      calc$merge_pop %>%
        group_by(group) %>%
        plot_mapbox()...
  })
}
```



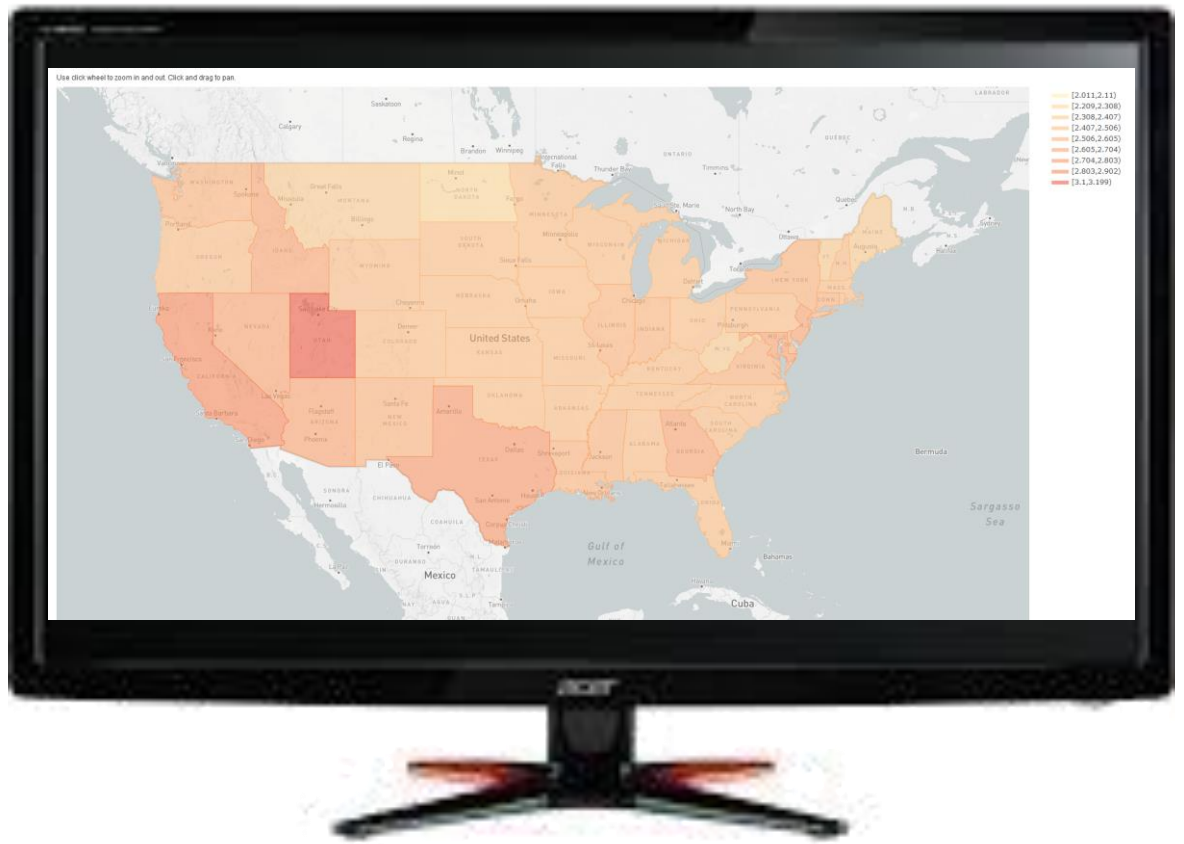




Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 1: Result

- Putting all this together, we end up with our multi-monitor system:

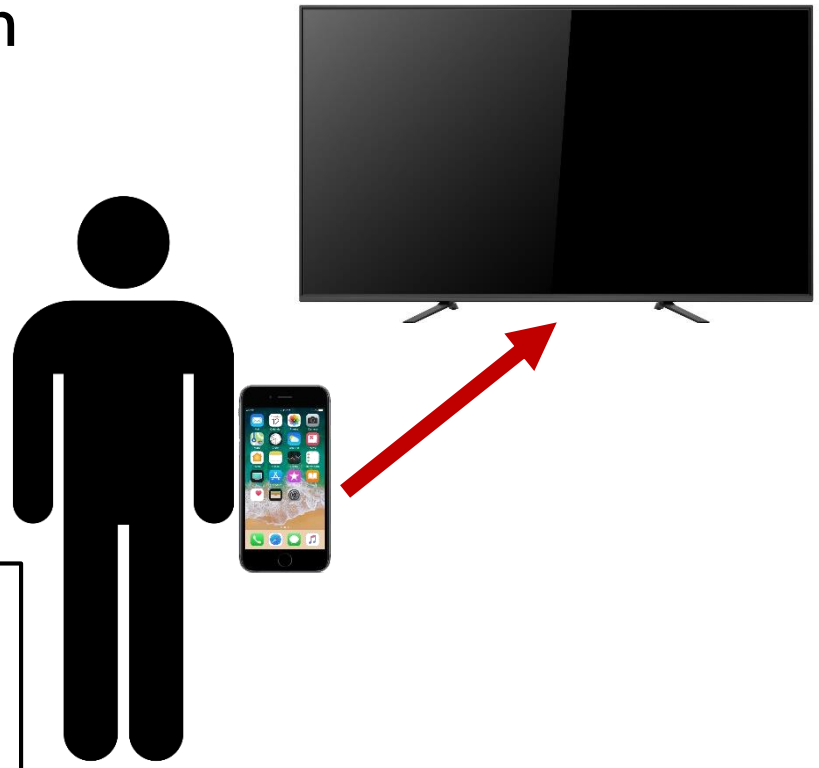


Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 2: Using an External Controller to Drive Cultural Awareness

- We next have a controller (phone, tablet) driving an external monitor in an art museum, so patrons can learn more about their favorite artists
- Begin by defining UI:

```
win_titles <- c("Controller", "Art_Monitor")
ui_list <- list()
```



Inputs

```
ui_list[["Controller"]] <-
fluidPage(…
  sidebarLayout(
    sidebarPanel(
      selectInput("art_wait",
…), …)))
```

Outputs

```
ui_list[["Art_Monitor"]] <-
fluidPage(…
      htmlOutput("info") …
…     tabPanel("Artist", …
htmlOutput("artist"))
      )
```

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

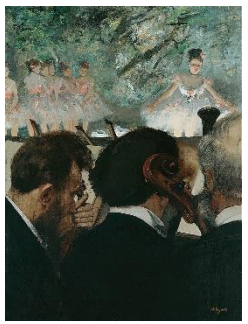
Case 2: Server Computation and Server Output

Server Computation

```
serv_calc <- list()

serv_calc[[1]] <- function(calc, sess){
  observeEvent(calc$go, {
    calc[["select_tab"]] <- calc$which_tab
    calc[["art_person"]] <- calc$art_wait
    calc[["art_born"]] <- artist_info…
    updateTabsetPanel(sess, "art",
                      selected = calc$select_tab)
  })
}
```

Server Outputs

```
serv_out <- list()

serv_out[["info"]] <-
    function(calc, sess){…}
serv_out[[“artist"]] <- …
serv_out[[“painting_1"]] <- …
serv_out[[“painting_2"]] <- …
serv_out[[“painting_3"]] <- …
serv_out[[“map"]] <- …
```

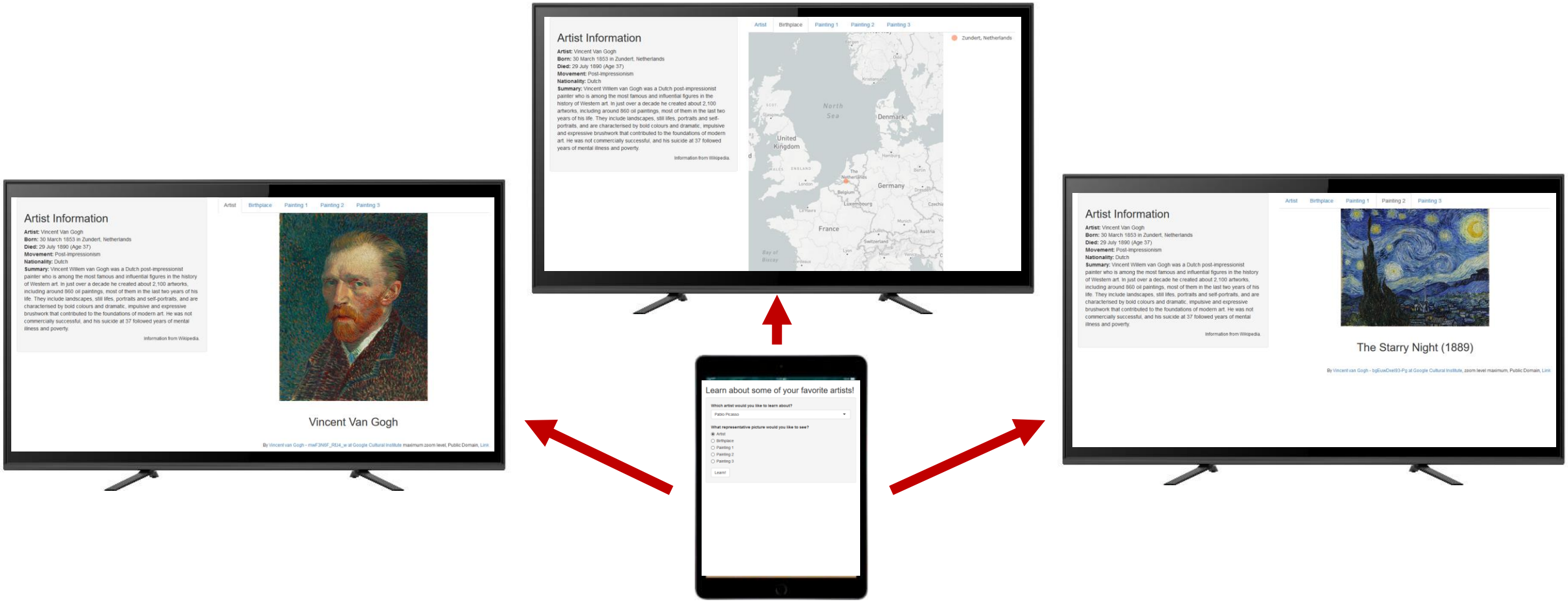


- Information from Wikipedia

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 2: Result

- With all these pieces, we end up with our ideal monitor control situation:

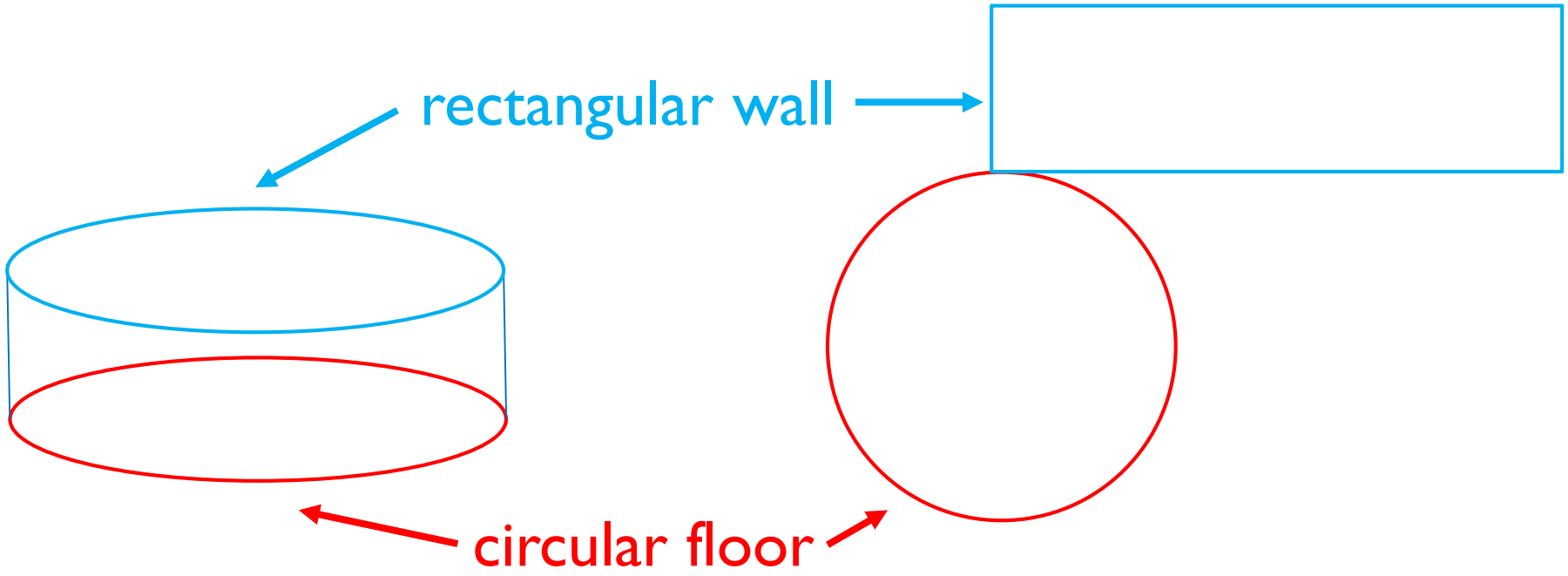


- Information from Wikipedia

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 3: An Immersive Shiny Application with the Rensselaer Campfire

- The Rensselaer Campfire's 3D structure enhances knowledge discovery by reducing cognitive load

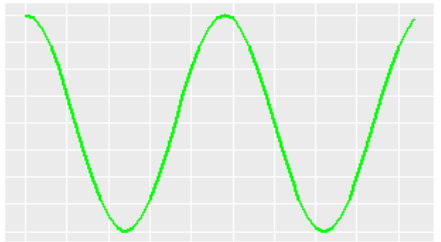


- Users surround and interact with the Campfire to explore their data

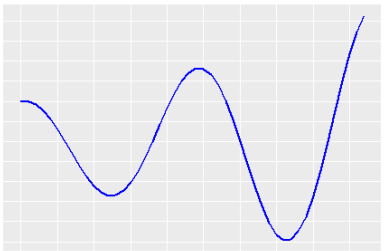
Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 3: Using the Campfire to Explore Circadian Rhythm Data

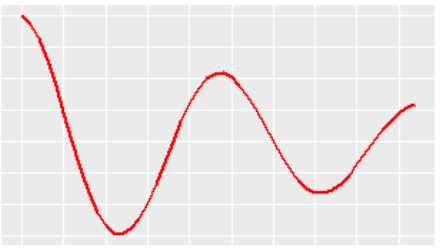
- In this case study, we use the Campfire to explore the function of **circadian rhythms**:
  - ~24-hour cycles reinforced by external cues (light)
  - In mouse data, they are amplitude-changing cosine waves
  - Interrupting rhythms leads to increased health risk of many diseases (cancer, diabetes, etc.)
- Use the Campfire to explore different functions of circadian genes and how they interact with each other



Harmonic



Forced



Damped

- ENCORE application: https://github.com/delosh653/ENCORE

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 3: User Interface Development

- As always, we begin with what we want our user interfaces to look like:

```
win_titles <- c("Controller", "Wall", "Floor")
ui_list <- list()
```

```
ui_win[["Controller"]] <- fluidPage(
  h2("Explore the function of circadian rhythms using the campfire!"),
  sidebarLayout(
    sidebarPanel(
      selectInput("new_path", "Which GO Term would you like to examine?",
        choices = c("metabolic process" = "GO:0008152", …))
    ),
    mainPanel()
  )
)
```

```
ui_win[["Wall"]] <- div(
  d3Output("wall", height = "663px")
)
```

```
ui_win[["Floor"]] <- div(
  d3Output("floor", height = "895px")
)
```

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

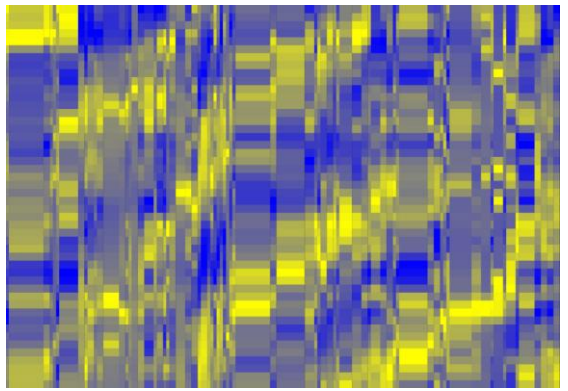
Case 3: Server Calculations and Output

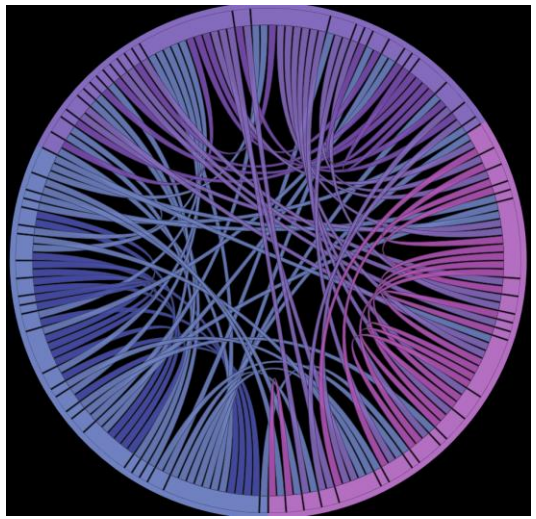
Server Computation

```
serv_calc <- list()

serv_calc[[1]] <- function(serverValues, sess){
  observeEvent(serverValues$new_path, {…})
}
serv_calc[[2]] <- function(serverValues, sess){
  observeEvent(serverValues$dark, {…})
}
serv_calc[[3]] <- function(serverValues, sess){
  observeEvent(serverValues$undark, {…})
}
```

Server Outputs

```
serv_out <- list()

serv_out[["wall"]] <-
    function(calc, sess){…}
serv_out[["floor"]] <- …
```



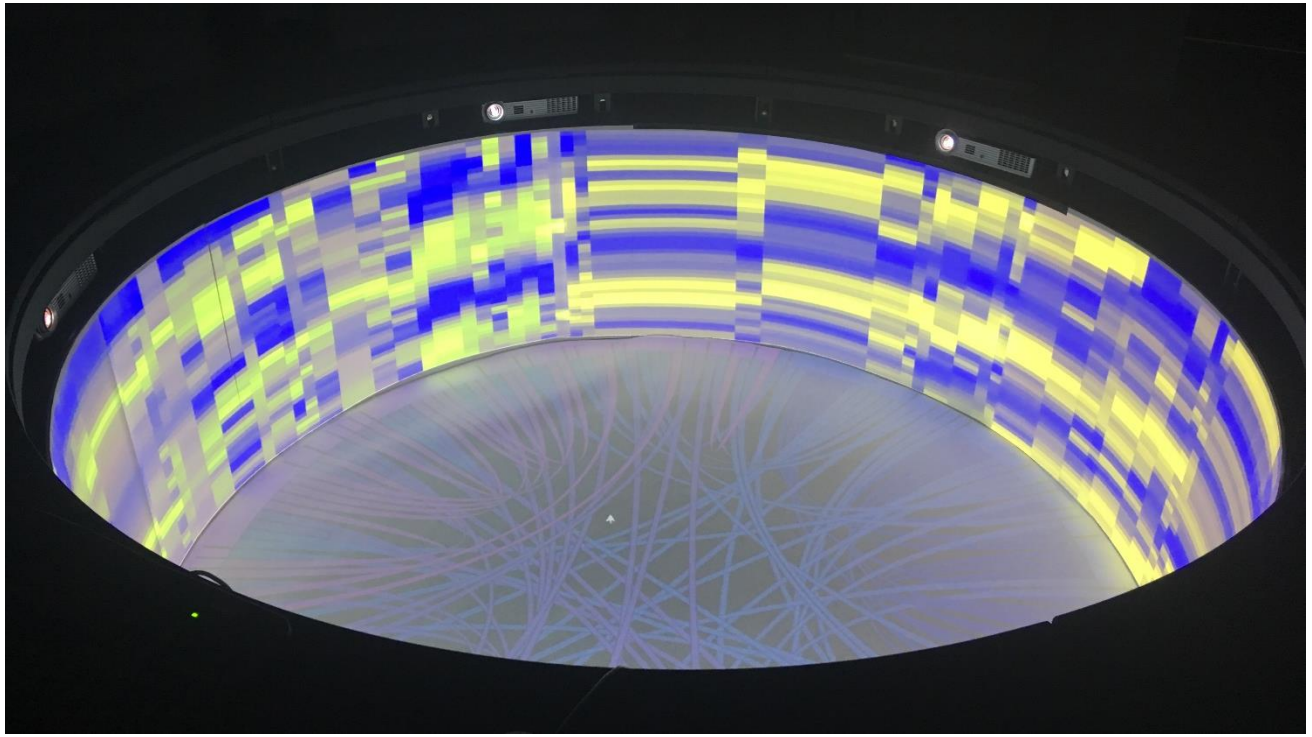


- Data from Hughes, et al. (2009)

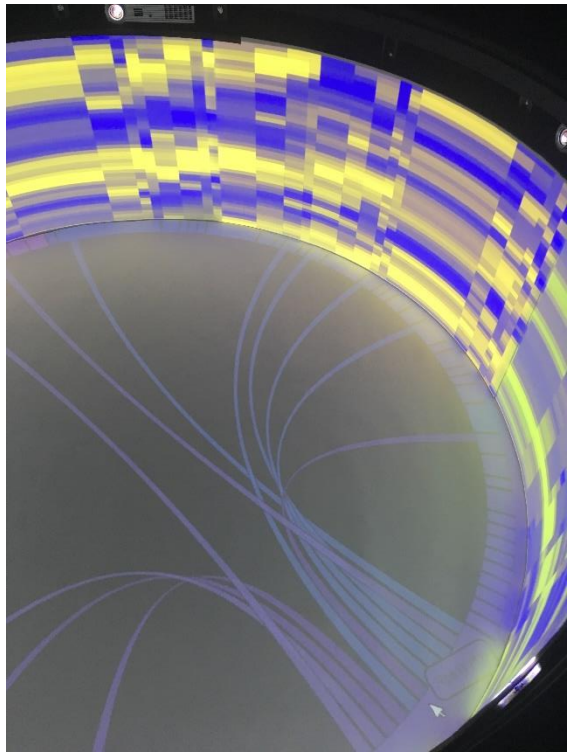
Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

Case 3: Result

- Once we've gone through our workflow, we can see our example for the function "metabolic process" in the Campfire:



Full Campfire



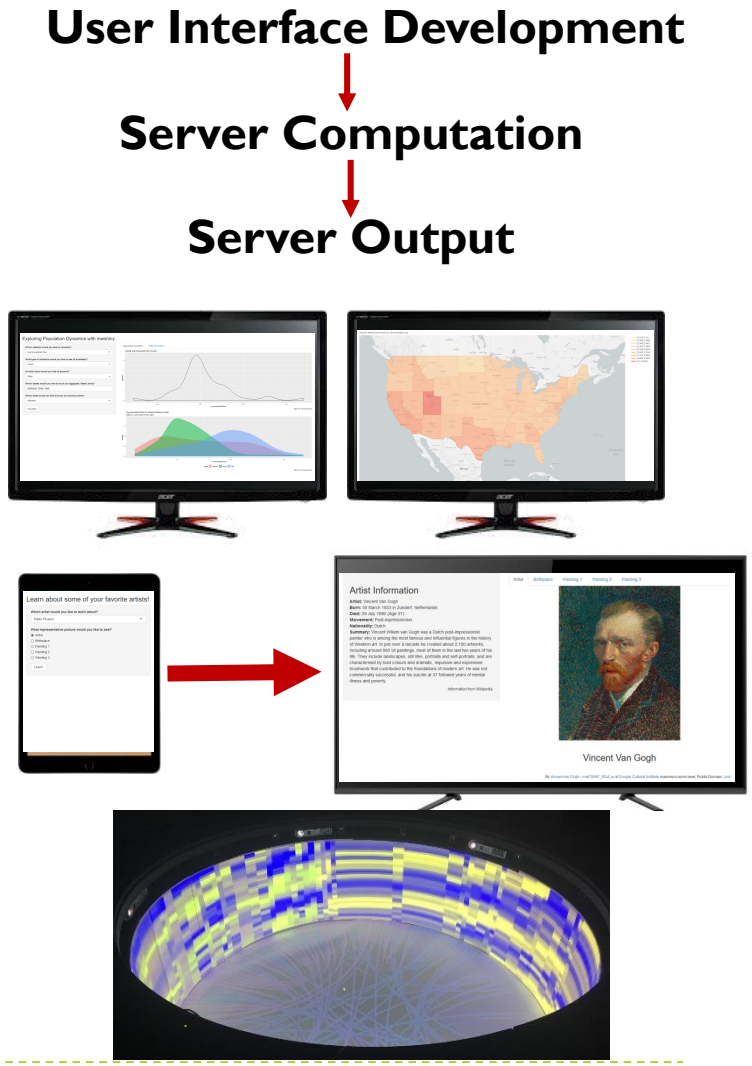
Hovering to see connections for *Rps11*

- Data from Hughes, et al. (2009)

Download scripts on Github:
https://github.com/delosh653/mwshiny-examples

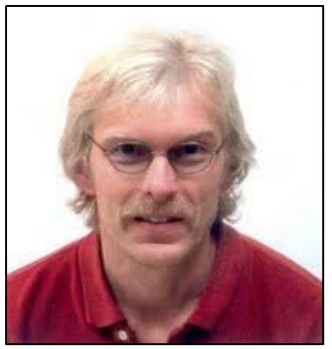
Summary: Multi-Window Shiny (mwshiny)

- mwshiny extends standard Shiny to have multiple windows
- mwshiny requires a breaks down Shiny workflow further to increase clarity
- Presented mwshiny's efficacy in three scenarios:
  1. Multi-monitor systems (U.S. Population Dynamics)
  2. Controller-driven monitor (Art Cultural Exploration)
  3. Alternative visualizations in the Campfire (Circadian Rhythm Function)



Acknowledgements

- Thank you!
  - Hurley lab: Jennifer Hurley, Emily Collins, Meaghan Jankowski
  - IDEA lab: Kristin Bennett, John Erickson
- Support:
  - National Science Foundation
  - Rensselaer Polytechnic Institute
  - National Institutes of Health



The Hurley lab hangin' out.