MONASH University

ETC5523: Communicating with Data

Communicating data with interactive web apps

Lecturer: *Emi Tanaka*

Department of Econometrics and Business Statistics

emi.tanaka@monash.edu

Week 3

cwd.numbat.space

Aim

- Use interactivity to enable data exploration, understanding and communication
- Design web apps with displays that fit for the purpose
- Make web applications using `shiny`

Why

Interactive web apps can

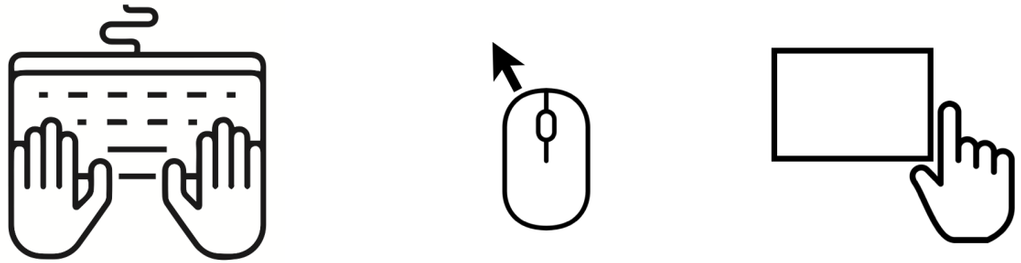
- connect people and data,
- make systems playful,
- prompt self-reflection,
- personalise the view, and
- reduce cognitive load.

Human Computer Interaction

> Open-ended dialogue between the user and the computer

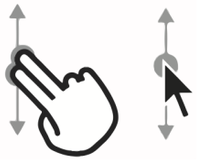
- Enable audience to some degree **co-author narrative**, i.e. narratives moves away from being author-guided to audience-driven.
- **Leverage user interaction techniques** to improve user experience, e.g.
  - Show details on demand
  - Reduce overall cognitive load
  - Personalised view

User Interactions



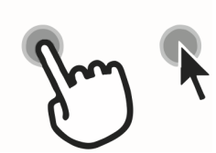
POINTING, HOVERING

SCROLLING

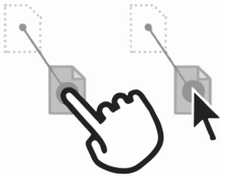


CLICKING

PRESSING



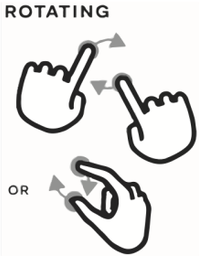
DRAGGING



SWIPING

PINCHING, SPREADING

ROTATING

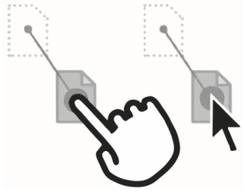


GESTURES WITH MULTIPLE FINGERS

User Inputs

CLICKING

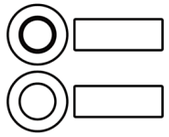
DRAGGING



text entry

button

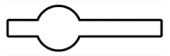
radio-button group



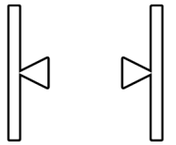
drop-down list

direct selection of data encodings

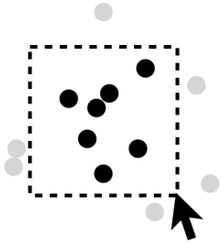
slider



range bars



selecting group of encodings



Criteria for the Design of Interactive Data Visualisation

Tominski, Christian, and Heidrun Schumann (2020) Interactive Visual Data Analysis. CRC Press.

Quality criteria

Expressiveness (Mandatory Condition)

An interactive visual representation is expressive if it allows the user to carry out the actions needed to acquire the desired information in the data.

Effectiveness (Goal-Oriented Condition)

A measure of how well the user can convey an interaction intent to the computer.

Efficiency (Desired Condition)

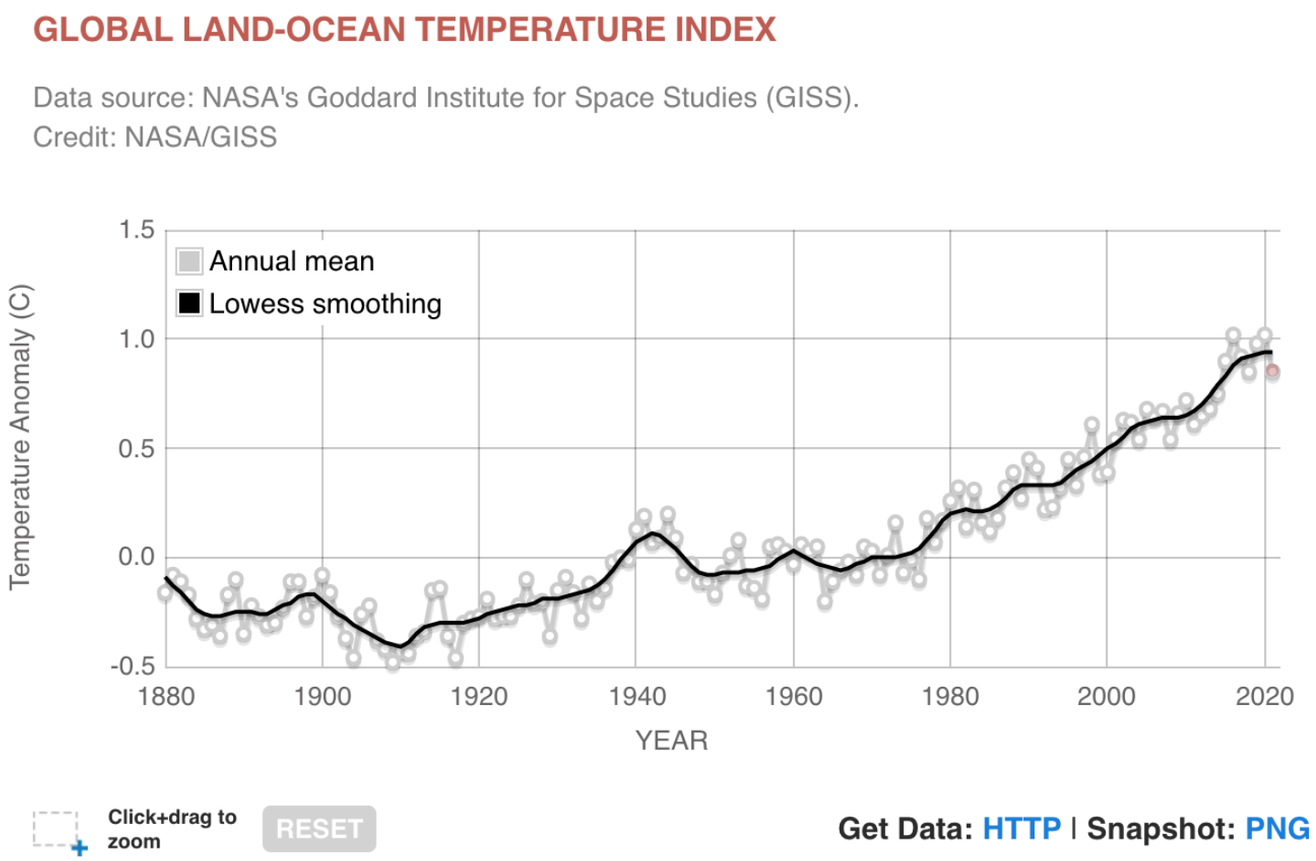
The balance of benefits and costs for using an interactive visualisation approach. E.g. does the human effort of building the interactive visualisation outweigh its benefits? Are the efforts of users to interact with it offset the information gained for users?

Goals

- **Exploration** promotes undirected search
- **Description** characterises observations by associated data elements
- **Explanation** identifies contributing causes behind an observation
- **Confirmation** find concrete evidences for or against a hypothesis
- **Presentation** communicates results of a confirmed analysis

Example: Global Temperature

https://climate.nasa.gov/vital-signs/global-temperature/

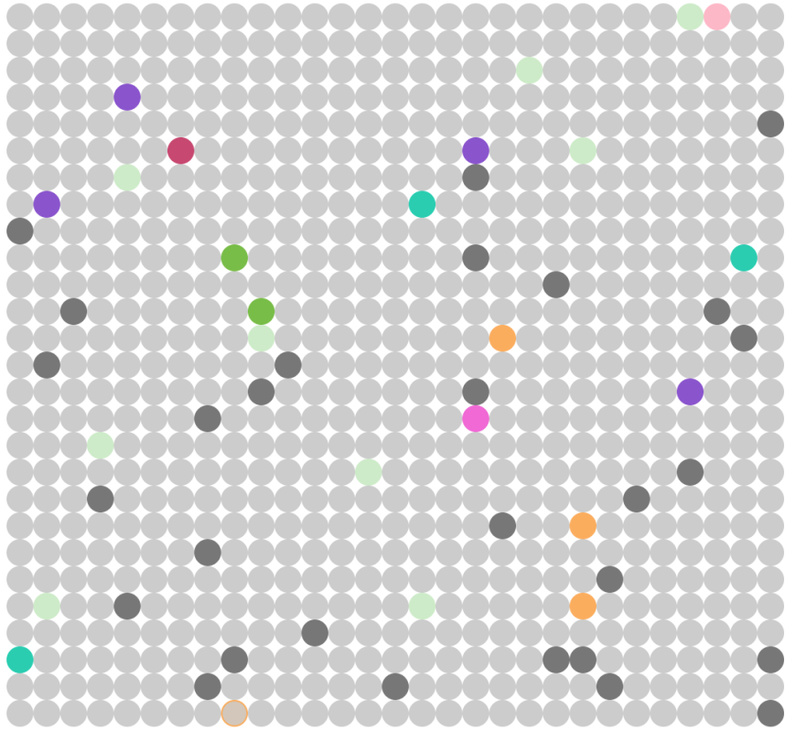


Example: Handwriting with Neural Network

Example: How you will die

https://flowingdata.com/2016/01/19/how-you-will-die/

I am male Native and currently 0 years old. PAUSE



AGE OF DEATH	DIED SO FAR	STILL ALIVE
23 years	1%	99%

CAUSE OF DEATH SO FAR

0%	Infection
0%	Cancer
0%	Blood
0%	Endocrine
0%	Mental
0%	Nervous
13%	Circulatory
0%	Respiratory
0%	Digestive
0%	Musculoskeletal
0%	Genitourinary
0%	Perinatal
13%	Congenital
50%	External Causes
25%	Other

What is `shiny`?

- Demo App

How to get started with `shiny`?

- RStudio > File > New File > Shiny Web App...
- Using snippet: Type `shinyapp` and Shift + Tab

User Interface

Writing HTML from R

```r
library(shiny) # exported from `htmltools`
tags$html(
  tags$body(
    h1('My first heading'),
    p('My first paragraph, with some ', strong('bold'), ' text.'),
    div(id = 'myDiv', class = 'simpleDiv',
        'Here is a div with some attributes.')
  )
)
```

```html
<html>
  <body>
    <h1>My first heading</h1>
    <p>
      My first paragraph, with some
      <strong>bold</strong>
       text.
    </p>
    <div id="myDiv" class="simpleDiv">Here is a div with some attributes.</div>
  </body>
</html>
```

- Use `includeCSS()` and `includeScript()` to include CSS and JS files

HTML Inputs Part 1

```
actionButton("id1", "Push")
```

Push

```
actionLink("id2", "Link")
```

Link

```
checkboxGroupInput("id3", "Select",
                   choices = c("Mon", "Tue", "Wed"),
                   selected = "Mon")
```

Select

- [x] Mon
- [ ] Tue
- [ ] Wed

```
checkboxInput("id4", "I accept")
```

- [ ] I accept

```
fileInput("id5", "Upload file")
```

Upload file

Browse... No file selected

HTML Inputs Part 2

```
numericInput("id6", "Enter number",
             value = 1, min = 1, max = 10, step = 1)
```

Enter number 1

```
radioButtons("id7", "Select one",
             choices = c("Pizza", "Dumplings", "Sushi"))
```

Select one

- (•) Pizza
- ( ) Dumplings
- ( ) Sushi

```
passwordInput("id8", "Enter password")
```

Enter password

```
textInput("id9", "Enter text", value = "Enter coments here")
```

Enter text Enter coments here

HTML Input Part 3

Note: calendar date picker pop up doesn't show up here.

```
dateInput("id10", "Select day")
```

Select day

```
dateRangeInput("id11", "Select days")
```

Select days

to

```
selectInput("id12", "Select a drink", choices = c("Tea", "Coffee"))
```

Select a drink

Tea

```
sliderInput("id13", "How many?", min = 0, max = 10, value = 0)
```

How many?

Layouts

fluidRow + columns

This is using bootstrap

```
fluidPage(
  fluidRow(column(width = 4,
                  h3("Some informative table"),
                  tableOutput("mytable")),
           column(width = 4, offset = 3,
                  h3("Fancy plot"),
                  plotOutput("myplot"))),
  fluidRow(column(width = 12,
                  "Minimum width is 1 and maximum width is 12"))
)
```

```
<div class="container-fluid">
  <div class="row">
    <div class="col-sm-4">
      <h3>Some informative table</h3>
      <div id="mytable" class="shiny-html-output"></div>
    </div>
    <div class="col-sm-4 offset-md-3 col-sm-offset-3">
      <h3>Fancy plot</h3>
      <div id="myplot" class="shiny-plot-output" style="width:100%;height:400px;"></div>
    </div>
```

```
11    </div>
12    <div class="row">
13      <div class="col-sm-12">Minimum width is 1 and maximum width is 12</div>
14    </div>
15  </div>
```

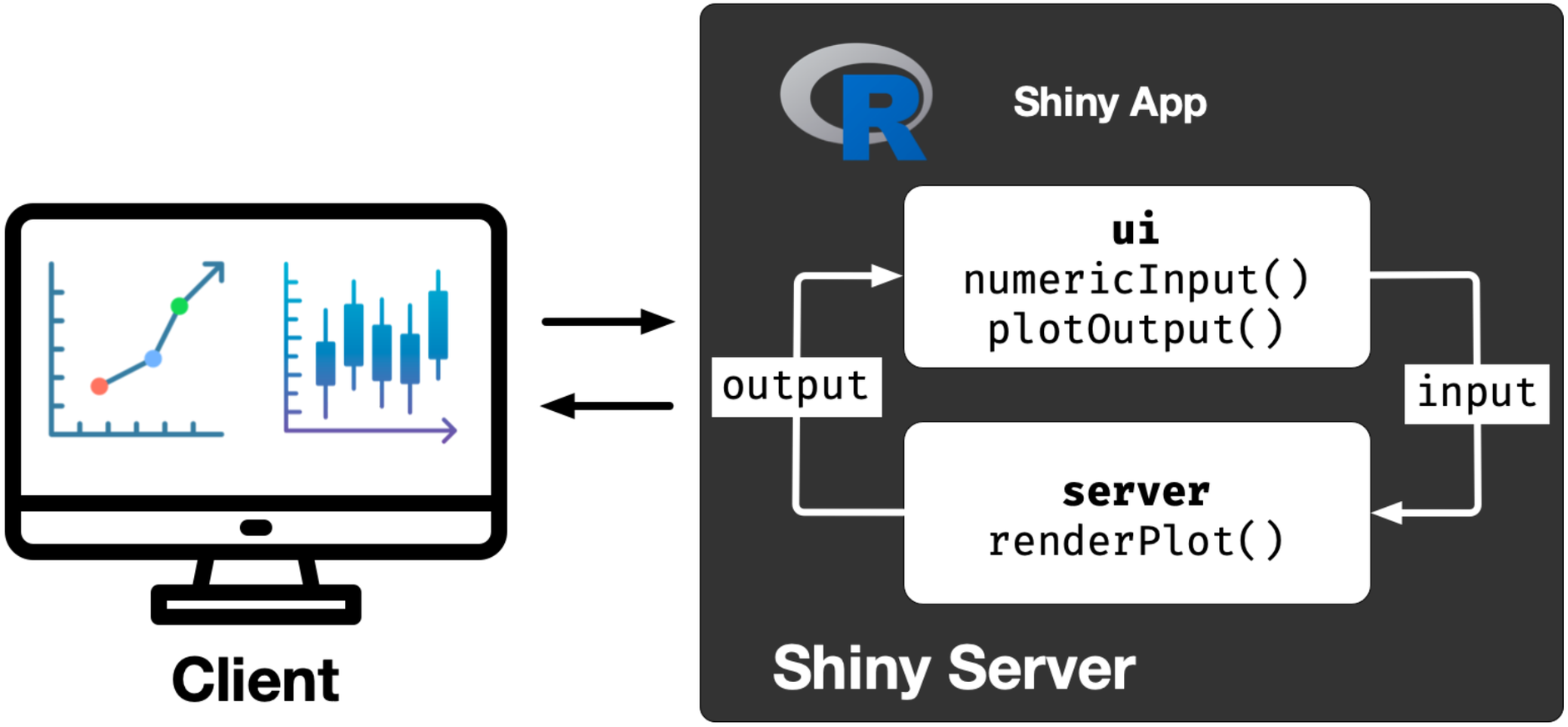
sidebarLayout

```
fluidPage(sidebarLayout(
  sidebarPanel(h3("User control"),
               actionButton("id1", "Push")),
  mainPanel(h3("Main Panel"),
            plotOutput("myplot"))
))
```

```
<div class="container-fluid">
  <div class="row">
    <div class="col-sm-4">
      <form class="well" role="complementary">
        <h3>User control</h3>
        <button id="id1" type="button" class="btn btn-default action-button">Push</button>
      </form>
    </div>
    <div class="col-sm-8" role="main">
      <h3>Main Panel</h3>
      <div id="myplot" class="shiny-plot-output" style="width:100%;height:400px;"></div>
    </div>
  </div>
</div>
```

Server & Client Communication

Demo App



Server and User Interface Outputs

server	ui
`renderDataTable`	`dataTableOutput`
`renderImage`	`imageOutput`
`renderPlot`	`plotOutput`
`renderPrint`	`verbatimTextOutput`
`renderTable`	`tableOutput`
`renderText`	`textOutput`
`renderUI`	`uiOutput` or `htmlOutput`

Reactivity

- `reactiveValues` creates your own reactive values
- `isolate` prevents reactions
- `reactive` caches its value to reduce computation and notifies its dependencies when it has been invalidated
- `observeEvent` runs code when the first argument changes
- `observe` runs code when any reactive elements within it changes

Debugging

- `browser()` + breaking points

How to deploy your Shiny app?

shinyapps.io

Week 3 Lesson

Summary

- We went through the benefits of interactivity for communicating data
- We considered how to design displays for web apps
- You learnt how to use make web apps using `shiny`

Resources

- Hohman, et al., “Communicating with Interactive Articles”, Distill, 2020.
- Introduction to Shiny Tutorials Course Mastering Shiny
- Debugging Shiny Techniques Article
- Cheatsheet for Shiny Cheatsheet