# Creating Shiny Apps for biostatisticians and bioinformaticians

ISGlobal

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Isaac Subirana

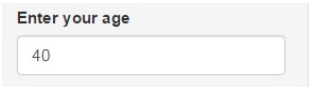
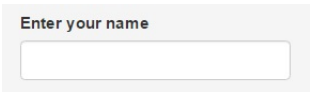
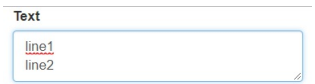
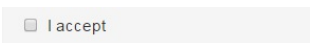
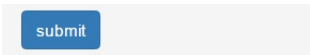
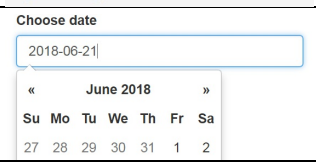
## Part II: Layout of the form elements

# Outline

## Part II: Form design

- Input elements
- Output elements
- Layout
- Conditional panels
- Exercise

# Input elements

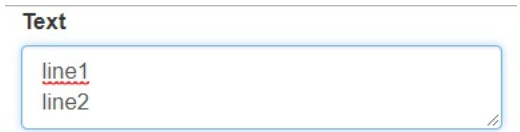
| Type | Function | Arguments | Example |
|---|---|---|---|
| Numeric input | `numericInput` | `inputId`, `label`, `value`, `min`, `max`, `step` |   |
| Text input | `textInput` | `inputId`, `label`, `value`, `width`, `placeholder` |   |
| Text input | `textAreaInput` | `inputId`, `label`, `value`, `width`, `placeholder` cols,... |   |
| Password input | `passwordInput` | `inputId`, `label`, `value`, `width` |   |
| Options list | `radioButtons` | `inputId`, `label`, `choices`, `selected`, `inline`, `width` |   |
| Drop-down list | `selectInput` | `inputId`, `label`, `choices`, `selected`, `multiple`, `selectize`, `width`, `size` |   |
| Drop-down list | `selectizeInput` | ... + `options` | |
| Numeric input (minimum, maximum) | `sliderInput` | `inputId`, `label`, `min`, `max`, `value`, `step`, `animate` |   |
| True/False | `checkboxInput` | `inputId`, `label`, `value`, `width` |   |
| Button | `actionButton` | `inputId`, `label`, `icon`, `width` |   |
| Date | `dateInput` | `inputId`, `label`, `value`, `format="yyyy-mm-dd"`, ... |   |

Check here all input elements available in Shiny.

# textAreaInput

- `textAreaInput` as `textInput` gets an introduced text.
- In `textAreaInput` the user can enter more than one line (use `cols` argument).
- Drag the arrow on bottom-left corner to resize the window.

```
ui <- fluidPage(
  textAreaInput("text", "Text", cols=4)
)
server <- function(input, output){}
shinyApp(ui, server)
```



# Drop-down list

- Use **`selectInput`**, **`selectizeInput`** functions.

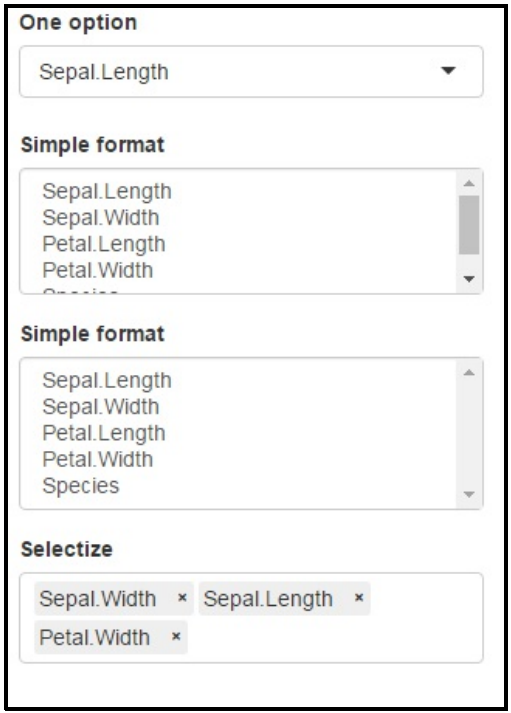
- To select more than one item **`multiple=TRUE`**.

- When **`multiple=TRUE`**, drop-down list can be displayed in two formats:

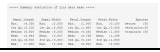
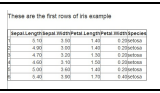
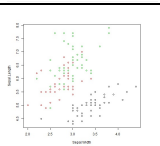
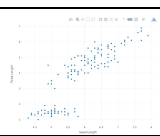
  1. **Simple format**: items placed in a column (one below the other). Number of shown items (windows height) can be set by the **`size`** argument.

  2. "**selectize**" **format**: It allows to search items in case-sensitive typing, and add more options by the **`options`** argument using the **`selectizeInput`** function. For more info visit this web

```r
ui <- fluidPage(

   selectInput("list1", "One option",
       names(iris)),

   selectInput("list2", "Simple format",
       names(iris),
       multiple=TRUE,
       selectize=FALSE),

   selectInput("list3", "Simple format (height)",
       names(iris),
       multiple=TRUE,
       size=ncol(iris),
       selectize=FALSE),

   selectizeInput("list4", "Selectize",
       names(iris),
       multiple=TRUE,
       options=list(plugins=list('remove_button',
                                 'drag_drop')))

)

server <- function(input, output){}

shinyApp(ui, server)
```



# Output elements

| Type | Function | Arguments | Example |
|---|---|---|---|
| R-console like text | `verbatimTextOutput` | `outputId`, `placeholder` |  |
| Text (handled by `cat`) | `textOutput` | `outputId`, `container`, `inline` |  |
| HTML interpreted text | `htmlOutput` | `outputId`, `inline` |  |
| "Regular" table | `tableOutput` | `outputId` |  |
| Dynamic table | `dataTableOutput` | `outputId` |  |
| Plots | `plotOutput`<br>`imageOutput` | `outputId`, `width`, `height`, `click`,... |  |
| Dynamic plots | `plotlyOutput` | `outputId`, `width`, `height`, `inline` |  |
| Dynamic maps | `leafletOutput` | `outputId`, `width`, `height` |  |

# R-console like text

```
+++++ Summary statistics of iris data base +++++


  Sepal.Length    Sepal.Width     Petal.Length    Petal.Width          Species
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   setosa    :50
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   versicolor:50
 Median :5.800   Median :3.000   Median :4.350   Median :1.300   virginica :50
 Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
 3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
 Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
```

```r
ui <- fluidPage(
  verbatimTextOutput("result")
)

server <- function(input, output) {
  output$result <- renderPrint({
    summary(iris)
  })
}

shinyApp(ui = ui, server = server)
```

# In-line text

**Age**

45

You are 45 years old

```
ui <- fluidPage(
  numericInput("agein", "Age", 30),
  "You are",
  textOutput("ageout", inline=TRUE),
  "years old"
)

server <- function(input, output){
  output$ageout <- renderText({
    input$agein
  })
}

shinyApp(ui, server)
```

**Exercice:** change `textOutput` and `renderText` by `verbatimTextOutput` and `renderPrint`

# HTML interpreted text

These are the first rows of iris example

| | Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|---|---|---|---|---|---|
| 1 | 5.10 | 3.50 | 1.40 | 0.20 | setosa |
| 2 | 4.90 | 3.00 | 1.40 | 0.20 | setosa |
| 3 | 4.70 | 3.20 | 1.30 | 0.20 | setosa |
| 4 | 4.60 | 3.10 | 1.50 | 0.20 | setosa |
| 5 | 5.00 | 3.60 | 1.40 | 0.20 | setosa |
| 6 | 5.40 | 3.90 | 1.70 | 0.40 | setosa |

```
library(xtable)
ui <- fluidPage(
  htmlOutput("result")
)
server <- function(input, output) {
  output$result<-renderPrint({
    print(xtable(head(iris)))
  })
}
shinyApp(ui = ui, server = server)
```

# "Regular" table

| | Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|---|---|---|---|---|---|
| 1 | 5.10 | 3.50 | 1.40 | 0.20 | setosa |
| 2 | 4.90 | 3.00 | 1.40 | 0.20 | setosa |
| 3 | 4.70 | 3.20 | 1.30 | 0.20 | setosa |
| 4 | 4.60 | 3.10 | 1.50 | 0.20 | setosa |
| 5 | 5.00 | 3.60 | 1.40 | 0.20 | setosa |
| 6 | 5.40 | 3.90 | 1.70 | 0.40 | setosa |

```r
ui <- fluidPage(
  tableOutput("result")
)
server <- function(input, output) {
  output$result<-renderTable({
    head(iris)
  })
}
shinyApp(ui = ui, server = server)
```

# Dynamic table

Show 25 entries Search:

| Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|---|---|---|---|---|
| 5.1 | 3.5 | 1.4 | 0.2 | setosa |
| 4.9 | 3.0 | 1.4 | 0.2 | setosa |
| 4.7 | 3.2 | 1.3 | 0.2 | setosa |
| 4.6 | 3.1 | 1.5 | 0.2 | setosa |
| 5.0 | 3.6 | 1.4 | 0.2 | setosa |
| 5.4 | 3.9 | 1.7 | 0.4 | setosa |
| 4.6 | 3.4 | 1.4 | 0.3 | setosa |
| 5.0 | 3.4 | 1.5 | 0.2 | setosa |

```
ui <- fluidPage(
  dataTableOutput("result")
)
server <- function(input, output) {
  output$result<-renderDataTable({
    iris
  })
}
shinyApp(ui = ui, server = server)
```

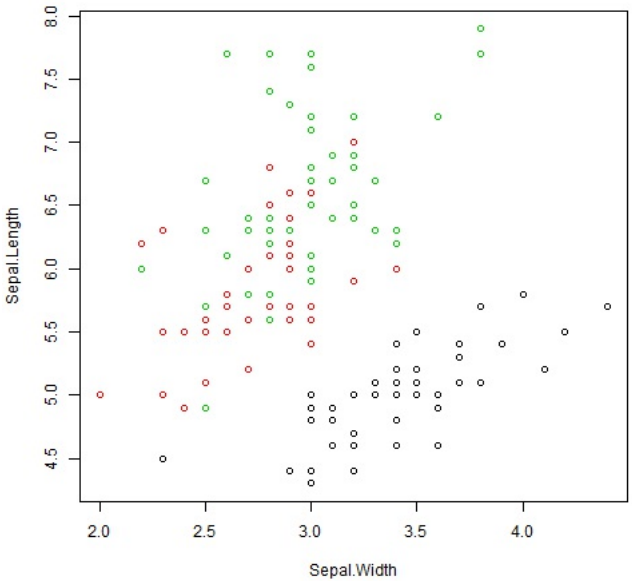
# Dynamic table: extensions

- No need to plug into Shiny app
- Wrap the data.frame using **`datatable`** function from **`DT`** package to add more options (filter, rownames, download buttons, ...)

```
library(DT)
DT::datatable(iris,
      rownames=FALSE,
      filter="top",
      extensions='Buttons',
      options=list(dom='Bfrtip',
                   buttons=c('copy','csv','excel','pdf','print')
              )
)
```

Execute this code in R or Rstudio

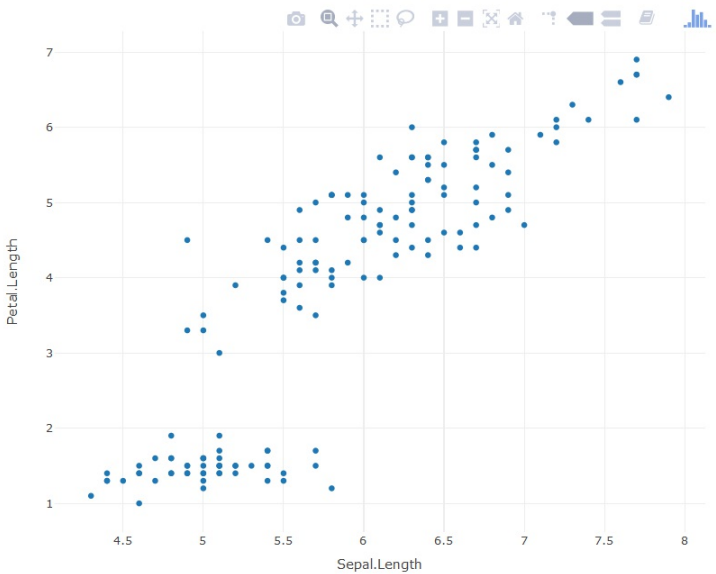
# Plots




```
ui <- fluidPage(

  plotOutput("result")

)

server <- function(input, output) {

  output$result<-renderPlot({
    plot(Sepal.Length ~ Sepal.Width,
         col = Species, data = iris)
  }, width = 500, height = 500)

}

shinyApp(ui = ui, server = server)
```

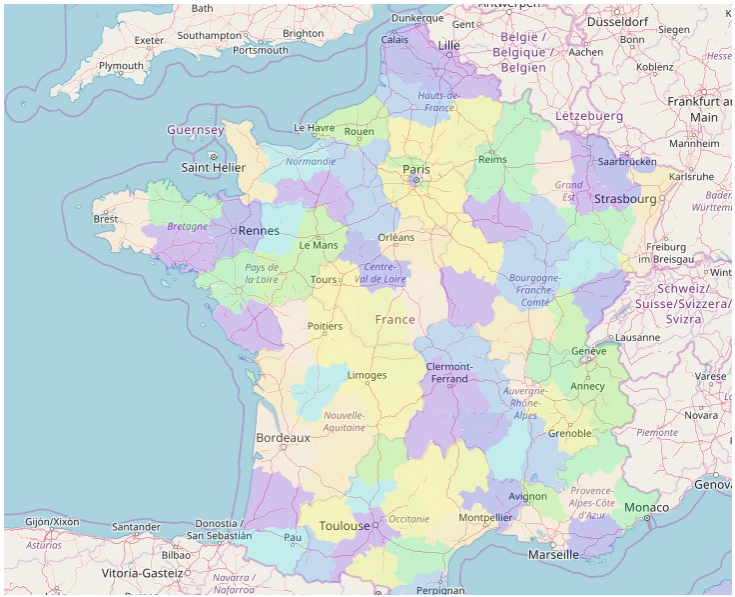
How would the figure look like if width and height are not specified?

# Dynamic plots




```r
library(plotly)

ui <- fluidPage(

  plotlyOutput("result")

)

server <- function(input, output) {

  output$result<-renderPlotly({
    plot_ly(data=iris,
            x=~Sepal.Length,
            y=~Petal.Length)
  })

}

shinyApp(ui = ui, server = server)
```

# Dynamic map



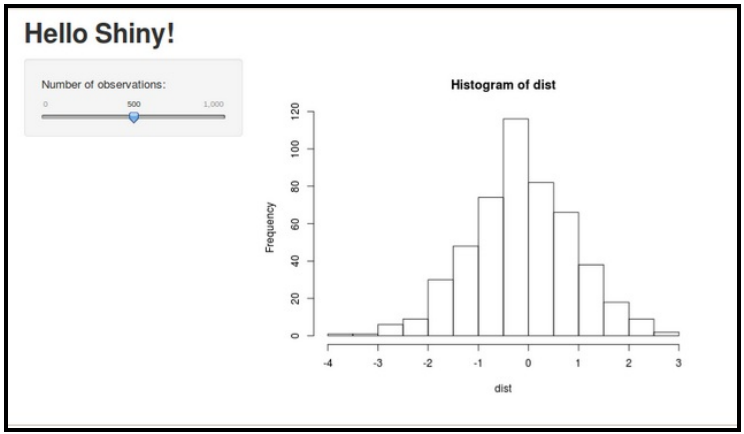

```r
library(leaflet)
library(maps)

fr <- map("france", fill=TRUE,
          plot=FALSE)

ui <- fluidPage(
  leafletOutput("plotmap")
)

server <- function(input, output) {
  output$plotmap<-renderLeaflet({
    leaflet(data=fr) %>%
      addTiles() %>%
      addPolygons(
        fillColor=topo.colors(10),
        stroke=FALSE)
  })
}

shinyApp(ui = ui, server = server)
```

```r
library(leaflet)
library(maps)
fr <- map("france", fill=TRUE, plot=FALSE)

leaflet(data=fr) %>% addTiles() %>%
    addPolygons(fillColor=topo.colors(10), stroke=FALSE)
```

# Layout

# Left and right panels

```
fluidPage(
  sidebarLayout(
    sidebarPanel(...),
    mainPanel(...)
  )
)
```




- This is the most common option.
- Equivalently, you can also use the function **`bootstrapPage`** instead of **`fluidPage`**.

# Rows and columns specification

```
fluidPage(

  fluidRow(
    column(4, ...),
    column(8, ...)
  ),

  fluidRow(
    column(6, ...),
    ...
  ),
  ...
)
```

- This is the most flexible option.
- You can set the column width.
- Height of columns **cannot** be set.
- The sum of columns widths must be 12.
- You can place as many columns as desired, even nested.
- Every row is created by `fluidRow` function.

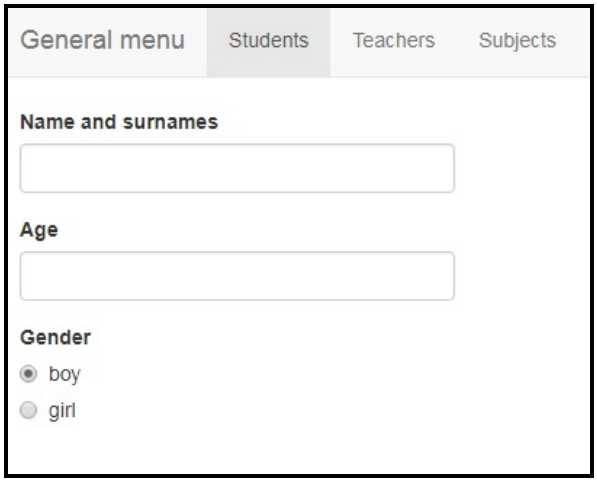
```r
ui <- fluidPage(
  titlePanel("Grid example"),
  ...
  ...
  actionButton("submit","")
)
server <- function(input, output) {}
shinyApp(ui = ui, server = server)
```

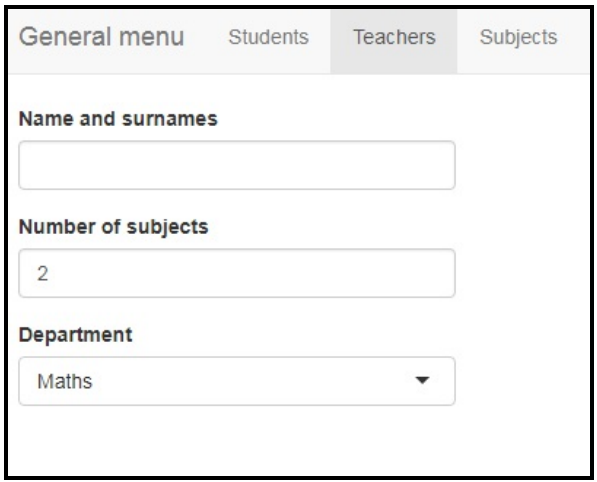

**Exercise:** Complete the code to place the elements as in this example

# General menu

```
navbarPage(
  tabPanel(...),
  tabPanel(...),
)
```

- It is not as frequently used as the previous ones.
- The functionality is the same as for tabs which will be explain below.
- Usefull for "big" applications than can be split in "sub-applications", one for each general menu tab.



# Tabs

```
ui <- fluidPage(
  tabsetPanel(id = "menu",
    tabPanel("Table",
    ...
    ),
    tabPanel("Summary",
    ...
    )
  )
)
```

Table | Summary

| Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|---|---|---|---|---|
| 5.10 | 3.50 | 1.40 | 0.20 | setosa |
| 4.90 | 3.00 | 1.40 | 0.20 | setosa |
| 4.70 | 3.20 | 1.30 | 0.20 | setosa |
| 4.60 | 3.10 | 1.50 | 0.20 | setosa |
| 5.00 | 3.60 | 1.40 | 0.20 | setosa |
| 5.40 | 3.90 | 1.70 | 0.40 | setosa |

Table | Summary

```
 Sepal.Length    Sepal.Width     Petal.Length    Petal.Width
Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   seto
1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   vers
Median :5.800   Median :3.000   Median :4.350   Median :1.300   virg
Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
```

- Elements are arranged one **behind** the other.
- Use `tabsetPanel` function to create a set of tabs.
- Use `tabPanel` function to create each single tab.
- You can use `navbarPage` as tabsetPanel inside `fluidPage`.
- With `navbarPage` you can insert icons in each tab (see next example).

# Vertical tabs

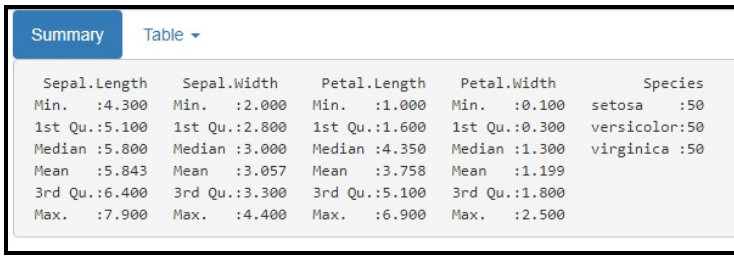
- Use **`navlistPage`** to place tabs vertically.
- As for **`navbarPage`**, you can use **`icon`** argument inside **`tabPanel`** to create icons.

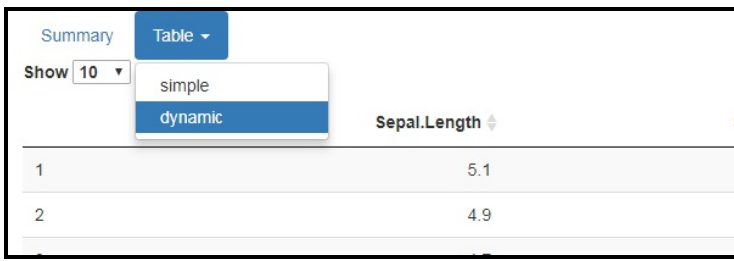
```
ui <- fluidPage(
  navlistPanel(
    tabPanel("Data",icon=icon("database"),
      fileInput("down","")
    ),
    tabPanel("Analyses",icon=icon("calculator"),
      numericInput("delta","Enter delta",3)
    )
  )
)

server <- function(input, output){}

shinyApp(ui, server)
```


# Merging several tabs (drop-down menu)

- Use **`navbar`** function with the tabs as its arguments.
- It is used inside **`tabsetPanel`** to create tabs.
- Although one tab does not contain a drop-down menu, **`tabPanel`** is used.
- You can specify the appearance with "type" argument of **`tabsetPanel`** function.

```
ui <- fluidPage(
  tabsetPanel(id="menu", type="pills",
    tabPanel("Tab 1",
      ...
    ),
    navbarMenu("Drop-down",
      tabPanel("Option 1",
        ...
      ),
      tabPanel("Option 2",
        ...
      )
    )
  )
)
```



# Conditional Panels

# Conditional Panels

- Conditional panels are used when some elements must be shown or not depending on some other input elements values.
- **`conditionalPanel`** function.
  - First argument: character. Logic expression written in "**javascript**" **language**.
  - Segond argument: form elements that will be appear when the logic expression is TRUE.

```
conditionalPanel(
  condition = "input.element==1",
  ...
)
```

# Example 1

```r
ui <- fluidPage(
  radioButtons("type",
      "what do you want to show?",
      c("Table"=1, "Summary"=2)),
   conditionalPanel(
     condition = "input.type==1",
     tableOutput("result1")
   ),
   conditionalPanel(
     condition = "input.type==2",
     verbatimTextOutput("result2")
   )
)

server <- function(input, output) {
  output$result1 <- renderTable(
    head(iris)
  )
  output$result2 <- renderPrint(
    summary(iris)
  )
}

shinyApp(ui = ui, server = server)
```

What do you want to show?

- (●) Table
- ( ) Summary

| Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|---|---|---|---|---|
| 5.10 | 3.50 | 1.40 | 0.20 | setosa |
| 4.90 | 3.00 | 1.40 | 0.20 | setosa |
| 4.70 | 3.20 | 1.30 | 0.20 | setosa |
| 4.60 | 3.10 | 1.50 | 0.20 | setosa |
| 5.00 | 3.60 | 1.40 | 0.20 | setosa |
| 5.40 | 3.90 | 1.70 | 0.40 | setosa |

What do you want to show?

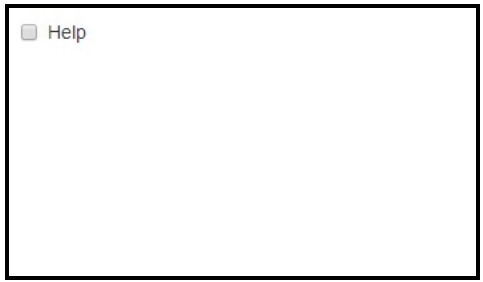
- ( ) Table
- (●) Summary

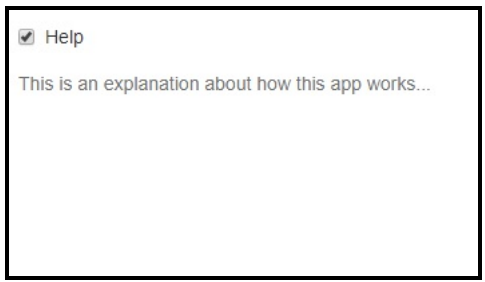
```
 Sepal.Length    Sepal.Width     Petal.Length    Petal.Width          Spec
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   setosa
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   versicolor
 Median :5.800   Median :3.000   Median :4.350   Median :1.300   virginica
 Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
 3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
 Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
```

**Exercise:** use `tabsetPanel`

# Example 2

```
ui <- fluidPage(

   checkboxInput("help", "Help"),

   conditionalPanel(
     condition = "input.help",
     helpText("This is an explanation
       about how this app works...")
   )

)

server <- function(input, output) {}

shinyApp(ui = ui, server = server)
```

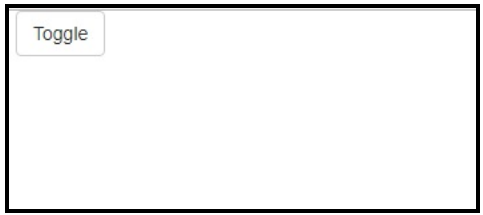


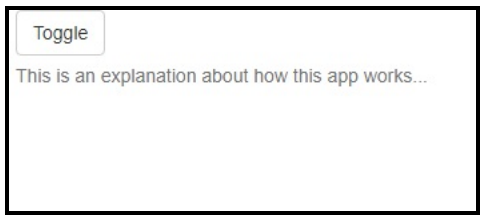




This text appears and disappears clicking on the check box.

# Example 3

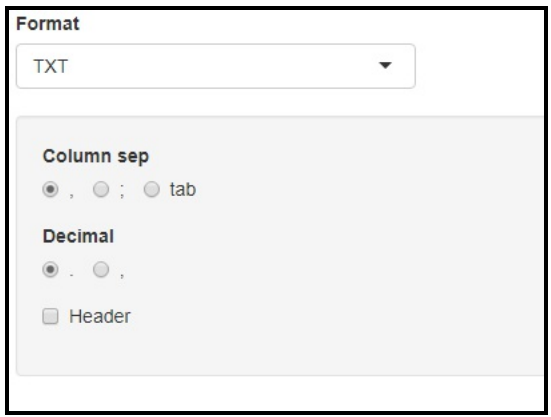
```r
library(shiny)

ui <- fluidPage(

  actionButton("toggle", "Toggle"),

  conditionalPanel(
    condition = "input.toggle%2==0",
    helpText("This is an explanation
      about how this app works...")
  )

)

server <- function(input, output) {}

shinyApp(ui = ui, server = server)
```



# Example 4

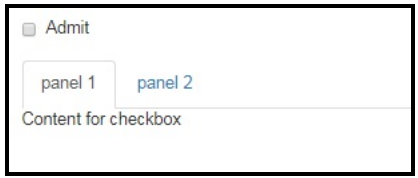
```
ui <- fluidPage(

   selectInput("format", "Format",
     c("SPSS"=1, "EXCEL"=2, "TXT"=3, "R"=4)),

   conditionalPanel(
     condition = "input.format==3",
     wellPanel(
       radioButtons("sep", "Column sep",
         c(",", ";", "tab"), inline = TRUE),
       radioButtons("dec", "Decimal",
         c(".", ","), inline = TRUE),
       checkboxInput("header", "Header")
     )
   )

)

server <- function(input, output) {}

shinyApp(ui = ui, server = server)
```


Note the **`wellPanel`** function to create a frame around the elements, and the **`inline`** argument of **`radioButtons`** function to place the items in horizontal.

# Example 5

```r
ui <- fluidPage(
   conditionalPanel(
       condition = "input.menu=='panel 1'",
       checkboxInput("check","Admit")
   ),
   conditionalPanel(
       condition = "input.menu=='panel 2'",
       textInput("name","Name","")
   ),
  tabsetPanel(id = "menu",
    tabPanel("panel 1",
      "Content for checkbox"
    ),
    tabPanel("panel 2",
      "Content for name"
    )
  )
)

server <- function(input, output) {}

shinyApp(ui = ui, server = server)
```





The result is different depending on the active tab.

# Exercise

# Exercice

Complete the code in the UI part to place the elements and tabs in the following form:

On the **left hand** of the form it must be a panel where:

- the user can choose one of the following distributions
  - exponential
  - normal
  - binomial
- Depending on the distribution selected, proper parameters must appear so that the user can enter their values:

On the **right hand** of the form there must be two tabs:

- First tab containg a histogram with 1,000 data randomly generated under the selected distribution with the specified parameters.
- Second tab containg a summary of generated data.

# Distribution exercise

**Choose distr**

Binomial

**Trials**

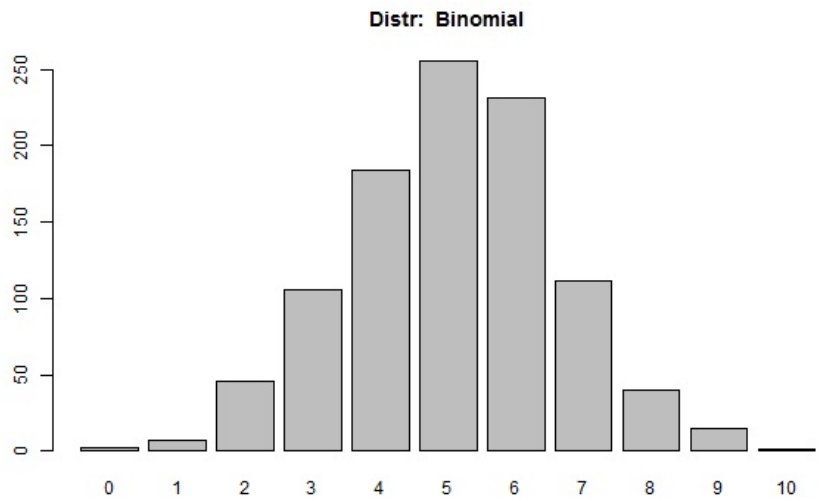
10

**Prob**

0 0.5 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Plot Summary



```r
ui <- fluidPage(

   titlePanel("Distribution"),

   sidebarLayout(

      sidebarPanel(

        ...

      ),

      mainPanel(

        ...

      )
   )
)
```

```r
server <- function(input, output) {

  output$summary <- renderPrint({
    if (input$distr=="Normal")
      data <- rnorm(1000, input$mu, input$sd)
    if (input$distr=="Exponential")
      data <- rexp(1000, input$lambda)
    if (input$distr=="Binomial")
      data <- rbinom(1000, input$n, input$p)
    summary(data)
  })

  output$plot <- renderPlot({
    if (input$distr=="Normal")
      data <- rnorm(1000, input$mu, input$sd)
    if (input$distr=="Exponential")
      data <- rexp(1000, input$lambda)
    if (input$distr=="Binomial")
      data <- rbinom(1000, input$n, input$p)
    if (input$distr=="Binomial"){
      datafact <- factor(data, levels=0:input$n)
      barplot(table(datafact))
    } else {
      hist(data, main="")
    }
    title(paste("Distr: ", input$distr))
  })

}
```