Getting Data from the Web with R

Part 7: Getting Data via Web Forms

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Readme

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4. Parsing XML / HTML content
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6. HTTP basics and the RCurl package
7. **Getting data via Web Forms**
8. Getting data via Web services

Data via Web Forms

Goal

Web Forms ...

The goal of the present slides is to show you **how to get data via web forms** with R

Synopsis

In a nutshell

We'll cover the following topics:

- Basics of HTML Forms
- HTTP requests in Web forms
- R package `"RHTMLForms"`
- How to use `"RCurl"` to query HTML Forms
- Case Studies

Some References

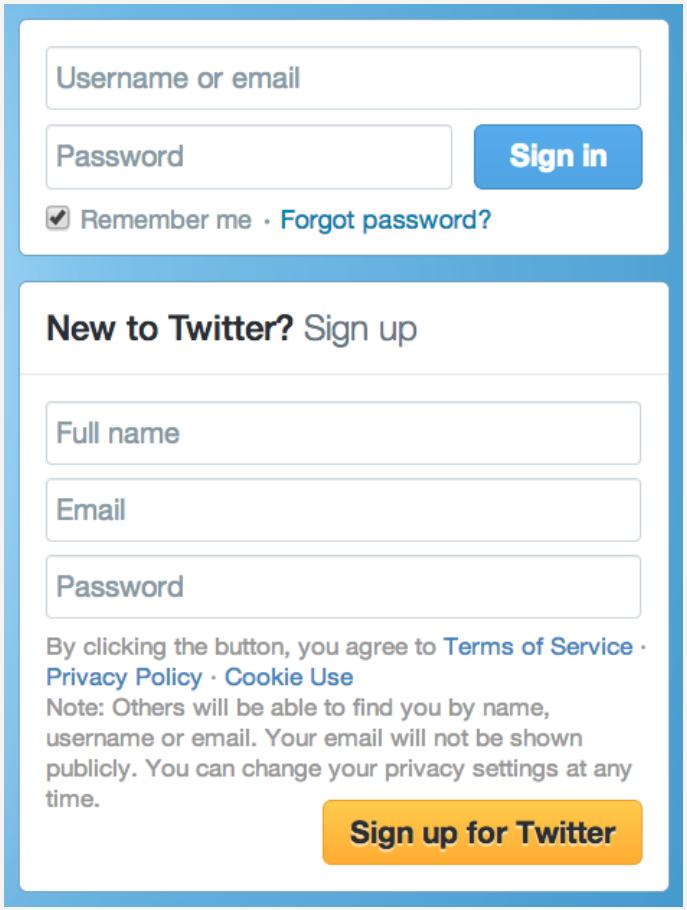
- XML and Web Technlogies for Data Sciences with R
  by Deb Nolan and Duncan Temple Lang
- HTML Forms W3C Tutorial

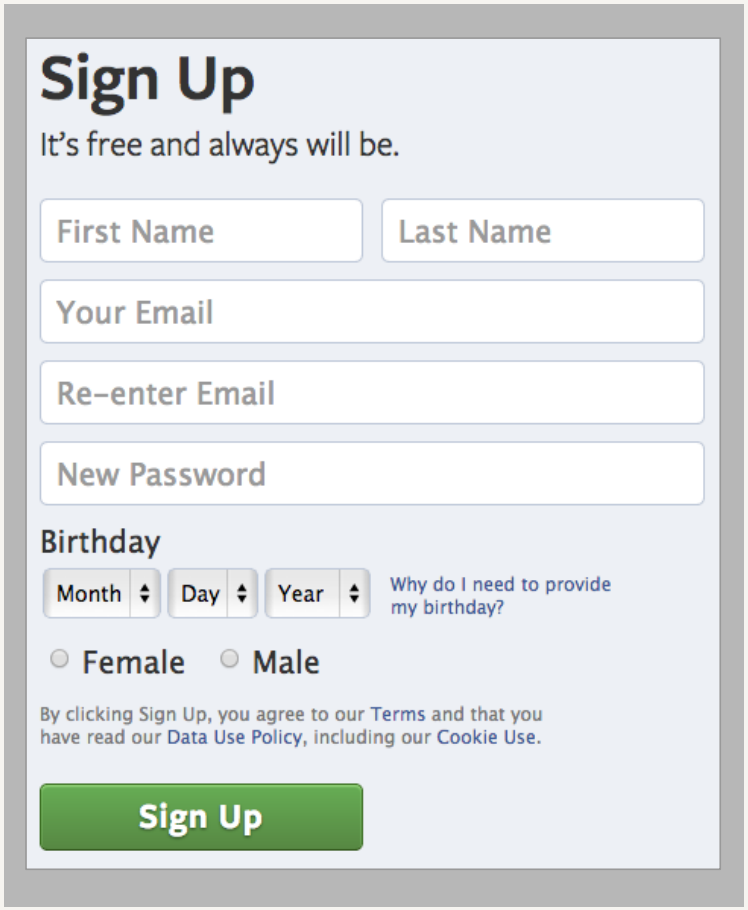
  `http://www.w3.org/TR/html401/interact/forms.html`
- R Package `"RHTMLForms"`

  `http://www.omegahat.org/RHTMLForms/`

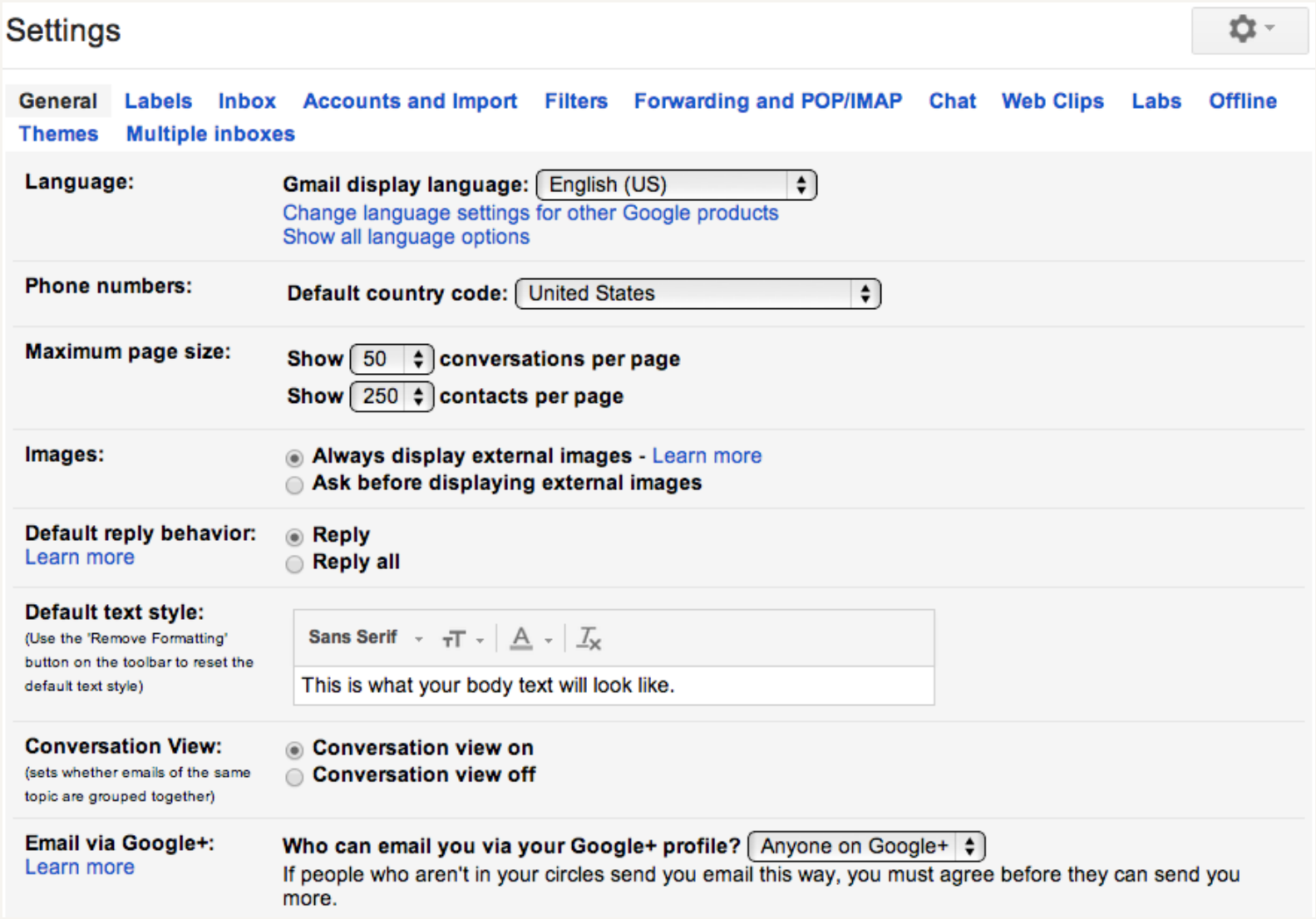
HTML Forms

Examples of HTML Forms





Examples of HTML Forms



HTML Forms?

We use HTML Forms practically everyday:

- when we sign in to our email accounts
- when we make transactions online
- when we post comments
- when we fill online surveys
- *etc*

HTML Forms

HTML Forms *(aka Web Forms)*:

- are used to gather information from the user
- transmit or *submit* data to a server
- add interactivity to websites

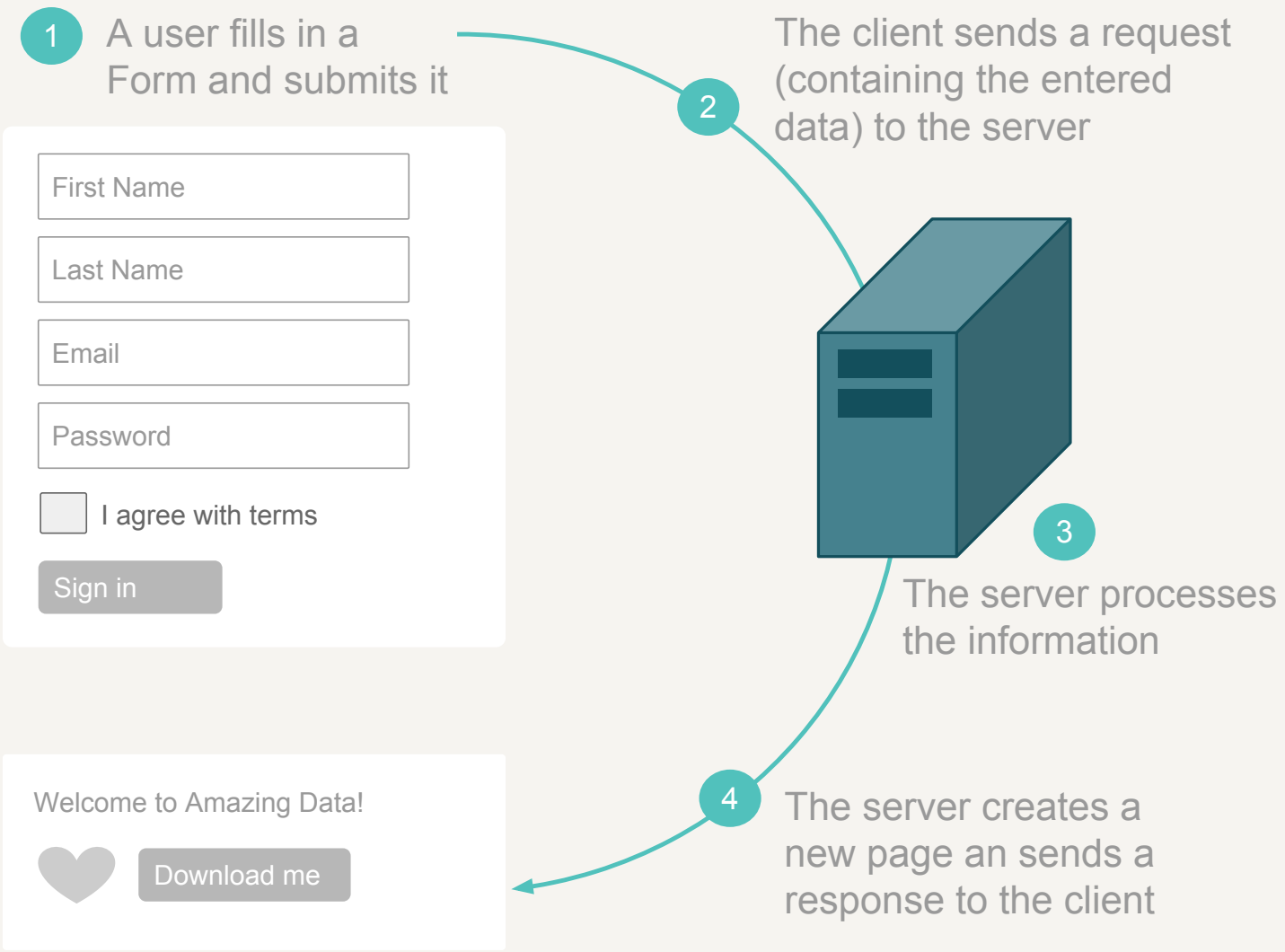
Importance

Why should we care?

Besides allowing websites to provide a way for interacting with users, HTML Forms play a prominent role regarding data on the Web.

Admittedly, **large amounts of data on the Web are accessible via HTML Forms**. Hence the importance for being familiar with the basic concepts around Web Forms.

How Forms Work



HTML Forms

Broadly speaking ...

Many websites have Forms that the visitors must use in order to provide some kind of input information.

This information is taken by the browser —ie the client— which submits a request to the server.

Based on the data submitted, the server takes an appropriate action and produces a customized response.

Basics of HTML Forms

HTML Form Element

Form Characteristics

- A Form is defined with an html `<form>` element.
- A `<form>` element has 2 main attributes: `action` and `method`
- A `<form>` element is a container for all the content of the form

Conceptual form

```
<form action="..." method="...">

   [The input elements go here]

</form>
```


Form Action and Method

Form Attributes

An HTML Form has 2 main attributes: **action** and **method**

- the `action` attribute points to the server side script that handles the form submission
- the `method` defines the type of HTTP request that is used to submit the information: `GET` or `POST`

HTML Forms

Form Controls

- The way Forms allow to capture input data is by using **form controls**
- Form controls live inside the `<form>` element
- There are several types of form controls (eg text boxes, select menus, checkboxes, radio buttons, submit buttons)
- Some of the more common controls are:
  - `<input>` (there are various classes of inputs)
  - `<textarea>`
  - `<select>`
  - `<option>`
  - `<button>`

Some HTML Form Controls

Control	Description
`<input type="text">`	text box
`<input type="password">`	password box
`<input type="radio">`	radio button
`<input type="checkbox">`	checkbox
`<input type="submit">`	submit button
`<input type="reset">`	reset button
`<input type="hidden">`	hidden field
`<input type="button">`	button
`<select>`	selection
`<option>`	selection
`<textarea>`	text area

Appearance of some Form Controls

Text input

Gaston

Password input

****

Text area

Enter your comments ...

Radio buttons

- small
- medium
- large

Checkboxes

- economy
- business
- first

Drop-down boxes

Continent

Africa
America
Asia
Europe
Ocenia

Image buttons

Sign in

Submitting buttons

Subscribe

File upload

Browse

Upload

About Form Controls

Form Control Names

The job of a form control is to gather one piece of information from the user. In order to uniquely identify the collected piece of data, controls have a `name` attribute.

Control examples: Username and Password

```
<form method="get" action="/bin/process">
    Enter your name: <input type="text" name="username"><br />
    Enter your password: <input type="password" name="password"><br />
</form>
```


HTML Form in a Website

Camping and Hiking > Backpacks > Backpacking Packs

ZOOM

ARROYO RED

Osprey Aether 70 Pack

Slip the Osprey Aether 70 pack onto your back and enjoy the comfort of a custom, heat-moldable hipbelt and a superb, lightweight design for your backcountry adventures.

$289.95

★★★★★ (44)

Item # 846410

REI Members get back an estimated **$ 29.00 on this item** as part of their annual member refund.

Choose Your Color/Size

* Color/Size is out of stock but can be backordered.

1 Quantity

add to cart | find in store | add to wish list

THE REI DIFFERENCE | 100% SATISFACTION GUARANTEED | GEAR & ADVICE YOU CAN TRUST

This item ships for free! Learn more

HTML Form Components

form element

<form id="productSelectForm2" name="additem" action="/AddItemToCartController" method="post">

selection element

<select id="sku" class="required prodLabel" name="sku" size="1"> … </select>

input text element

<input id="quantity" class="required" type="text" name="quantity" maxlength="4" value="1">

button element

<button id="cartFormButton" class="medium primary button" type="submit"> … </button>

</form>

Submitting Forms

Form Submission

Submission Request

Once the user fills in a Form and hits the submit button —or any other type of submit action— the browser gathers the input data and sends a request to the web browser.

HTTP Request Methods

There are 2 *requesting* mechanisms for submitting Web forms:

- using an **HTTP GET** request
- using an **HTTP POST** request

Form Submission

HTTP Request Methods

The type of request —`GET` or `POST`— depends on the **method** specified in the Web Form.

Attribute `method`

Remember that the HTTP request method is specified with the attribute `method` inside the `<form>` element.

Forms and HTTP Requests

HTTP methods in forms

The way the browser gathers the input data is by collecting the **name** and **value** of each of the controls. We say that the browser packs them into `"name=value"` pairs.

Both methods, `GET` and `POST`, take the set of `name=value` pairs to parametrize the request.

The difference between `GET` and `POST` is in **how the name=value pairs are delivered to the Web server.**

Toy Example: Coffee Form

Choose your coffee:

Beverage

Espresso
Americano
Cappuccino
Latte
Mocha

What Size?

small medium large

Decaf:

no yes

```
<form  method="get | post"  action="/bin/process">
   Choose your coffee: <br />
   <select name="beverage">
     <option value="esp">Espresso</option>
     <option value="ame">Americano</option>
     <option value="cap">Cappuccino</option>
     <option value="lat">Latte</option>
     <option value="moc">Mocha</option>
   </select> <br />


   What size?
   <input type="radio" name="size" value="small" />small
   <input type="radio" name="size" value="medium" />medium
   <input type="radio" name="size" value="large" />large<br />


   Decaf:
   <input type="checkbox" name="decaf" value="no" />no
   <input type="checkbox" name="decaf" value="yes" />yes
</form>
```

Encoding of Name-Value Pairs

Name-Value Pairs

The browser gathers the **name** and **value** of each of the control fields forming `name=value` pairs:

- `beverage=esp`
- `size=small`
- `decaf=no`

Query String

The `name=value` pairs are concatenated together into a **query string** using `"&"` as a field separator:

`beverage=esp&size=small&decaf=no`

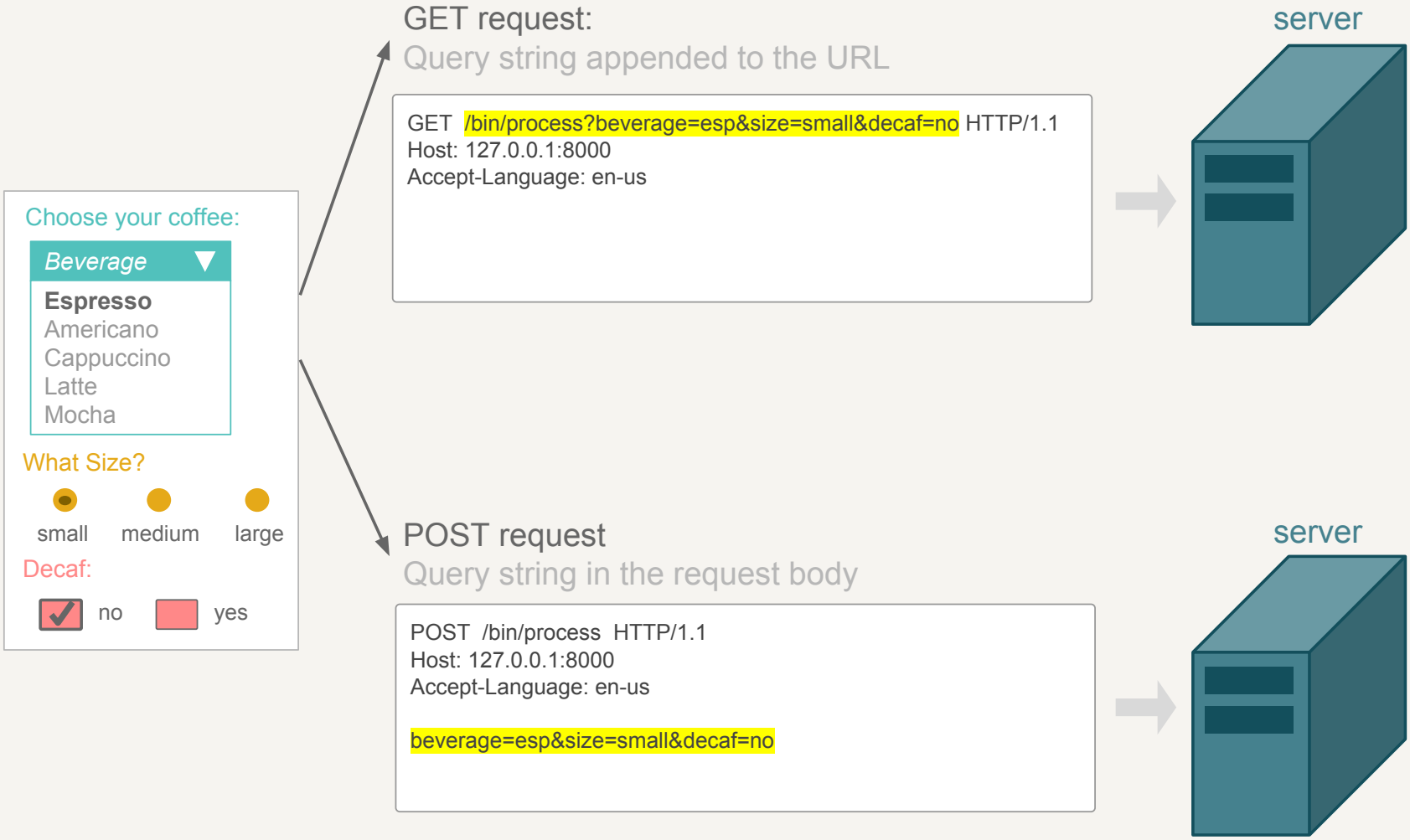
Query String and Submit Methods

GET or POST

The way the query string is handled depends on the request method:

- If `GET` is used, name-value pairs are appended to the requested URL
- If `POST` is used, the name-value pairs are sent as part of the request body

Query String in GET and POST



GET Method

GET method

With `GET`, the parameters are appended to the action and included as part of the URL in the HTTP request.

Query string appended to URL

```
GET /bin/process?beverage=esp&size=small&decaf=no HTTP/1.1
Host: 127.0.0.1:8000
Accept-Language: en-us
```


POST Method

POST method

With `POST`, the parameters are sent in the body of the HTTP request and the URL is simply the action

Query string as part of the request body

```
POST /bin/process HTTP/1.1
Host: 127.0.0.1:8000
Accept-Language: en-us

beverage=esp&size=small&decaf=no
```


R package "RHTMLForms"

Package RHTMLForms

RHTMLForms

There are several approaches to get data via Web Forms in R. One very nice way to do that is by using the package "RHTMLForms" (by Duncan Temple Lang)

What for?

"RHTMLForms" is an ad-hoc package that allows us to interact with Web Forms in a simple manner without having to worry about all the overwhelming details behind the HTTP requests, the control fields, and the query strings.

Installing RHTMLForms

Package Source

At the moment of this writing, "RHTMLForms" is NOT available on CRAN. Instead, the package must be downloaded from:

http://www.omegahat.net/RHTMLForms/

For these slides I'm using the package version 0.6-0 from the source file —*tarball*— RHTMLForms_0.6-0.tar.gz

Once you downloaded the package tar.gz file, you can proceed with the installation in R.

Installing RHTMLForms

Installation

Let's assume the *tarball* file `RHTMLForms_0.6-0.tar.gz` is in your `Downloads` directory.

To install `"RHTMLForms"` in R type the following in your console:

```
# installing RHTMLForms
install.packages("~/Downloads/RHTMLForms_0.6-0.tar.gz",
                 repos = NULL, type = "source")
```


Working with HTML Forms

Preliminaries

Getting data via HTML Forms requires you to understand the type of Forms you are interacting with:

- what method the Forms use (`GET` or `POST`)
- what control inputs they have (buttons, text, etc)
- what type of output is produced by the Server

Working with HTML Forms

Preliminaries

There's a *workflow procedure* that we should follow to take full advantage of `"RHTMLForms"`:

1. we start by **exploring the website** that contains the Forms (how many forms, what structure they have, etc)
2. we get a **description** of the Forms we are interested in
3. we **figure out what inputs** we need to pass to the Forms
4. we **submit** the necessary requests
5. we **process** the documents produced by the Server

Using RHTMLForms

Let's start with the Google search form

Structure of the Google Search Form

If you oepn your *web inspection tool* or see the source code of Google's Search homepage, you should be able to identify the HTML form:

```
<form action="/search" id="f" method="get">
  <div id="hf"></div>
  <div id="fkbx">
    <input id="q" jsaction="mousedown:ntp.fkbxclk" aria-hidden="true"
     autocomplete="off" name="q" tabindex="-1" style="opacity: 0;">
    <div id="fkbx_crt"></div>
    <div id="fkbx-spch" tabindex="1" aria-label="Search by voice"
     style="display: block;"></div>
    <div id="fkbx-hspch" tabindex="1" aria-label="Listening for "Ok Google"">
    </div>
    <div id="fkbx-hht">Say "Ok Google"</div>
  </div>
</form>
```


getHTMLFormDescription()

The main function to *explore* the Forms in a website is `getHTMLFormDescription()` which allows us to process an HTML document and get a description of its Forms:

```
# load RHTMLForms
library(RHTMLForms)

# google url
google = "http://www.google.com"

# get forms
google_forms = getHTMLFormDescription(google)

google_forms


## $f
## HTML Form: http://www.google.com/search
## q: [  ]
```

In this case there's only one form: `q` (which is a query search)

```
# put the form in a separate object
gform = google_forms$f

# object attributes
attributes(gform)


## $names
## [1] "formAttributes" "elements"       "url"
##
## $class
## [1] "HTMLFormDescription"
```

Note that the `gform` is of class `"HTMLFormDescription"`

getHTMLFormDescription()

We can obtain a number of descriptive features from an object of class "HTMLFormDescription":

```
# form attributes
gform$formAttributes


##                          action
## "http://www.google.com/search"
##                          method
##                           "get"
## attr(,"class")
## [1] "HTMLFormAttributes"


# form url
gform$url


##                          action
## "http://www.google.com/search"
```

```
# form elements
gform$elements


## $ie
## ie: ISO-8859-1
##
## $hl
## hl: en
##
## $source
## source: hp
##
## $biw
## biw:
##
## $bih
## bih:
##
## $q
## q: [  ]
##
## $gbv
## gbv: 1
##
## attr(,"class")
## [1] "HTMLFormElementsList"
```

Working with `getHTMLFormDescription()`

What does `getHTMLFormDescription()` do?

- parses an HTML document and processes each `<form>` element
- returns a list containing the identified `<form>`'s
- each list element is of class `"HTMLFormDescription"`
- determines the URL to which we should submit the form
- identifies the method for submitting the form (`GET`, `POST`)

For each `"HTMLFormDescription"` element we can check

- `$formAttributes`
- `$elements`
- `$url`

createFunction()

There's a very handy function called `createFunction()` that we can use on each of the elements `"HTMLFormDescription"`

`createFunction()` generates an R function for **form submission**. Together with the package `"RCurl"`, `createFunction()` allows us to specify values for each of the Form parameters, and obtain the result from the Web server.

getHTMLFormDescription()

`createFunction()` allows us to create an R function to generate our own *Google Search Form Submission*.

```
# create submitting function for google search Form
google_submit = createFunction(gform)
```

With the created function, and using `"RCurl"`, we can submit a search Form. Then we can parse the obtained outcome with one of the functions from `"XML"`:

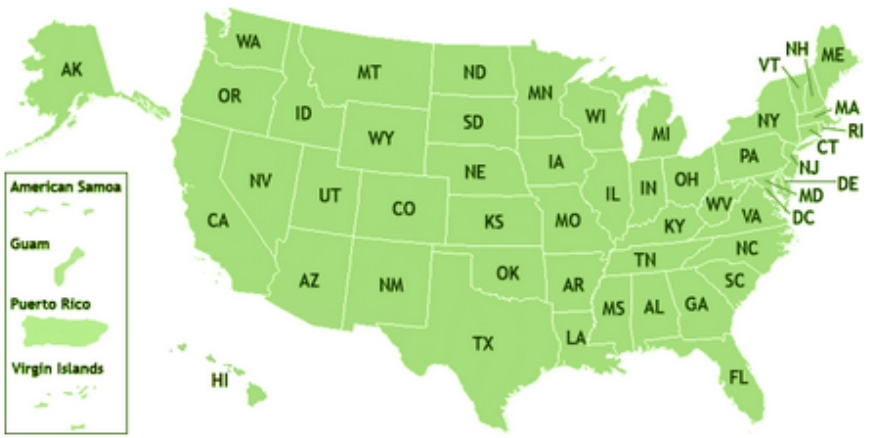
```
# load RCurl
library(RCurl)

# submit a search of the term "R project"
r_project = google_submit("R project")

# we can then parse the content
library(XML)
r_project = htmlParse(r_project)
```


Case Study: National Parks

Find a National Park

BROWSE ALPHABETICALLY: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

BY STATE:



BY NAME: park name GO

BY LOCATION: Select Location GO

BY CATEGORY: Select Category GO

BY THEME: Select Theme GO

» View All Park Pages

National Parks Conservation Association

NPCA

The website of the *National Parks Conservation Association* (NPCA) has a page that allows us to find a National Park:

`http://www.npca.org/parks/`

What for

Let's use `"RHTMLForms"` to get information and descriptions about the forms available in the *Find a National Park* page.

Finding a National Park

Let's start with `getHTMLFormDescription()` to get the list of form descriptions:

```
# npca url
npca = "http://www.npca.org/parks"

# get descriptions of forms
park_forms = getHTMLFormDescription(npca)

# how many forms
length(park_forms)
```

```
## [1] 10
```

We are interested in the Forms that have to do with *Finding a National Park*

Inspecting NPCA Forms

The first three Forms are NOT the ones we want:

```
# 1st form (not interesting)
park_forms[[1]]


## HTML Form: /search-results.html
## q: [ Search... ]


# 2nd form (not interesting)
park_forms[[2]]


## HTML Form: http://npca.convio.net/site/Survey
## cons_email: [  ]


# 3rd form (not interesting)
park_forms[[3]]


## HTML Form: http://my.npca.org/site/Donation2?df_id=1333&Level=1716&1333.donation=form1&s_subsrc=sidebar_
## donation_amount: on
```

Inspecting NPCA Forms

The 4th Form does have to do with *Finding a National Park*

```
# 4th form (now we're talking)
park_forms[[4]]


## HTML Form: /exploring-our-parks/parks/search.jsp
## query: [ park name ]


# park name form
park_name = park_forms[[4]]

# form attributes
park_name$formAttributes


##                                  action
## "/exploring-our-parks/parks/search.jsp"
##                                  method
##                                   "get"
## attr(,"class")
## [1] "HTMLFormAttributes"
```

This is a **query** input that uses a `GET` method

Park State Form

Let's get the 5th form in a separate object before creating a submission form function:

```
# 5th form (park state form)
park_state = park_forms[[5]]
park_state$elements


## $state
## state: [  ]  , al, ak, as, az, ar, ca, co, ct, de, dc, fl, ga, gu, hi, id, il, in, ia, ks, ky, la, me, m
##
## attr(,"class")
## [1] "HTMLFormElementsList"


park_state$formAttributes


##                                       action
## "/exploring-our-parks/parks/park-list.html"
##                                       method
##                                        "get"
## attr(,"class")
## [1] "HTMLFormAttributes"
```

Park State Form

Here's how to create a submission form function for the Park State Form:

```
require(RCurl)

# create 'form submission' function for park state
park_state_fun = createFunction(park_state)

# submission for parks in California
cal_parks = park_state_fun("California")
```

Finally, we can use the `getHTMLLinks()` function from `"XML"` to extract all the links:

```
require(XML)

# then we can extract the links
cal_park_links = getHTMLLinks(cal_parks)
```

