Web scraping 2
Advanced Crime Analysis UCL

Bennett Kleinberg

21 Jan 2019

Getting data from the Internet

Webscraping 2

Today

- “Real” webscraping: basics of a webpage
- Access webpage in the wild
- Retrieve wild data
- Download data through webscraping

APIs: Pros & Cons

Pro

- easiy to access
- nicely documentation
- **works even if website changes**

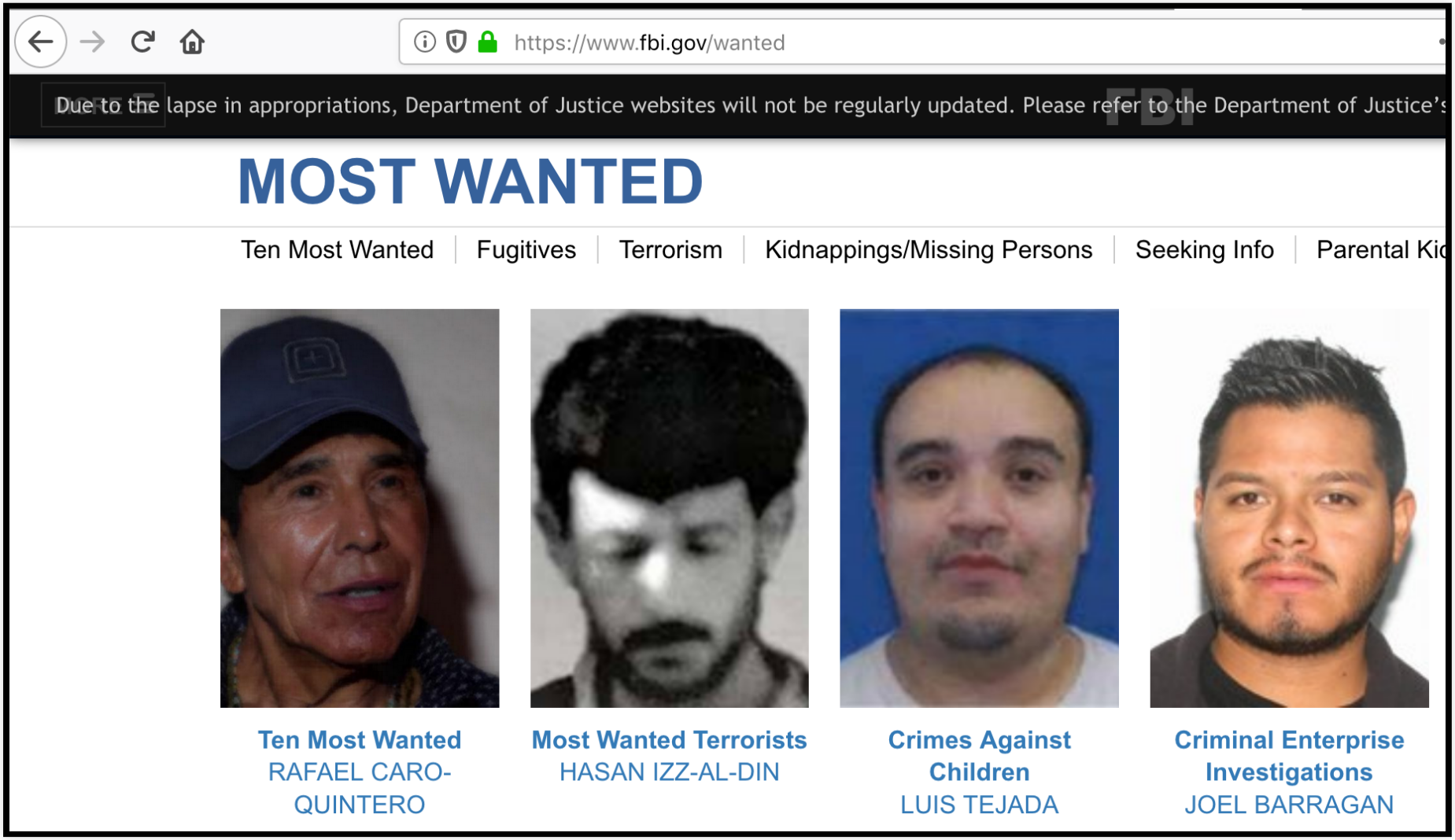
Cons

- quota limits ($ $ $)
- under the platforms' control
- only for few platforms

Don’t let the data determine your research!

COOL

But what about:



UK MISSING PERSONS UNIT

National Crime Agency (GB) | https://www.missingpersons.police.uk/en-gb/case-

Bureau Reference:	18-009282
Location	London
Gender	Male
Date found	21 September 2018
Age	30 - 40
Ethnicity	White European

View case details

View case details

Bureau Reference:	18-006195
Location	Dunsden
Gender	Male
Date found	15 May 2018
Age	16 - 100
Ethnicity	White European

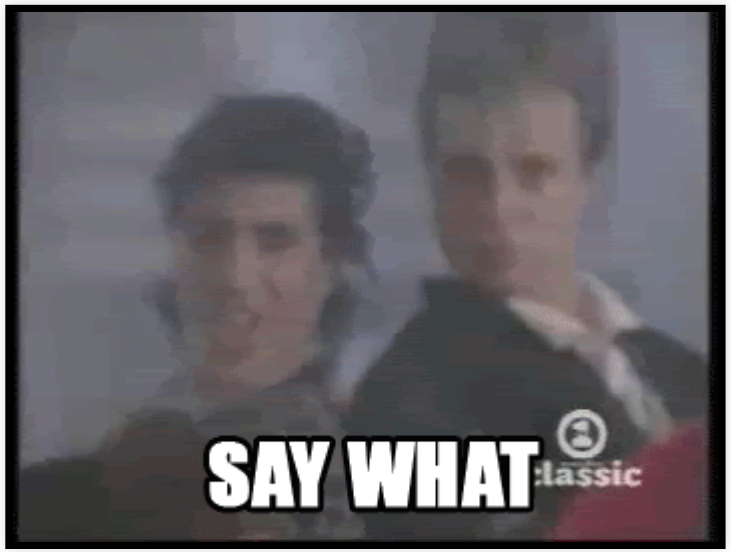
View case details

No APIs

- incels.me
- stormfront
- 4chan
- **APIs are restrictive!**

... what about:

Your research question –> no API?



Main problem:

Really ‘juicy’ data of the Internet vs **APIs**

“Real” webscraping: basics of a webpage

Three elements of a webpage

1. Structure
2. Behaviour
3. Style

Three elements of a webpage

1. Structure
2. Behaviour
   - JavaScript (**!= Java**)
   - user interaction
   - examples: alerts, popups, server-interaction
3. Style

Three elements of a webpage

1. Structure
2. Behaviour
3. Style
    - CSS (Cascading Style Sheets)
    - formatting, design, responsiveness
    - examples: submit buttons, app interaces

Three elements of a webpage

1. Structure
    - HTML (hypertext markup language)
    - structured with `<tags>`
    - contains the pure content of the webpage
2. Behaviour
3. Style

For now: HTML

The very basics of HTML:

Raw architecture of a webpage

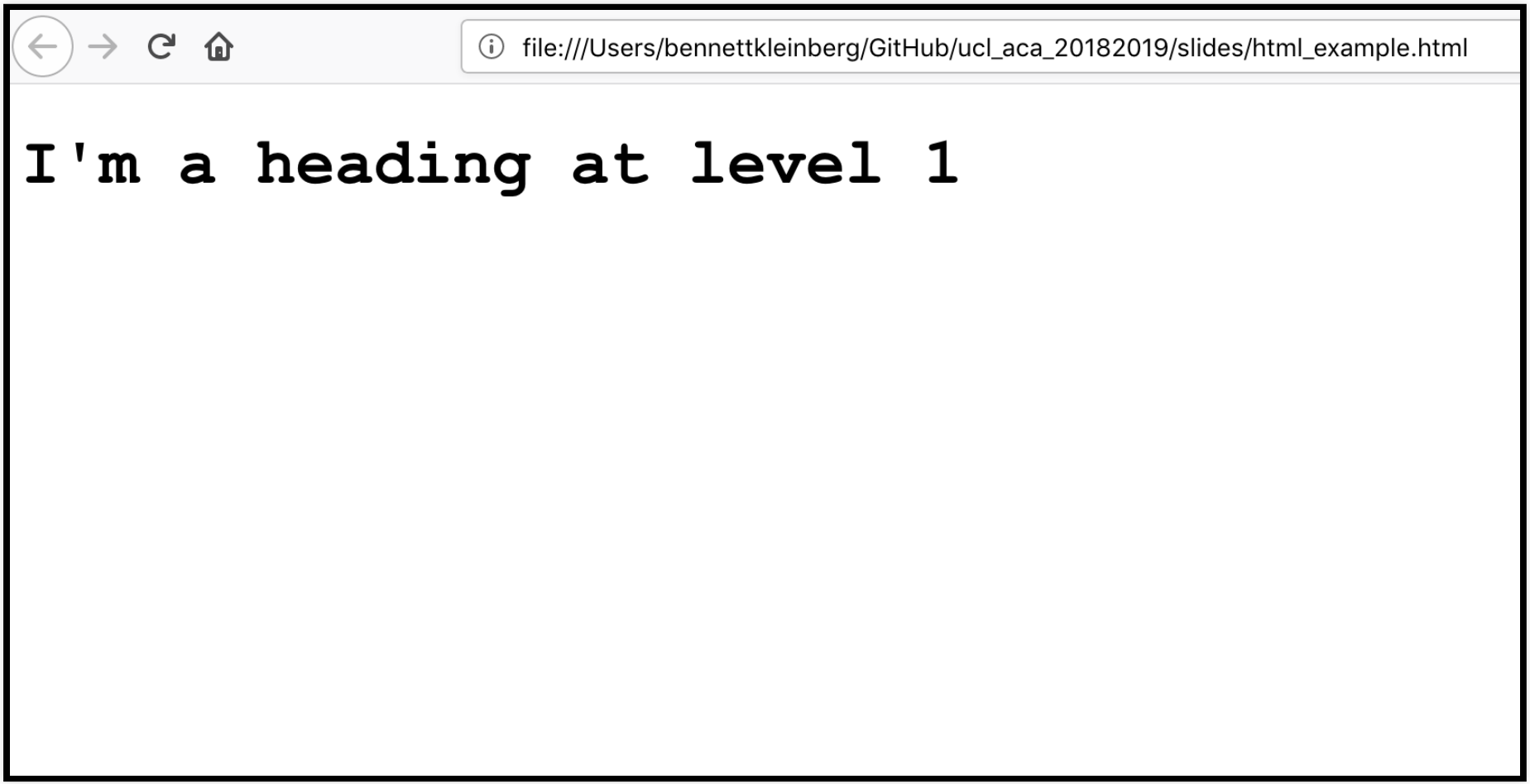
```
<!DOCTYPE html>
<html>
<body>

HERE COMES THE VISIBLE PART!!

</body>
</html>
```

Note: Every tags `< >` is closed `< />`. Content is contained within the tag.

HTML basics

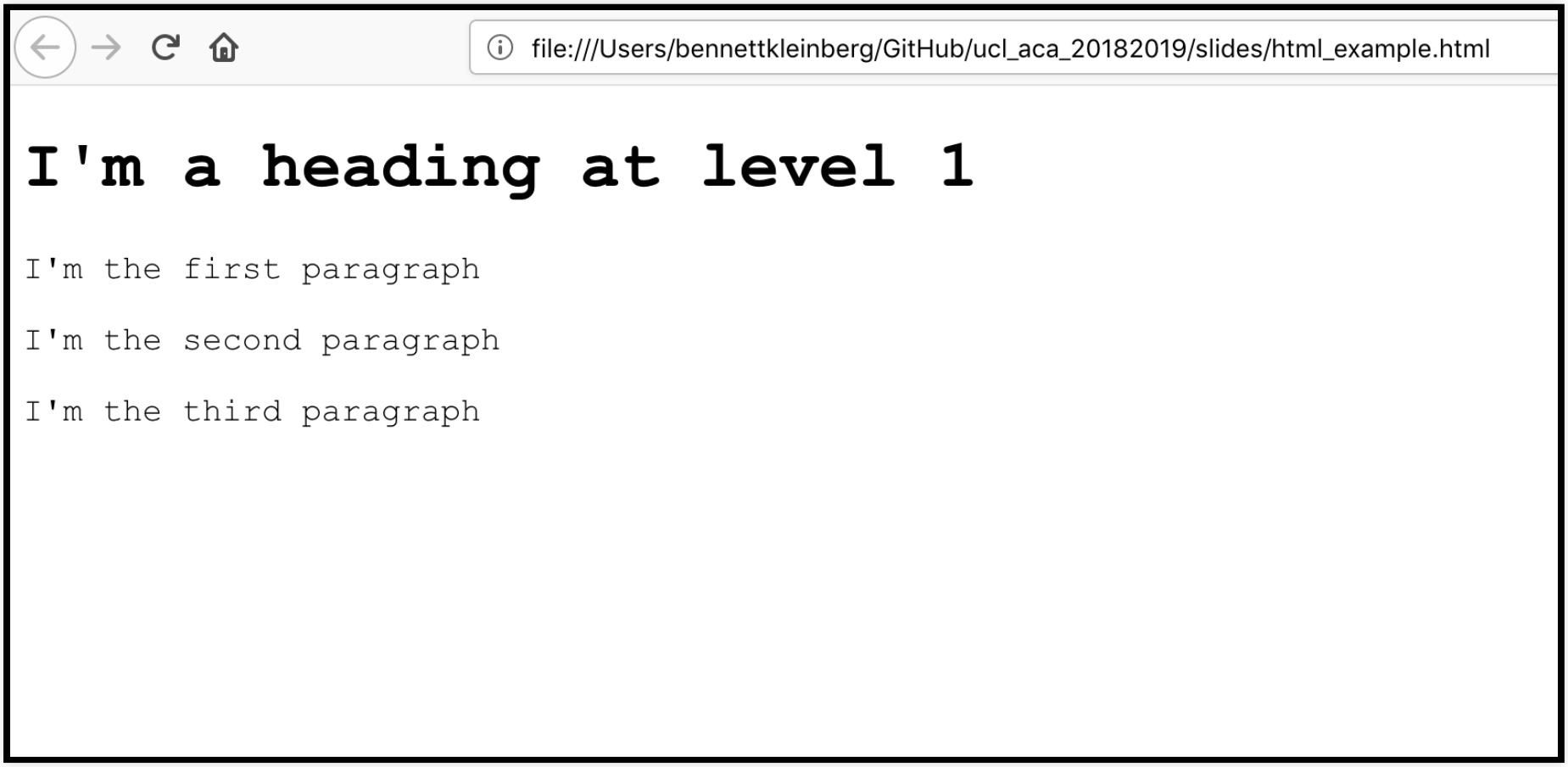
Ways to put content in the `<body> ... </body>` tag:

- headings: `<h1>I'm a heading at level 1</>`



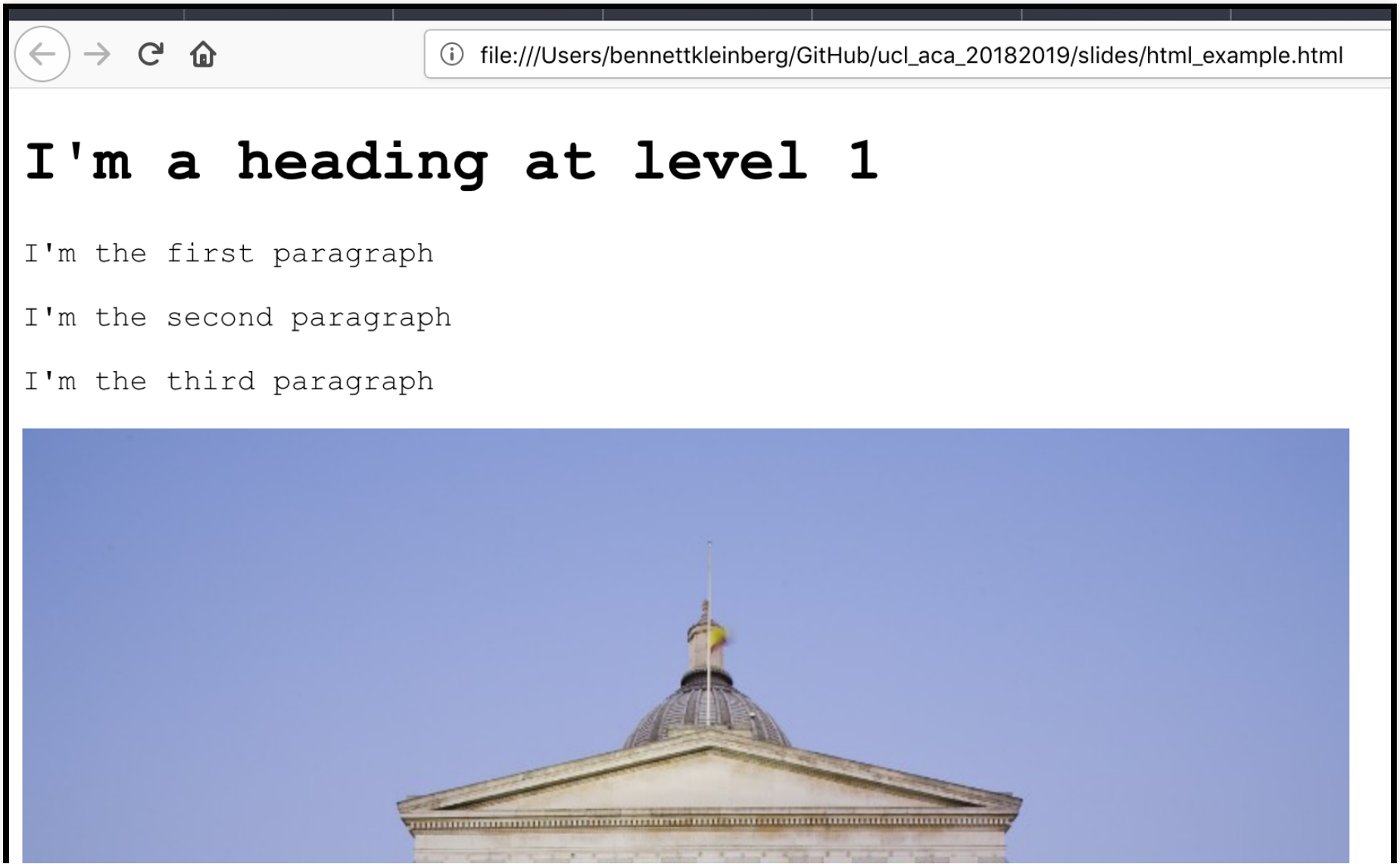
Content in the body tag

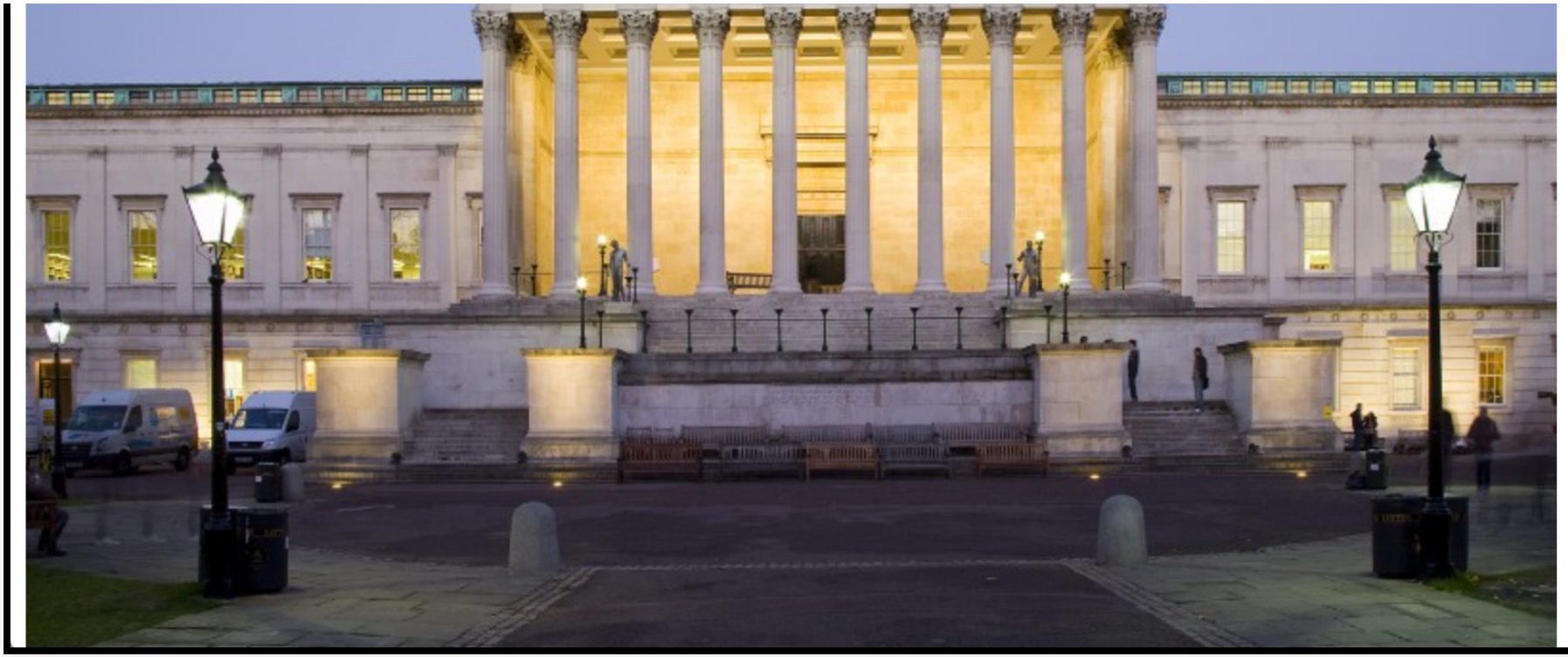
- paragraphs: `<p>This is a paragraph</p>`



Content in the body tag

- images: `<img src="./img/ucl.jpg">`

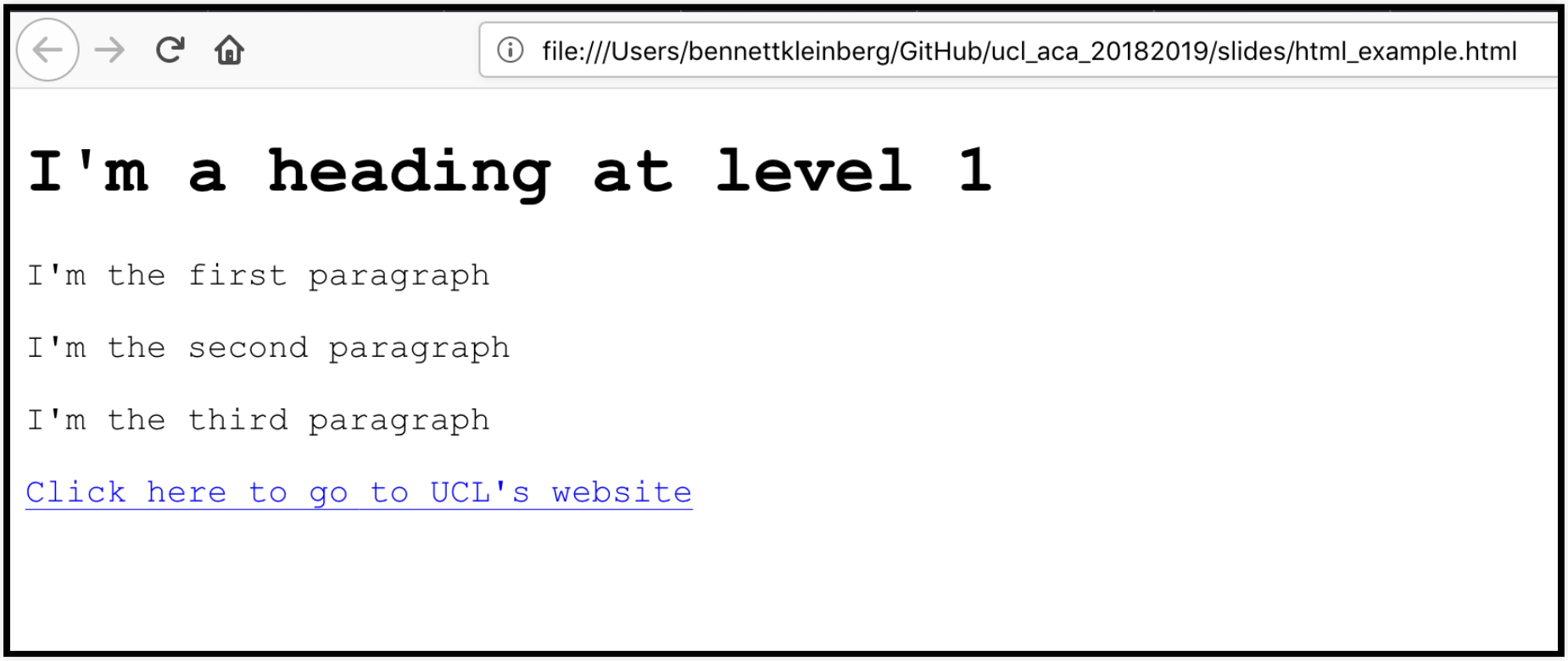




Content in the body tag

- links:

```
<a href="https://www.ucl.ac.uk/">Click here t
```

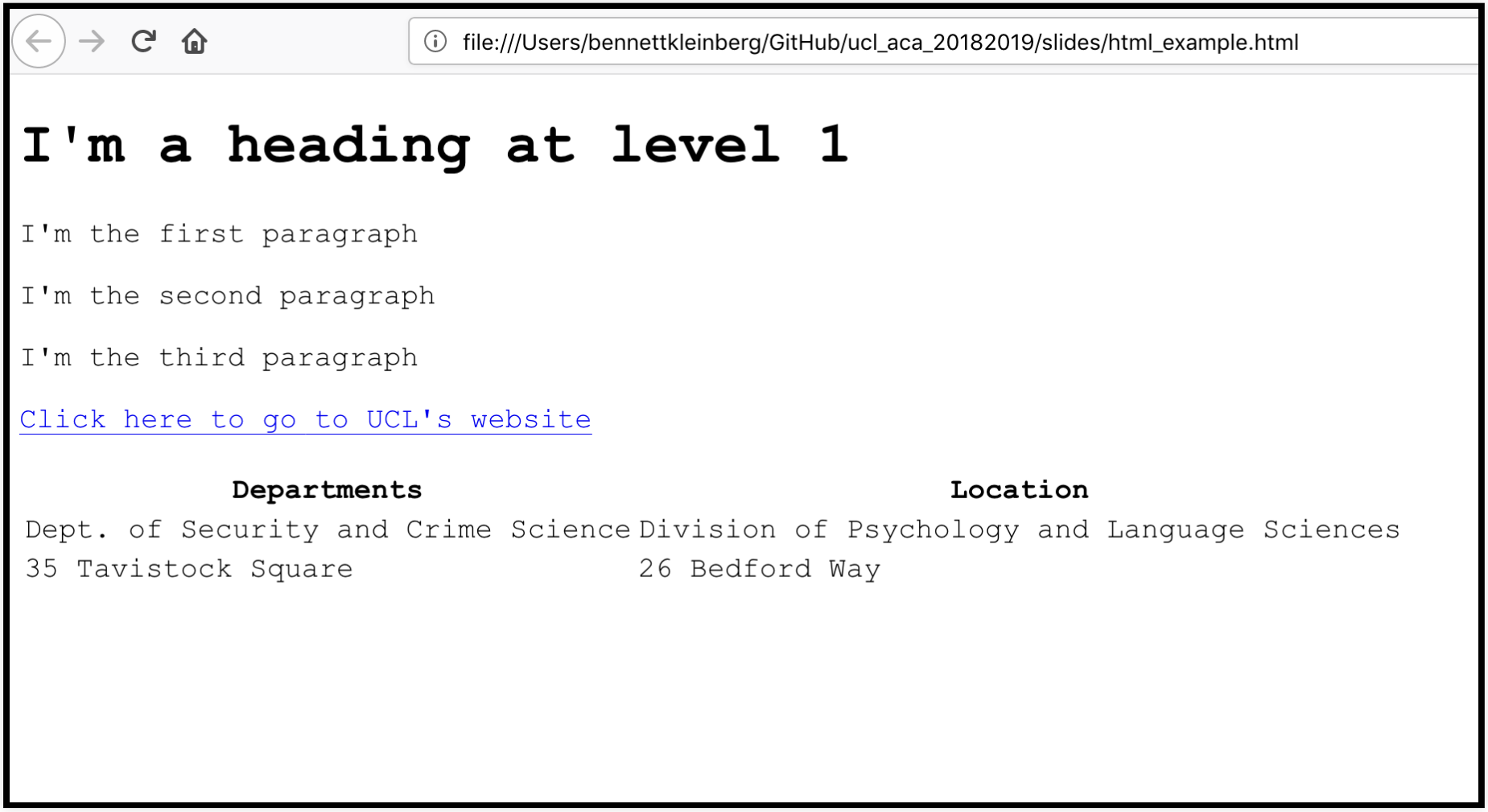


Content in the body tag

- tables

```
<table>
  <tr>
    <th>Departments</th>
    <th>Location</th>
  </tr>
  <tr>
    <td>Dept. of Security and Crime Science</td>
    <td>Division of Psychology and Language Sciences</td>
  </tr>
  <tr>
    <td>35 Tavistock Square</td>
    <td>26 Bedford Way</td>
  </tr>
</table>
```

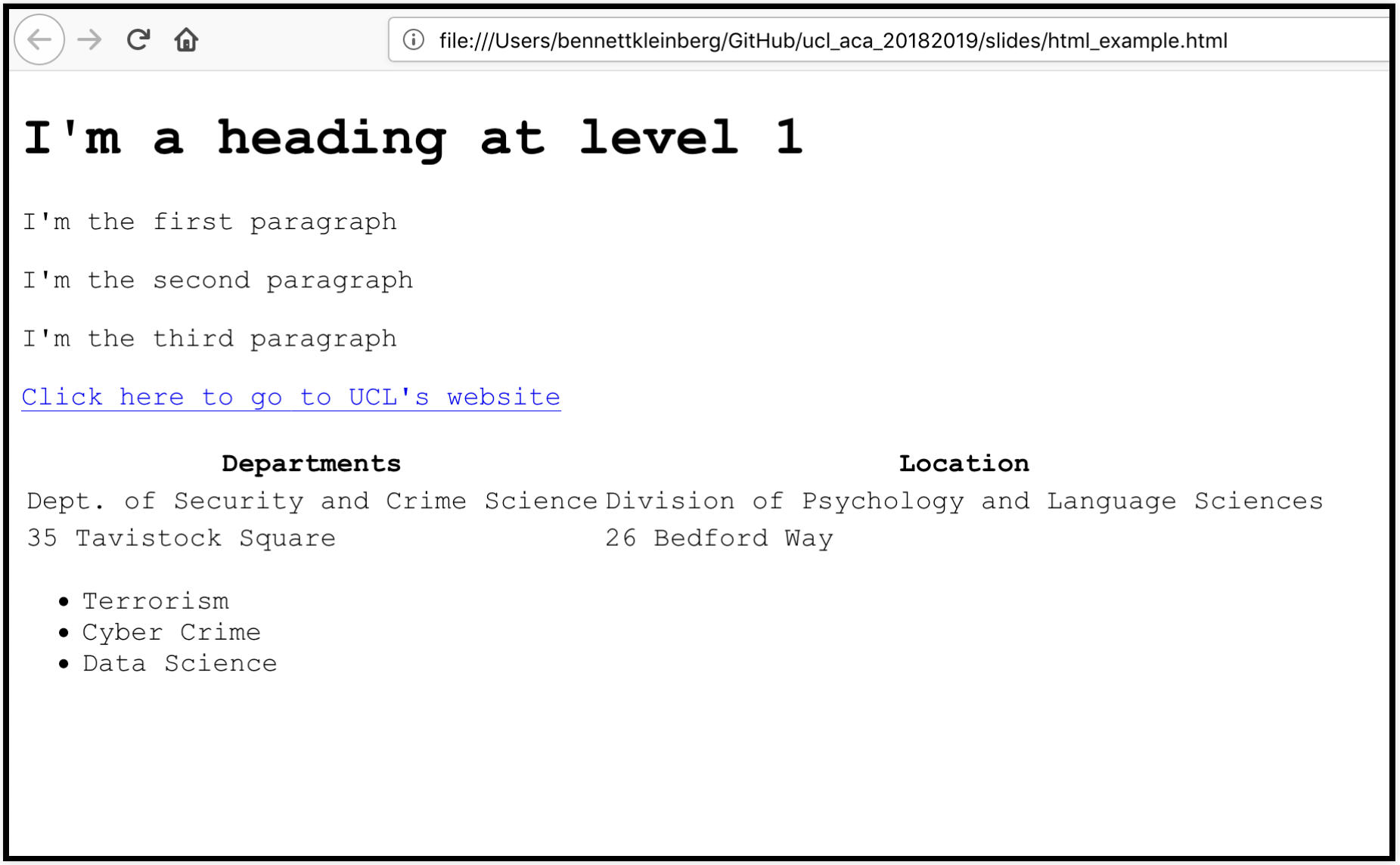
Html `<table>...</table>`



Content in the body tag

- lists

```
<ul>
  <li>Terrorism</li>
  <li>Cyber Crime</li>
  <li>Data Science</li>
</ul>
```


file:///Users/bennettkleinberg/GitHub/ucl_aca_20182019/slides/html_example.html
I'm a heading at level 1
I'm the first paragraph
I'm the second paragraph
I'm the third paragraph
Click here to go to UCL's website
Departments
Location
Dept. of Security and Crime Science
35 Tavistock Square
Division of Psychology and Language Sciences
26 Bedford Way
Terrorism
Cyber Crime
Data Science

HTML basics

Elements (can) have IDs:

```
<p id='paragraph1'>This is a paragraph</p>
<img id='ucl_image' src="./img/ucl.jpg">
```

Same for tables, links, etc.

Every element can have an ID.

You need unique IDs! Two elements cannot have the same ID.

HTML basics

Common elements (can) have CLASSES:

```
<p id="paragraph1" class="paragraph_class">I am the first paragraph</p>
<p class="paragraph_class">I am the second paragraph</p>
<p class="paragraph_class">I am the third paragraph</p>
```

Multiple elements can have the same class.

Now what?

Web scraping logic

If all webpages are built in this structure…

… then we could access this structure programmatically.

But where do I find that structure?

Is it just “there”?

YES!!

How to see the html structure?

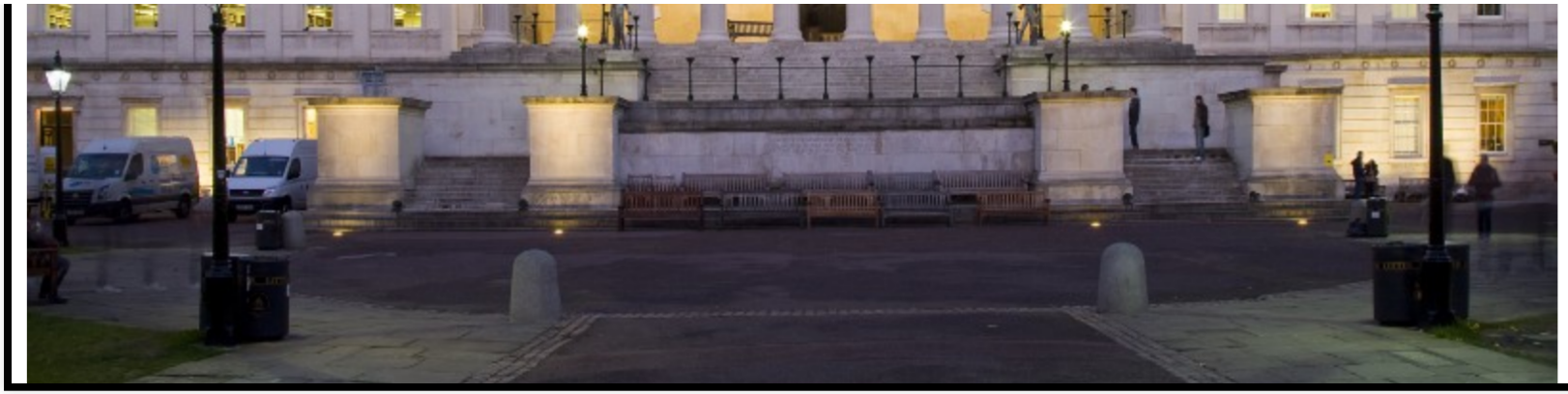
file:///Users/bennettkleinberg/GitHub/ucl_aca_20182019/slides/html_example.html

I'm a heading at level 1

I'm the first paragraph

I'm the second paragraph

I'm the third paragraph



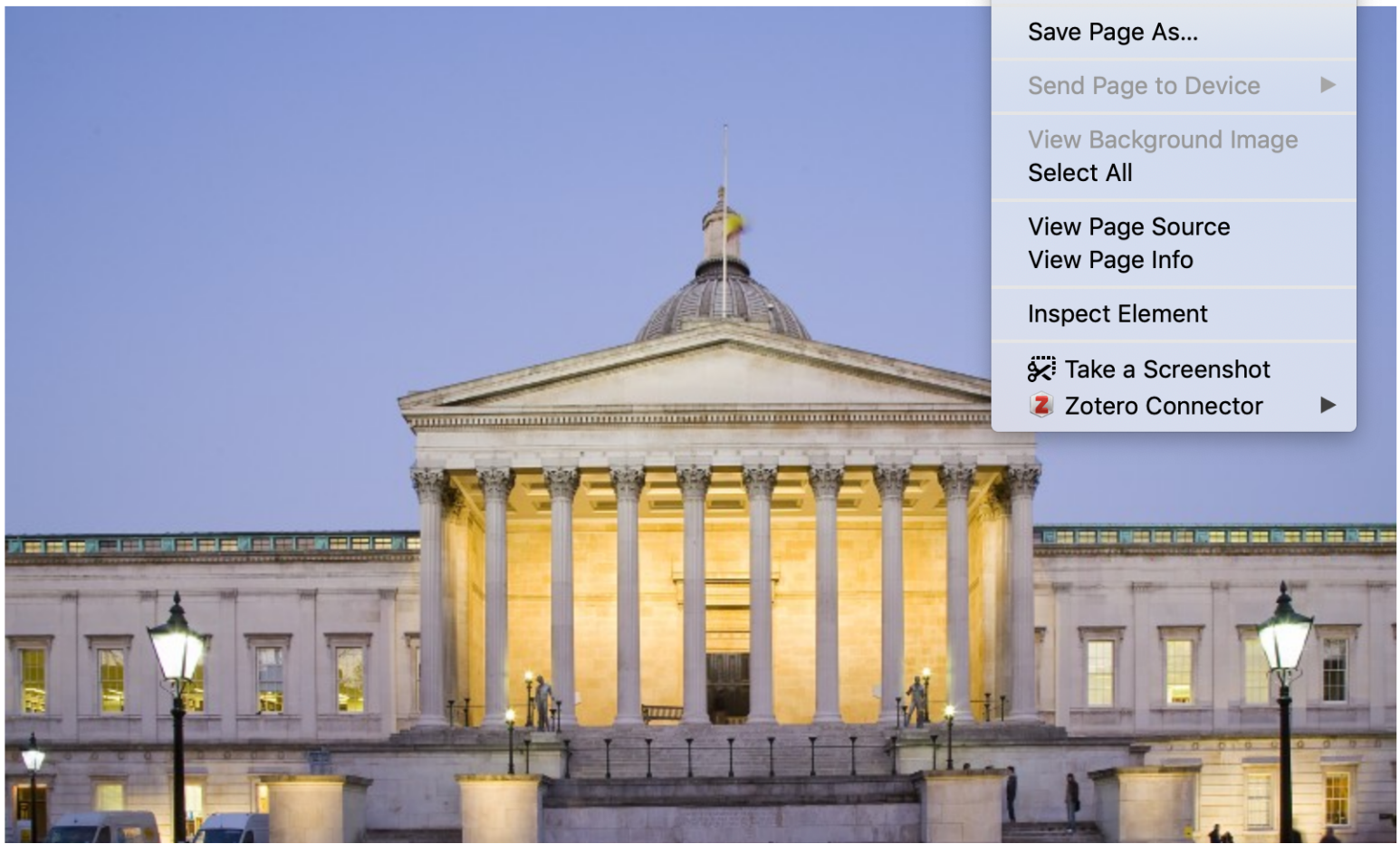
file:///Users/bennettkleinberg/GitHub/ucl_aca_20182019/slides/html_example.html

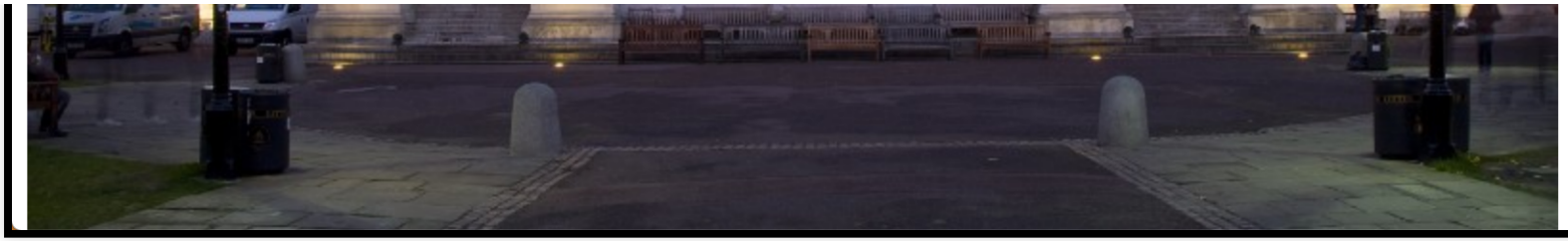
I'm a heading at level 1

I'm the first paragraph

I'm the second paragraph

I'm the third paragraph





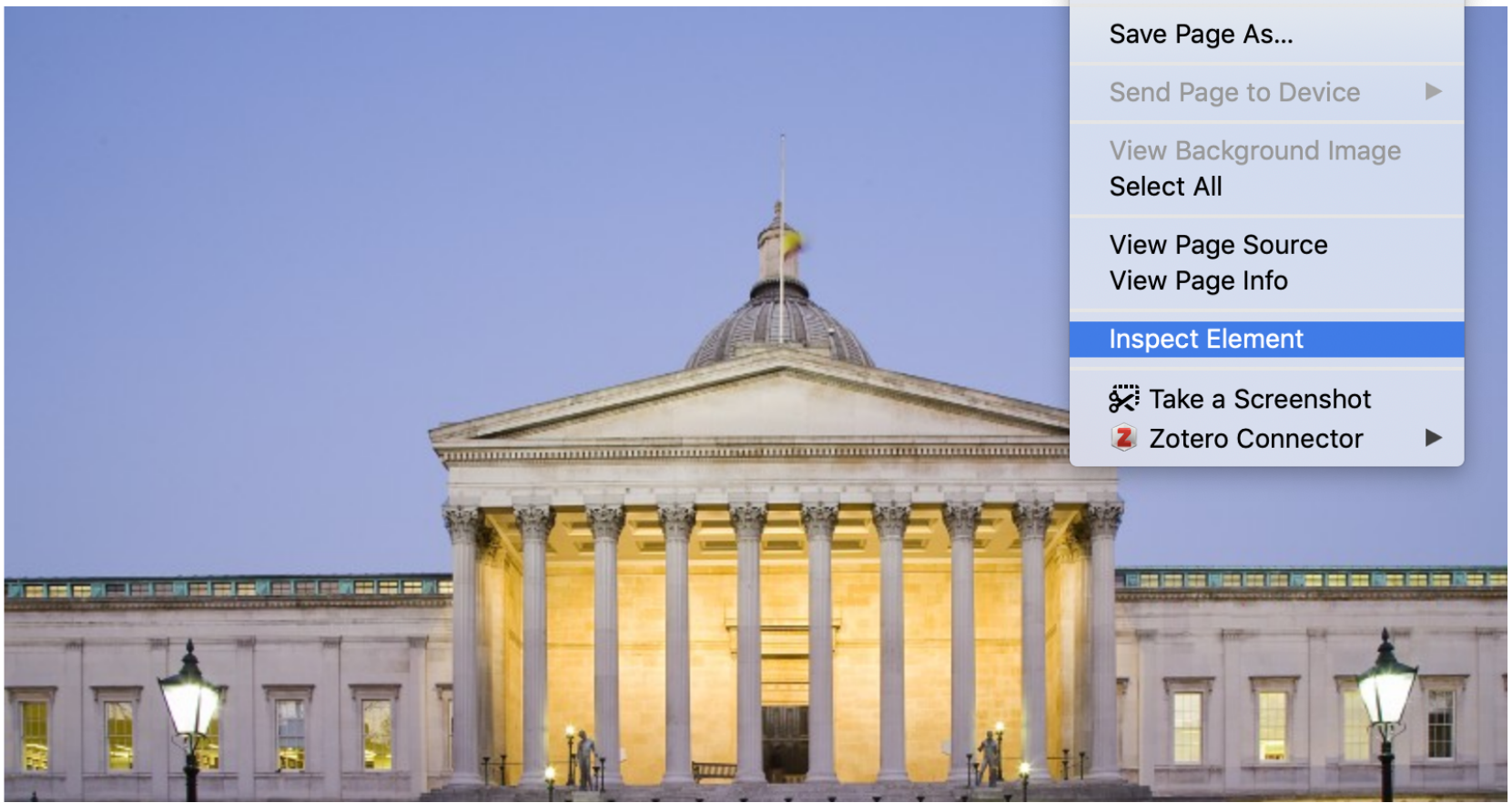
file:///Users/bennettkleinberg/GitHub/ucl_aca_20182019/slides/html_example.html

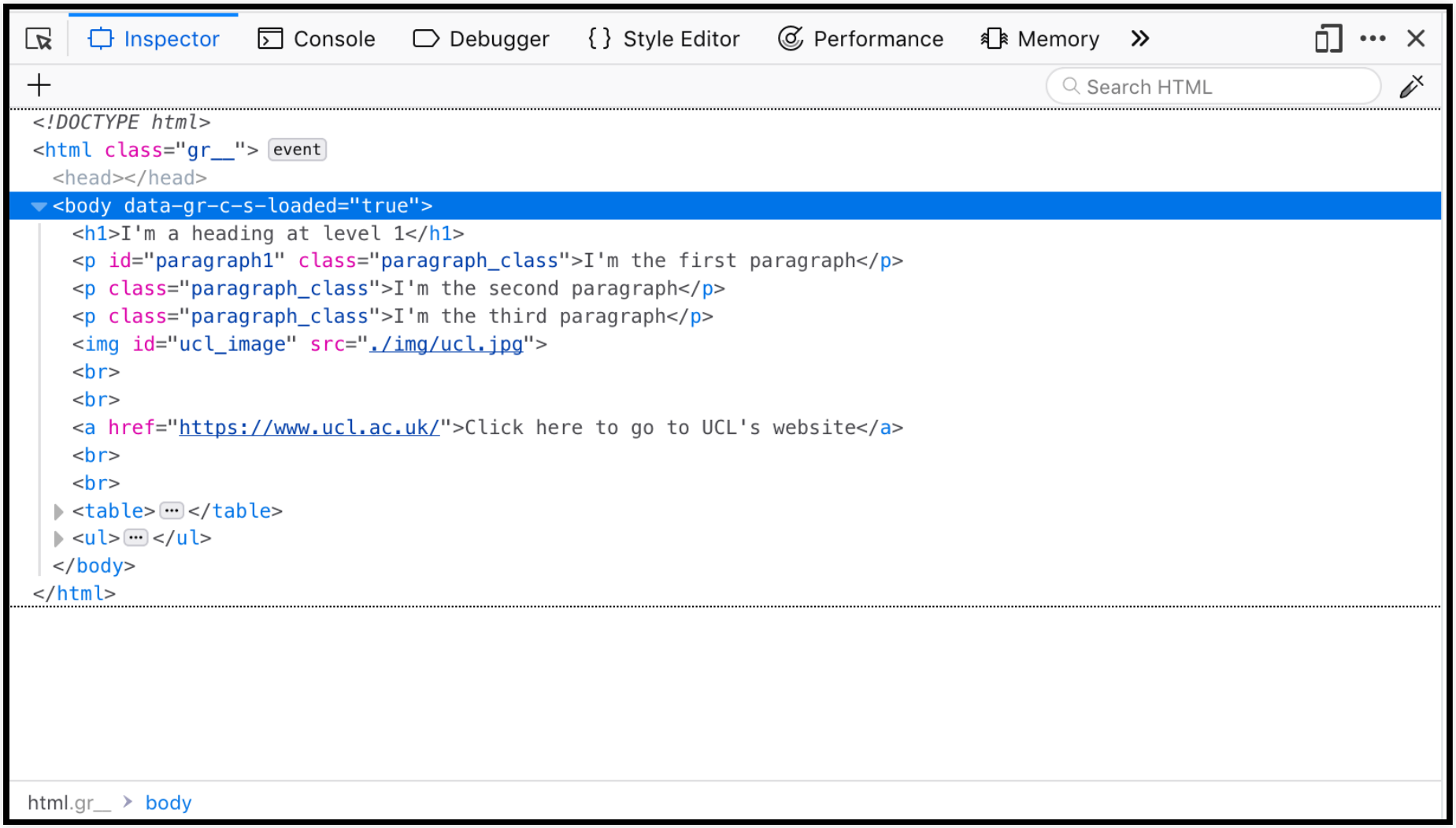
I'm a heading at level 1

I'm the first paragraph

I'm the second paragraph

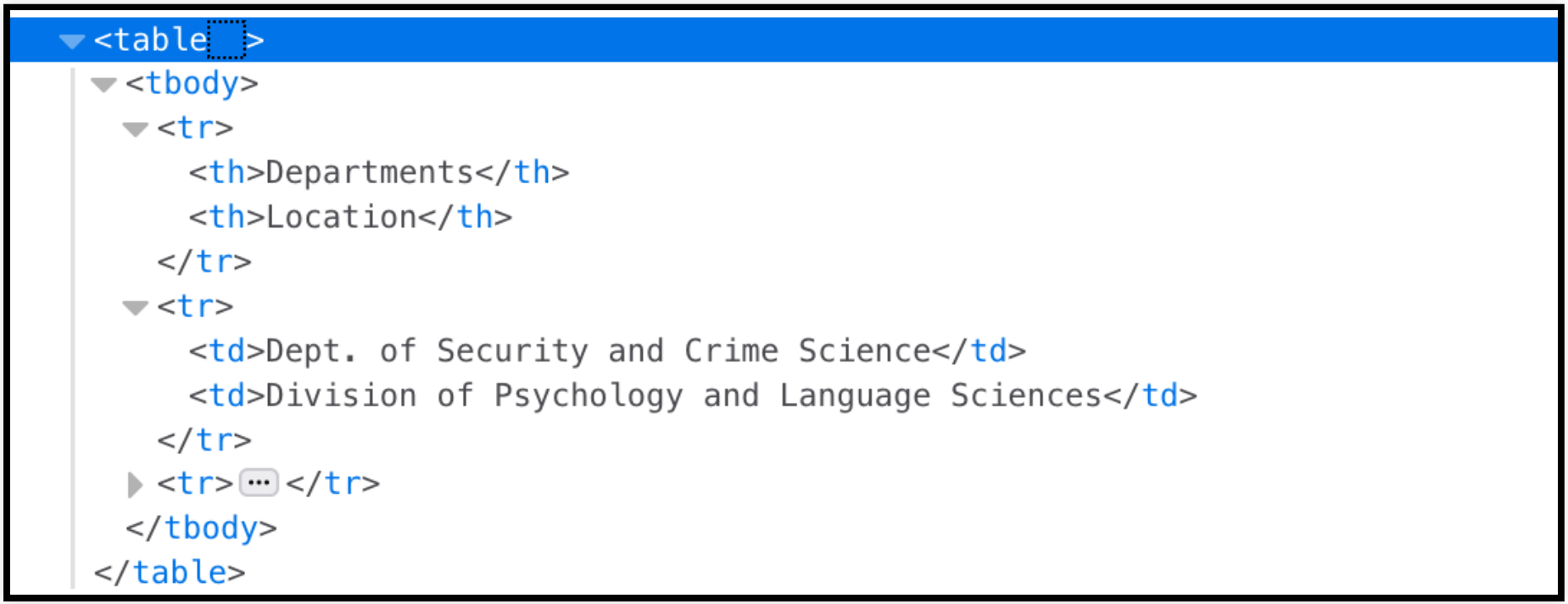
I'm the third paragraph



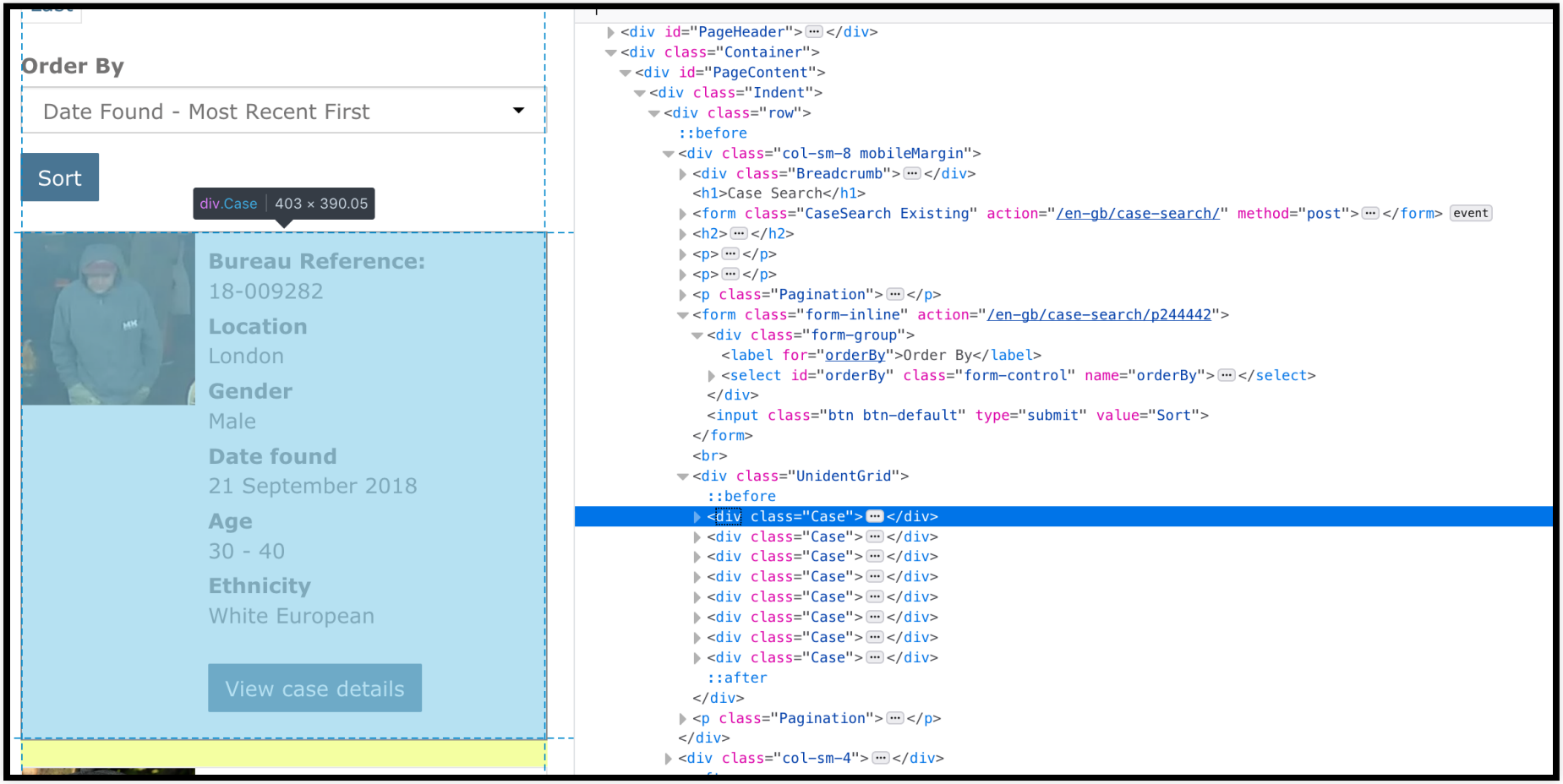

Inspector
Console
Debugger
Style Editor
Performance
Memory
Search HTML
<!DOCTYPE html>
<html class="gr__"> event
<head></head>
<body data-gr-c-s-loaded="true">
<h1>I'm a heading at level 1</h1>
I'm the first paragraph
I'm the second paragraph
I'm the third paragraph
<img id="ucl_image" src="./img/ucl.jpg">

Click here to go to UCL's website

<table> ··· </table>
 ···
</body>
</html>
html.gr__ > body

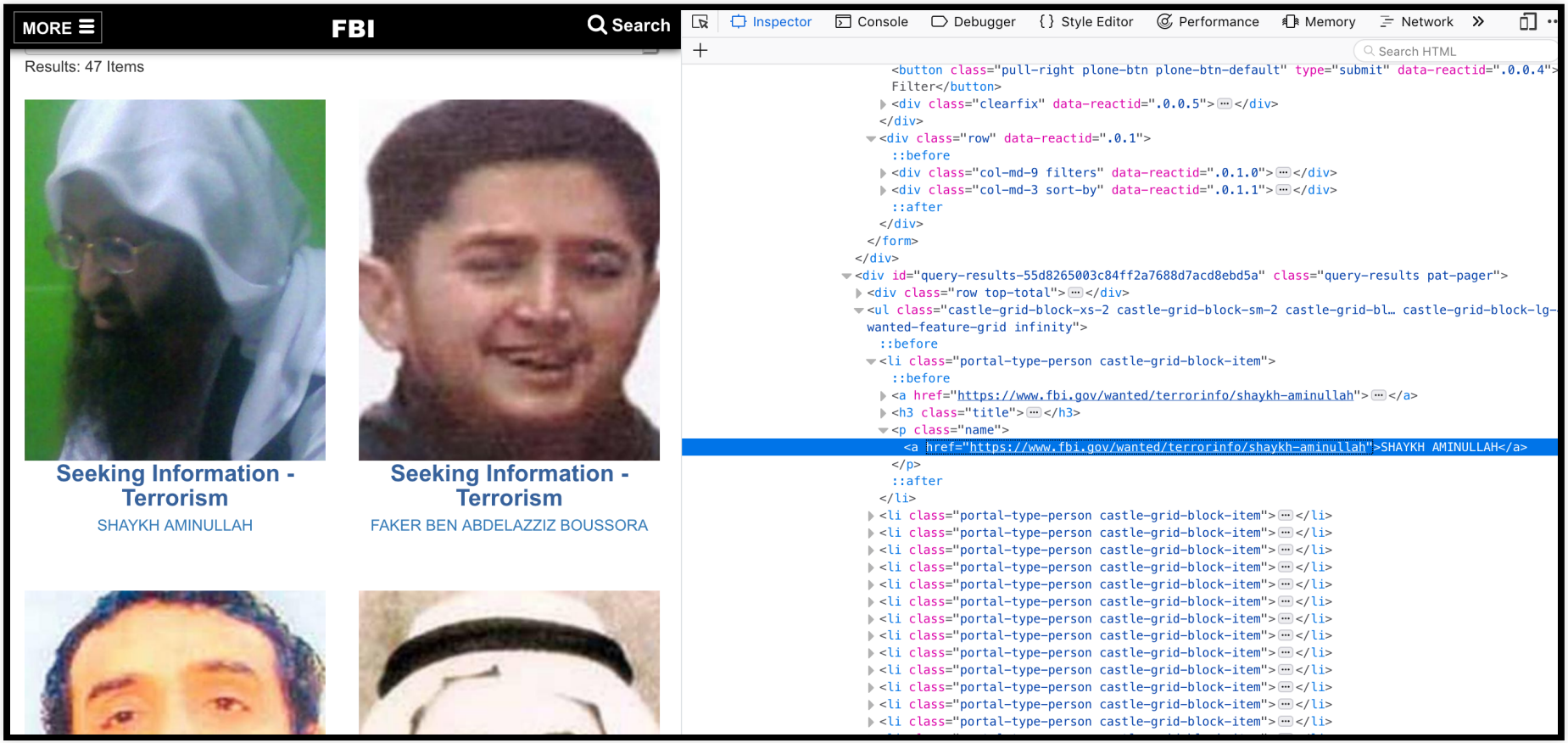

<table>
<tbody>
<tr>
<th>Departments</th>
<th>Location</th>
</tr>
<tr>
<td>Dept. of Security and Crime Science</td>
<td>Division of Psychology and Language Sciences</td>
</tr>
<tr>...</tr>
</tbody>
</table>

Example 1: Missing persons



Example 1: Missing persons

Example 2: FBI most wanted



Webscraping in a nutshell

1. understand the structure of a webpage
2. exploit that structure for web-scraping

Webscraping in practice

Case for today: Missing persons FBI

https://www.fbi.gov/wanted/kidnap

Explore the target page

Aims

1. Get a list of all names
2. Store the bio information
3. Extract the “details” description
4. Download the poster

Getting started

Set up your workspace first:

```
library(rvest)
```

```
## Loading required package: xml2
```

```
target_url = 'https://www.fbi.gov/wanted/kidnap'
```

Remember...

- understanding the structure of a webpage
- exploiting that structure for web-scraping

1. Get a list of all names

understanding the structure of a webpage

https://www.fbi.gov/wanted/kidnap

1. Get a list of all names

exploiting that structure for web-scraping

Access the full html page (snapshot-mode):

```
target_page = read_html(target_url)
target_page
```

```
## {xml_document}
## <html lang="en" data-gridsystem="bs3">
## [1] <head>\n<meta http-equiv="Content-Type" content="text/html; charse
## [2] <body id="visual-portal-wrapper" class="  portaltype-folder site-
```

1. Get a list of all names

Key here: look for the `<h3>` heading with class `title`:

```
target_page %>%
  html_nodes('h3.title')
```

```
## {xml_nodeset (40)}
##  [1] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ar
##  [2] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ar
##  [3] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/je
##  [4] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/fe
##  [5] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ma
##  [6] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/mi
##  [7] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/as
##  [8] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ja
##  [9] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/il
## [10] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ca
## [11] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/li
## [12] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ky
## [13] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/bi
## [14] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ja
## [15] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/sh
## [16] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ah
## [17] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ru
```

```
#note: equivalent to "html_nodes(target_page, 'h3.title')""
```

```
#note: equivalent to  html_nodes(target_page, "h3.title")
```

1. Get a list of all names

A closer look:

```
all_titles = target_page %>%
  html_nodes('h3.title')

all_titles[1]
```

```
## {xml_nodeset (1)}
## [1] <h3 class="title">\n<a href="https://www.fbi.gov/wanted/kidnap/ar
```

It's the text of the `<a href=...>` tag.

1. Get a list of all names

So what we want is:

1. Access the full html page
2. Search all h3 headings with class “title”
3. Find all `<a >` tags (= links)
4. Extract the text

1. Get a list of all names

1. Access the full html page `read_html(target_url)`
2. Search all h3 headings with class “title”
   `html_nodes('h3.title')`
3. Find all `<a >` tags (= links) `html_nodes('a')`
4. Extract the text `html_text()`

1. Get a list of all names

Combined:

```
all_names = target_page %>%
  html_nodes('h3.title') %>%
  html_nodes('a') %>%
  html_text()
```

1. Get a list of all names

```
all_names
```

```
##  [1] "ARIANNA FITTS"
##  [2] "ANGELA MAE MEEKER"
##  [3] "JENNIFER LYNN MARCUM"
##  [4] "FELIX BATISTA"
##  [5] "MARK HIMEBAUGH"
##  [6] "MICHAELA JOY GARECHT"
##  [7] "ASHLEY SUMMERS"
##  [8] "JAYME CLOSS"
##  [9] "ILENE BETH MISHELOFF"
## [10] "CARLA VICENTINI"
## [11] "LISA IRWIN"
## [12] "KYRON RICHARD HORMAN"
## [13] "BIANCA LEBRON"
## [14] "JABEZ SPANN"
## [15] "SHANNA GENELLE PEOPLES"
## [16] "ABBY LYNN PATTERSON"
## [17] "RUOCHEN LIAO"
## [18] "JOSHUA KESHABA SIERRA GARCIA"
```

2. Store the bio information

understanding the structure of a webpage

https://www.fbi.gov/wanted/kidnap

2. Store the bio information

We know: there's a table with class `wanted-person-description` that contains the data we want.

But: we need to access each 'kidnapped' person!?

For-loops to the rescue…

2. Store the bio information

exploiting that structure for web-scraping

So what we want is:

1. *Access the full html page*
2. *Search all h3 headings with class “title”*
3. *Find all* `<a >` *tags (= links)*
4. Extract the ~~text~~ actual link
5. Access that page
6. Extract the table with class `wanted-person-description`

2. Store the bio information

```
all_persons_links = target_page %>%
  html_nodes('h3.title') %>%
  html_nodes('a') %>%
  html_attr('href')

all_persons_links
```

```
##  [1] "https://www.fbi.gov/wanted/kidnap/arianna-fitts"
##  [2] "https://www.fbi.gov/wanted/kidnap/angela-mae-meeker"
##  [3] "https://www.fbi.gov/wanted/kidnap/jennifer-lynn-marcum"
##  [4] "https://www.fbi.gov/wanted/kidnap/felix-batista"
##  [5] "https://www.fbi.gov/wanted/kidnap/mark-himebaugh"
##  [6] "https://www.fbi.gov/wanted/kidnap/michaela-joy-garecht"
##  [7] "https://www.fbi.gov/wanted/kidnap/ashley-summers"
##  [8] "https://www.fbi.gov/wanted/kidnap/jayme-closs"
##  [9] "https://www.fbi.gov/wanted/kidnap/ilene-beth-misheloff"
## [10] "https://www.fbi.gov/wanted/kidnap/carla-vicentini"
## [11] "https://www.fbi.gov/wanted/kidnap/lisa-irwin"
## [12] "https://www.fbi.gov/wanted/kidnap/kyron-richard-horman"
## [13] "https://www.fbi.gov/wanted/kidnap/bianca-lebron"
## [14] "https://www.fbi.gov/wanted/kidnap/jabez-spann"
## [15] "https://www.fbi.gov/wanted/kidnap/shanna-genelle-peoples"
## [16] "https://www.fbi.gov/wanted/kidnap/abby-lynn-patterson"
## [17] "https://www.fbi.gov/wanted/kidnap/ruochen-liao"
## [18] "https://www.fbi.gov/wanted/kidnap/joshua-keshaba-sierra-garcia"
```

2. Store the bio information

Now what?

```
for(i in all_persons_links){
  print(i)
}
```

```
## [1] "https://www.fbi.gov/wanted/kidnap/arianna-fitts"
## [1] "https://www.fbi.gov/wanted/kidnap/angela-mae-meeker"
## [1] "https://www.fbi.gov/wanted/kidnap/jennifer-lynn-marcum"
## [1] "https://www.fbi.gov/wanted/kidnap/felix-batista"
## [1] "https://www.fbi.gov/wanted/kidnap/mark-himebaugh"
## [1] "https://www.fbi.gov/wanted/kidnap/michaela-joy-garecht"
## [1] "https://www.fbi.gov/wanted/kidnap/ashley-summers"
## [1] "https://www.fbi.gov/wanted/kidnap/jayme-closs"
## [1] "https://www.fbi.gov/wanted/kidnap/ilene-beth-misheloff"
## [1] "https://www.fbi.gov/wanted/kidnap/carla-vicentini"
## [1] "https://www.fbi.gov/wanted/kidnap/lisa-irwin"
## [1] "https://www.fbi.gov/wanted/kidnap/kyron-richard-horman"
## [1] "https://www.fbi.gov/wanted/kidnap/bianca-lebron"
## [1] "https://www.fbi.gov/wanted/kidnap/jabez-spann"
## [1] "https://www.fbi.gov/wanted/kidnap/shanna-genelle-peoples"
## [1] "https://www.fbi.gov/wanted/kidnap/abby-lynn-patterson"
## [1] "https://www.fbi.gov/wanted/kidnap/ruochen-liao"
## [1] "https://www.fbi.gov/wanted/kidnap/joshua-keshaba-sierra-garcia"
```

2. Store the bio information

Before you write a loop…

```
arianna = all_persons_links[1]
temp_target_url = arianna
temp_target_page = read_html(temp_target_url)
```

Single-case proof.

2. Store the bio information

```
description = temp_target_page %>%
  html_nodes('table.wanted-person-description') %>%
  html_table()

description
```

```
## [[1]]
##                      X1                                      X2
## 1 Date(s) of Birth Used                       September 6, 2013
## 2        Place of Birth                              California
## 3                  Hair                                   Black
## 4                  Eyes                                   Brown
## 5                Height      2'0" (at time of disappearance)
## 6                Weight 45 pounds (at time of disappearance)
## 7                   Sex                                  Female
## 8                  Race                                   Black
## 9           Nationality                                American
```

2. Store the bio information

What we need for the for-loop:

1. do this for each link
2. store it somewhere (easiest: in a list)
3. log progress

2. Store the bio information

```
list_for_data = list()
for(i in all_persons_links){
  print(paste('Accessing:', i))
  temp_target_url = i
  temp_target_page = read_html(temp_target_url)
  description = temp_target_page %>%
    html_nodes('table.wanted-person-description') %>%
    html_table()
  index_of_i = which(i == all_persons_links)
  list_for_data[[index_of_i]] = description
  print('--- NEXT ---')
}
```

```
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/arianna-fitts"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/angela-mae-meeker"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/jennifer-lynn-marcur
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/felix-batista"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/mark-himebaugh"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/michaela-joy-garecht
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/ashley-summers"
```

```
## [1] "--- NEXT ---"

## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/jayme-closs"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/ilene-beth-mishelof
```

2. Store the bio information

Now we have a list of tables.

Each table contains the details of one missing person:

```
# thirteenth element in the list
list_for_data[[13]]
```

```
## [[1]]
##                         X1                 X2
## 1 Date(s) of Birth Used    June 26, 1991
## 2                   Hair  Long Dark Brown
## 3                   Eyes             Hazel
## 4                 Height             4'11"
## 5                 Weight       115 pounds
## 6                    Sex            Female
## 7                   Race White (Hispanic)
```

3. Extract the “details” description

understanding the structure of a webpage

https://www.fbi.gov/wanted/kidnap

3. Extract the “details” description

We want: the text of the `<div >` with class `wanted-person-details`

exploiting that structure for web-scraping

So what we want is:

1. *Access the full html page*
2. *Search all h3 headings with class “title”*
3. *Find all* `<a >` *tags (= links)*
4. Extract the ~~text~~ actual link
5. Access that page
6. Extract the ~~table with class~~ ~~`wanted-person-description`~~ `<div >` with class `wanted-person-details`

3. Extract the “details” description

Start with single-case proof:

```
arianna = all_persons_links[1]
temp_target_url = arianna
temp_target_page = read_html(temp_target_url)

person_details = temp_target_page %>%
  html_nodes('div.wanted-person-details') %>%
  html_text()
```

3. Extract the “details” description

```
person_details
```

```
## [1] "\nDetails:\nArianna Fitts was reported missing from the San Franc
```

3. Extract the "details" description

Putting it in a loop:

```
list_for_person_details = list()
for(i in all_persons_links){
  print(paste('Accessing:', i))
  temp_target_url = i
  temp_target_page = read_html(temp_target_url)
  person_details = temp_target_page %>%
    html_nodes('div.wanted-person-details') %>%
    html_text()
  index_of_i = which(i == all_persons_links)
  list_for_person_details[[index_of_i]] = person_details
  print('--- NEXT ---')
}
```

```
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/arianna-fitts"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/angela-mae-meeker"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/jennifer-lynn-marcur
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/felix-batista"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/mark-himebaugh"
## [1] "--- NEXT ---"
```

```
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/michaela-joy-garech
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/ashley-summers"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/jayme-closs"
## [1] "--- NEXT ---"
## [1] "Accessing: https://www.fbi.gov/wanted/kidnap/ilene-beth-mishelof
```

3. Extract the “details” description

```
#look at the 20th element
list_for_person_details[[20]]
```

```
## [1] "\nDetails:\nErica Nicole Hunt was last seen on July 4, 2016, nea
```

4. Download the poster

understanding the structure of a webpage

https://www.fbi.gov/wanted/kidnap

4. Download the poster

What do we want?

understanding the structure of a webpage

Each kidnapped person has a ‘download link’…

```
https://www.fbi.gov/wanted/kidnap/arianna-fitts/download.pdf
```

Don’t overthink it!

4. Download the poster

Compare these two:

```
https://www.fbi.gov/wanted/kidnap/arianna-fitts/download.pdf
```

```
arianna
```

```
## [1] "https://www.fbi.gov/wanted/kidnap/arianna-fitts"
```

Notice something?

4. Download the poster

We can just 'work around' this:

```
download_url_arianna = paste(tolower(arianna), '/download.pdf', sep="")
download_url_arianna
```

```
## [1] "https://www.fbi.gov/wanted/kidnap/arianna-fitts/download.pdf"
```

https://www.fbi.gov/wanted/kidnap/arianna-fitts/download.pdf

4. Download the poster

Make use of R's vectorised structure:

```
all_download_links = paste(tolower(all_persons_links), '/download.pdf', s
all_download_links
```

```
##  [1] "https://www.fbi.gov/wanted/kidnap/arianna-fitts/download.pdf"
##  [2] "https://www.fbi.gov/wanted/kidnap/angela-mae-meeker/download.pdf
##  [3] "https://www.fbi.gov/wanted/kidnap/jennifer-lynn-marcum/download
##  [4] "https://www.fbi.gov/wanted/kidnap/felix-batista/download.pdf"
##  [5] "https://www.fbi.gov/wanted/kidnap/mark-himebaugh/download.pdf"
##  [6] "https://www.fbi.gov/wanted/kidnap/michaela-joy-garecht/download
##  [7] "https://www.fbi.gov/wanted/kidnap/ashley-summers/download.pdf"
##  [8] "https://www.fbi.gov/wanted/kidnap/jayme-closs/download.pdf"
##  [9] "https://www.fbi.gov/wanted/kidnap/ilene-beth-misheloff/download
## [10] "https://www.fbi.gov/wanted/kidnap/carla-vicentini/download.pdf"
## [11] "https://www.fbi.gov/wanted/kidnap/lisa-irwin/download.pdf"
## [12] "https://www.fbi.gov/wanted/kidnap/kyron-richard-horman/download
## [13] "https://www.fbi.gov/wanted/kidnap/bianca-lebron/download.pdf"
## [14] "https://www.fbi.gov/wanted/kidnap/jabez-spann/download.pdf"
## [15] "https://www.fbi.gov/wanted/kidnap/shanna-genelle-peoples/downloa
## [16] "https://www.fbi.gov/wanted/kidnap/abby-lynn-patterson/download.p
## [17] "https://www.fbi.gov/wanted/kidnap/ruochen-liao/download.pdf"
## [18] "https://www.fbi.gov/wanted/kidnap/joshua-keshaba-sierra-garcia/d
```

4. Download the poster

Now:

1. access each
2. “download” (= write) the file
    - needs a filename on your computer

4. Download the poster

Create filenames:

```
library(stringr)
file_names = paste(all_names, '.pdf', sep="")
file_names
```

```
##  [1] "ARIANNA FITTS.pdf"
##  [2] "ANGELA MAE MEEKER.pdf"
##  [3] "JENNIFER LYNN MARCUM.pdf"
##  [4] "FELIX BATISTA.pdf"
##  [5] "MARK HIMEBAUGH.pdf"
##  [6] "MICHAELA JOY GARECHT.pdf"
##  [7] "ASHLEY SUMMERS.pdf"
##  [8] "JAYME CLOSS.pdf"
##  [9] "ILENE BETH MISHELOFF.pdf"
## [10] "CARLA VICENTINI.pdf"
## [11] "LISA IRWIN.pdf"
## [12] "KYRON RICHARD HORMAN.pdf"
## [13] "BIANCA LEBRON.pdf"
## [14] "JABEZ SPANN.pdf"
## [15] "SHANNA GENELLE PEOPLES.pdf"
## [16] "ABBY LYNN PATTERSON.pdf"
## [17] "RUOCHEN LIAO.pdf"
## [18] "JOSHUA KESHABA SIERRA GARCIA.pdf"
```

4. Download the poster

Refine filenames:

```
refined_file_names = tolower(str_replace_all(string = file_names, patter
refined_file_names
```

```
##  [1] "arianna_fitts.pdf"
##  [2] "angela_mae_meeker.pdf"
##  [3] "jennifer_lynn_marcum.pdf"
##  [4] "felix_batista.pdf"
##  [5] "mark_himebaugh.pdf"
##  [6] "michaela_joy_garecht.pdf"
##  [7] "ashley_summers.pdf"
##  [8] "jayme_closs.pdf"
##  [9] "ilene_beth_misheloff.pdf"
## [10] "carla_vicentini.pdf"
## [11] "lisa_irwin.pdf"
## [12] "kyron_richard_horman.pdf"
## [13] "bianca_lebron.pdf"
## [14] "jabez_spann.pdf"
## [15] "shanna_genelle_peoples.pdf"
## [16] "abby_lynn_patterson.pdf"
## [17] "ruochen_liao.pdf"
## [18] "joshua_keshaba_sierra_garcia.pdf"
```

4. Download the poster

Download each pdf from the url and use the refined filenames

```
for(i in 1:length(all_download_links)){
  print(paste('Accessing URL: ', all_download_links[i], sep=""))
  download.file(url = all_download_links[i]
                , destfile = refined_file_names[i]
                , mode = "wb")
}
```

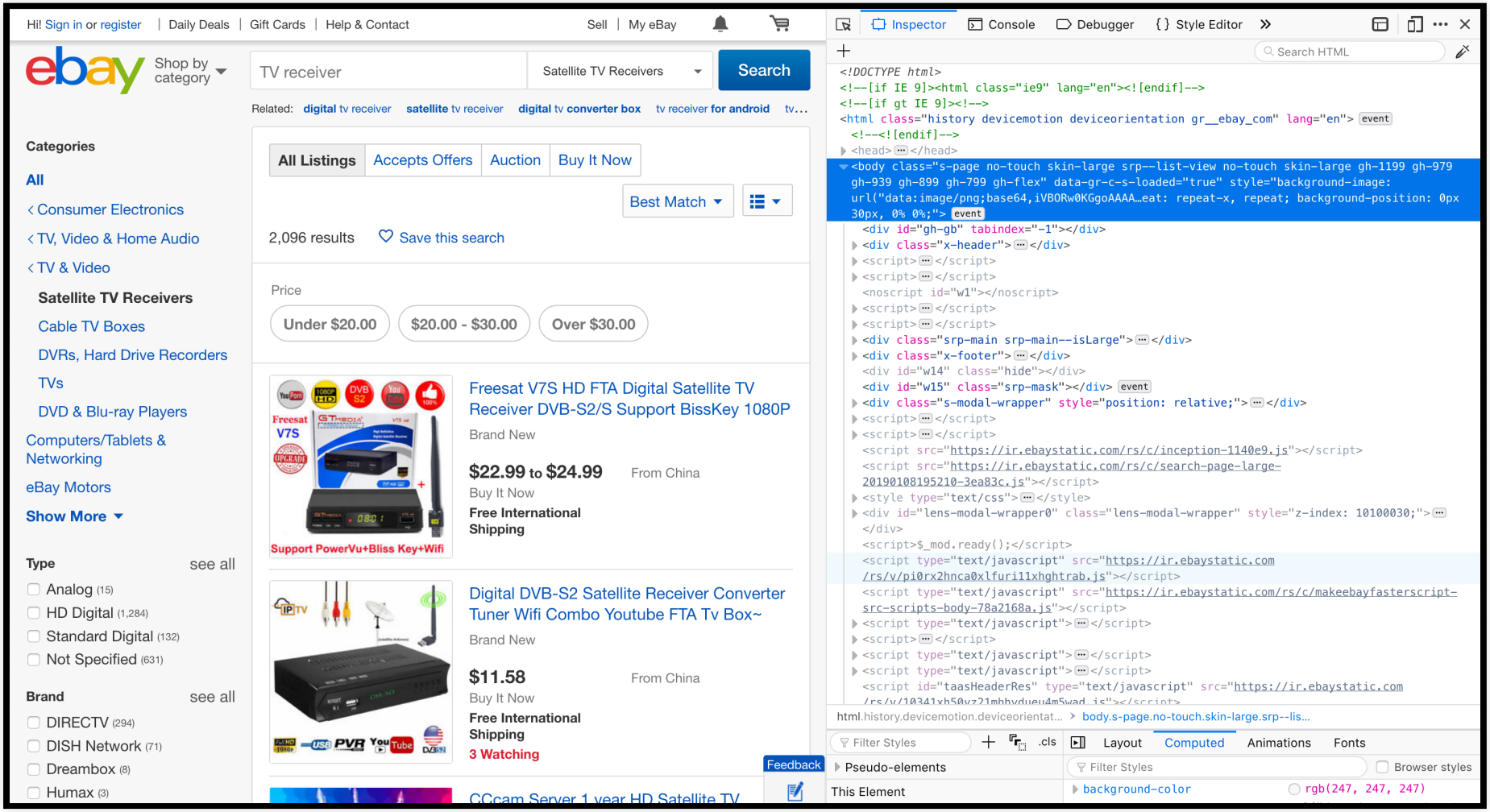
```
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/arianna-fitts/do
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/angela-mae-meeke
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/jennifer-lynn-ma
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/felix-batista/do
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/mark-himebaugh/d
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/michaela-joy-gar
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/ashley-summers/d
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/jayme-closs/down
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/ilene-beth-mishe
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/carla-vicentini/
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/lisa-irwin/downl
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/kyron-richard-ho
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/bianca-lebron/do
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/jabez-spann/down
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/shanna-genelle-p
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/abby-lynn-patter
## [1] "Accessing URL: https://www.fbi.gov/wanted/kidnap/ruochen-liao/dow
```

Notes on webscraping

- highly customisable (= juicy data)
- basically: “anything goes”
- can be unstable/sensitive to html changes

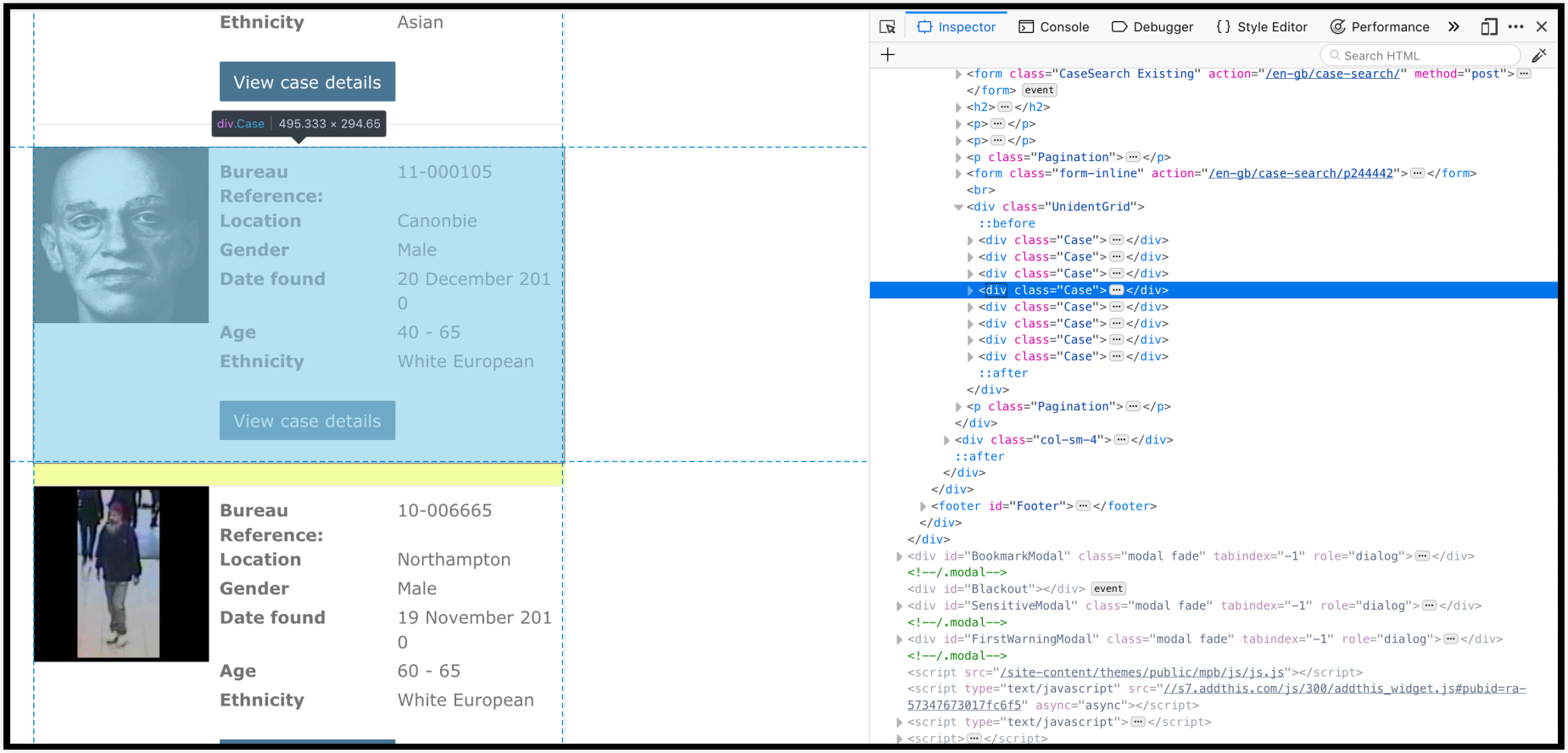
What this means

Same idea, different code details:



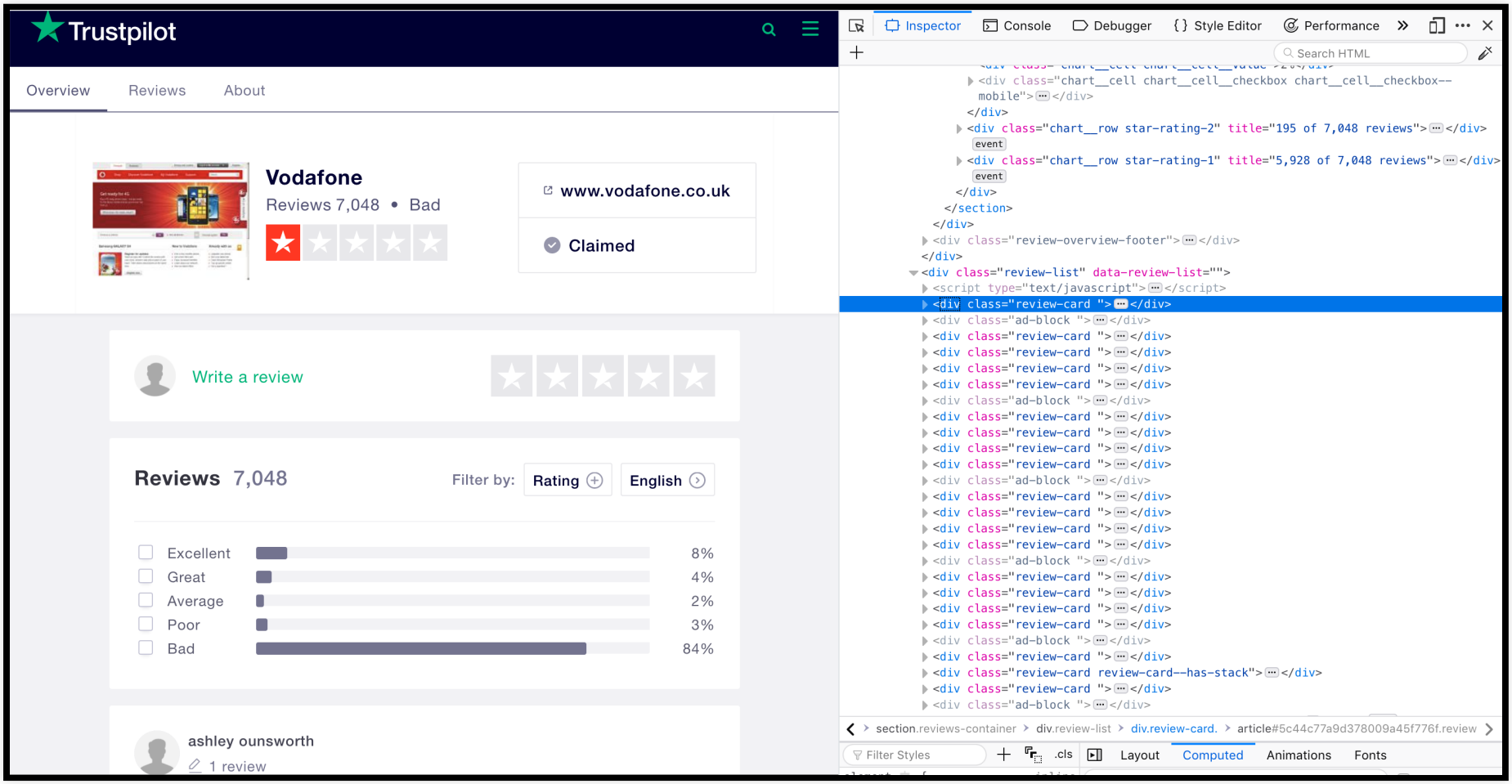
What this means

Same idea, different code details:



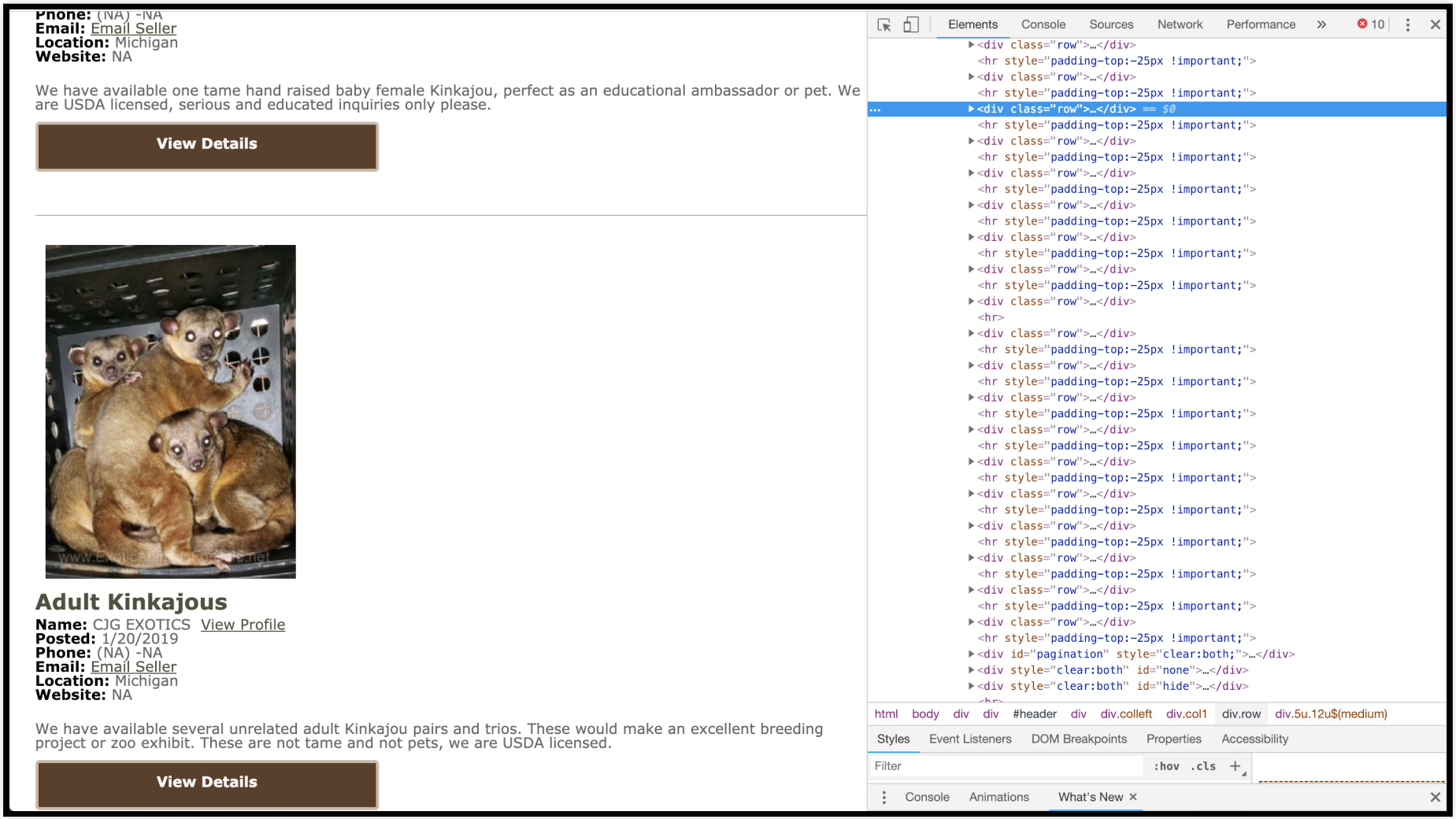
What this means

Same idea, different code details:



What this means

Same idea, different code details:



RECAP

- **Always: problem first, never the method first!**
- **Method follows problem!**
- HTML structure key to ‘real’ webscraping
- Webscraping:
  - understanding the structure of a webpage
  - exploiting that structure for web-scraping
- principle is always the same: understand + exploit the html structure

Outlook

Tutorial: APIs + Webscraping in R

Homework: Do the readings for today (blogposts/guides)

Next week: Text data 1

END