Computational Sociology

Web scraping

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Plan

1. What is web-scraping?
2. When should I use it?
3. How to scrape a web page using R
4. Crawling websites using R
5. `selenium` and browser automation

What is web-scraping?

Terminology

- Web-scraping is a method to collect data from websites
  - We use the code underlying a webpage to collect data (**scraping**)
  - The process is then repeated for other pages on the same website in an automated fashion (**crawling**)

What is web-scraping?

Challenges

- Different websites have different structures, so a script used to scrape one website will likely have to be changed to scrape another
- Websites can be internally inconsistent, making them difficult to scrape
- Some websites are easier to crawl than others
- Some websites limit or prohibit scraping

When should I use it?

Commercial use cases

- Search engines
  - Google scrapes websites to create a searchable index of the internet
- Price comparison
  - Kayak scrape airlines to compare flight prices, other websites do the same for hotels and rental cars
- Recruitment
  - Recruitment companies scrape LinkedIn to get data on workers

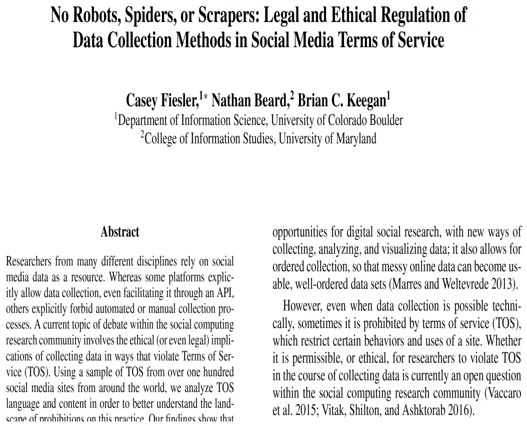
When should I use it?

Social scientific use cases

- Web-scraping is a useful tool to collect data from websites without APIs
  - Large social media platforms and other sites have APIs but smaller websites do not
    - Local newspapers, forums, small businesses, educational institutions, etc.
- Often we want to collect data from a single website
  - e.g. All posts written on a forum
- Sometimes we might want to collect data from many websites
  - e.g. All schools in a school district

When should I use it?

Ethical and legal considerations



No Robots, Spiders, or Scrapers: Legal and Ethical Regulation of Data Collection Methods in Social Media Terms of Service

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Abstract

Researchers from many different disciplines rely on social media data as a resource. Whereas some platforms explicitly allow data collection, even facilitating it through an API, others explicitly forbid automated or manual collection processes. A current topic of debate within the social computing research community involves the ethical (or even legal) implications of collecting data in ways that violate Terms of Service (TOS). Using a sample of TOS from over one hundred social media sites from around the world, we analyze TOS language and content in order to better understand the landscape of prohibitions on this practice. Our findings show that

opportunities for digital social research, with new ways of collecting, analyzing, and visualizing data; it also allows for ordered collection, so that messy online data can become usable, well-ordered data sets (Marres and Weltevrede 2013).

However, even when data collection is possible technically, sometimes it is prohibited by terms of service (TOS), which restrict certain behaviors and uses of a site. Whether it is permissible, or ethical, for researchers to violate TOS in the course of collecting data is currently an open question within the social computing research community (Vaccaro et al. 2015; Vitak, Shilton, and Ashktorab 2016).

When should I use it?

Ethical and legal considerations

- Fiesler, Beard, and Keegan (2020) review the legal cases related to web-scraping and analyze website terms of service
  - "In short, it is an unsettled question as to whether it is explicitly illegal (or even a criminal act) to violate TOS."
  - No academic or journalist has ever been prosecuted for violating a website terms of service to collect data for research
- They analyze terms of service of over 100 social media websites
  - Terms of service are ambiguous, inconsistent, and lack context

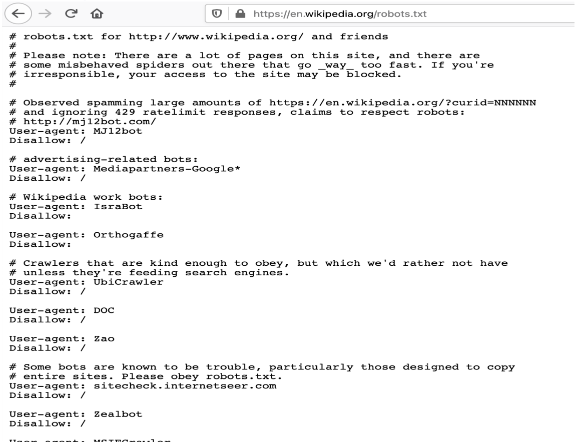
When should I use it?

Best-practices

- Only scrape publicly available data
  - i.e. You can access the page on the web without logging in
- Do not scrape copyright protected data
- Try not to violate website terms of service
- Do not burden the website
  - Limit the number of calls you make (similar to rate-limiting in APIs)
- Avoid using the data in a way that may interfere with business
  - i.e. Don't copy valuable data from a small business and share it on Github

How to scrape a web page

Start by looking up “robots.txt’ ’



```
# robots.txt for http://www.wikipedia.org/ and friends
#
# Please note: There are a lot of pages on this site, and there are
# some misbehaved spiders out there that go _way_ too fast. If you're
# irresponsible, your access to the site may be blocked.
#

# Observed spamming large amounts of https://en.wikipedia.org/?curid=NNNNNN
# and ignoring 429 ratelimit responses, claims to respect robots:
# http://mj12bot.com/
User-agent: MJ12bot
Disallow: /

# advertising-related bots:
User-agent: Mediapartners-Google*
Disallow: /

# Wikipedia work bots:
User-agent: IsraBot
Disallow:

User-agent: Orthogaffe
Disallow:

# Crawlers that are kind enough to obey, but which we'd rather not have
# unless they're feeding search engines.
User-agent: UbiCrawler
Disallow: /

User-agent: DOC
Disallow: /

User-agent: Zao
Disallow: /

# Some bots are known to be trouble, particularly those designed to copy
# entire sites. Please obey robots.txt.
User-agent: sitecheck.internetseer.com
Disallow: /

User-agent: Zealbot
Disallow: /

User-agent: MSIECrawler
```

How to scrape a web page

Decoding `robots.txt`

- **`User-agent`** = the name of the scraper
  - **`*`** = All scrapers
- **`Allow: /path/`** = OK to scrape
- **`Disallow: /path/`** = Not OK to scrape
  - **`Disallow: /`** = Not OK to scrape any pages
- **`Crawl-Delay: N`** = Wait `N` miliseconds between each call to the website

How to scrape a web page

Terminology

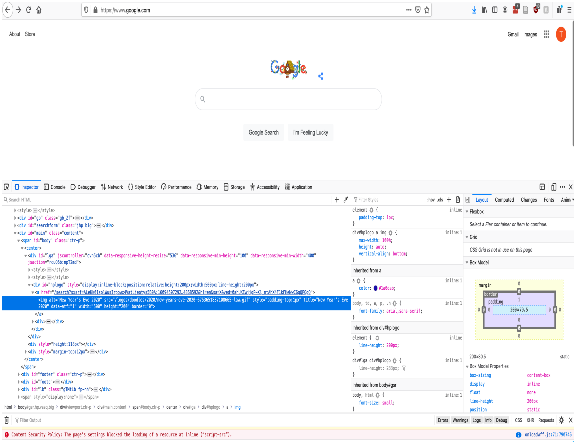
- A web-page is loaded using a **URL** (Uniform Resource Locator)
- The underlying code we are interested in is usually **HTML** (Hypertext Markup Language)
- Many websites use **CSS** (Cascading Style Sheets) to structure HTML
  - This will help us to find what we are interested in
    - See https://flukeout.github.io/ for an interactive tutorial on using CSS selectors
    - Chrome Plugin to help find CSS elements: https://selectorgadget.com/

How to scrape a web page

Inspecting HTML

- Open up a website and right click on any text or image on the screen
  - You should see an option `Inspect Element`
  - This will allow you to see the code used to generate the page

How to scrape a web page



```
<style>…</style>
<div id="gb" class="gb_Zf">…</div>
<div id="searchform" class="jhp big">…</div>
<div id="main" class="content">
  <span id="body" class="ctr-p">
    <center>
      <div id="lga" jscontroller="cvn5cb" data-responsive-height-resize="536" data-responsive-min-height="100" data-responsive-min-width="400"
      jsaction="rcuQ6b:npT2md">
        <style>…</style>
        <style>…</style>
        <div id="hplogo" style="display:inline-block;position:relative;height:200px;width:500px;line-height:200px">
          <a href="/search?sxsrf=ALeKk01splWusIrpowx4VatLjeotys5B0A:16094507292…4868592&hl=en&sa=X&ved=0ahUKEwjjgP-Xl_ntAhX4F1kFHeNwC6gQPQgO">
            <img alt="New Year's Eve 2020" src="/logos/doodles/2020/new-years-eve-2020-6753651837108665-law.gif" style="padding-top:1px" title="New Year's Eve
            2020" data-atf="1" width="500" height="200" border="0">
          </a>
          <div>…</div>
        </div>
      </div>
      <div style="height:118px"></div>
      <div style="margin-top:12px">…</div>
    </center>
  </span>
<div id="footer" class="ctr-p">…</div>
<div id="footc">…</div>
<div id="lb" class="gTMtLb fp-nh">…</div>
<span style="display:none">…</span>
```

html › body#gsr.hp.vasq.big › div#viewport.ctr-p › div#main.content › span#body.ctr-p › center › div#lga › div#hplogo › a › img

```
element {                          inline
  padding-top: 1px;
}
div#hplogo a img {                 inline:1
  max-width: 100%;
  height: auto;
  vertical-align: bottom;
}
Inherited from a
a {                                inline:1
  color: #1a0dab;
}
body, td, a, p, .h {               inline:1
  font-family: arial,sans-serif;
}
Inherited from div#hplogo
element {                          inline
  line-height: 200px;
}
div#lga div#hplogo {               inline:1
  ~~line-height: 233px;~~
}
Inherited from body#gsr
body, html {                       inline:1
  font-size: small;
}
```

```
margin 0
border 0
padding 1
200×79.5
200×80.5    static
Box Model Properties
box-sizing     content-box
display        inline
float          none
line-height    200px
position       static
```

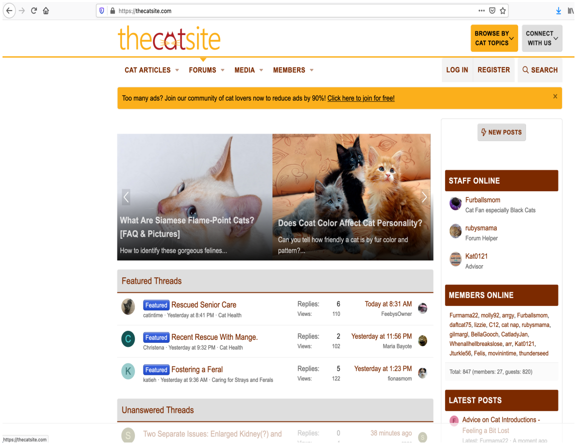
```
Content Security Policy: The page's settings blocked the loading of a resource at inline ("script-src").    onloadwff.js:71:790746
```

How to scrape a web page

Using `rvest` to scrape HTML

```
library(rvest)
library(dplyr)
library(stringr)
```

How to scrape a web page



https://thecatsite.com

thecatsite

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CONNECT WITH US

CAT ARTICLES · FORUMS · MEDIA · MEMBERS · LOG IN · REGISTER · SEARCH

Too many ads? Join our community of cat lovers now to reduce ads by 90%! Click here to join for free!

What Are Siamese Flame-Point Cats? [FAQ & Pictures]

How to identify these gorgeous felines...

Does Coat Color Affect Cat Personality?

Can you tell how friendly a cat is by fur color and pattern?...

NEW POSTS

Featured Threads

Featured Rescued Senior Care
catintime · Yesterday at 8:41 PM · Cat Health
Replies: 6 Views: 110
Today at 8:31 AM FeebysOwner

Featured Recent Rescue With Mange.
Christena · Yesterday at 9:32 PM · Cat Health
Replies: 2 Views: 102
Yesterday at 11:56 PM Maria Bayote

Featured Fostering a Feral
katieh · Yesterday at 9:36 AM · Caring for Strays and Ferals
Replies: 5 Views: 122
Yesterday at 1:23 PM fionasmom

Unanswered Threads

Two Separate Issues: Enlarged Kidney(?) and
Replies: 0
38 minutes ago

STAFF ONLINE

Furballsmom
Cat Fan especially Black Cats

rubysmama
Forum Helper

Kat0121
Advisor

MEMBERS ONLINE

Furmama22, molly92, arrgy, Furballsmom, daftcat75, lizzie, C12, cat nap, rubysmama, gilmargl, BellaGooch, CatladyJan, Whenallhellbreakslose, arr, Kat0121, Jturkle56, Felis, movinintime, thunderseed

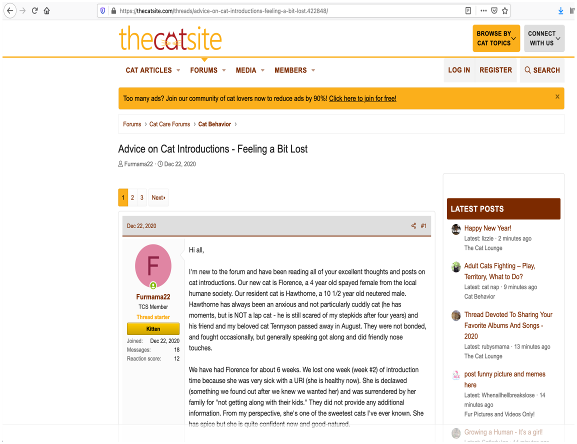
Total: 847 (members: 27, guests: 820)

LATEST POSTS

Advice on Cat Introductions - Feeling a Bit Lost
Latest: Furmama22 · A moment ago

https://thecatsite.com

How to scrape a web page



Too many ads? Join our community of cat lovers now to reduce ads by 90%! Click here to join for free!

Forums › Cat Care Forums › Cat Behavior ›

Advice on Cat Introductions - Feeling a Bit Lost

Furmama22 · Dec 22, 2020

1 2 3 Next

Dec 22, 2020 #1

Furmama22
TCS Member
Thread starter
Kitten

Joined:	Dec 22, 2020
Messages:	18
Reaction score:	12

Hi all,

I'm new to the forum and have been reading all of your excellent thoughts and posts on cat introductions. Our new cat is Florence, a 4 year old spayed female from the local humane society. Our resident cat is Hawthorne, a 10 1/2 year old neutered male. Hawthorne has always been an anxious and not particularly cuddly cat (he has moments, but is NOT a lap cat - he is still scared of my stepkids after four years) and his friend and my beloved cat Tennyson passed away in August. They were not bonded, and fought occasionally, but generally speaking got along and did friendly nose touches.

We have had Florence for about 6 weeks. We lost one week (week #2) of introduction time because she was very sick with a URI (she is healthy now). She is declawed (something we found out after we knew we wanted her) and was surrendered by her family for "not getting along with their kids." They did not provide any additional information. From my perspective, she's one of the sweetest cats I've ever known. She has spice but she is quite confident now and good-natured.

LATEST POSTS

Happy New Year!
Latest: lizzie · 2 minutes ago
The Cat Lounge

Adult Cats Fighting – Play, Territory, What to Do?
Latest: cat nap · 9 minutes ago
Cat Behavior

Thread Devoted To Sharing Your Favorite Albums And Songs - 2020
Latest: rubysmama · 13 minutes ago
The Cat Lounge

post funny picture and memes here
Latest: Whenallhellbreakslose · 14 minutes ago
Fur Pictures and Videos Only!

Growing a Human - It's a girl!

How to scrape a web page

Using `rvest` to scrape HTML

```
url <- "https://thecatsite.com/threads/advice-on-cat-introductions-feel
thread <- read_html(url)
```

How to scrape a web page

Collecting messages

First, we parse the HTML to obtain the text of each message on the page. Here we use the CSS selector `.message-body`, which selects all elements with class `message-body`. The `html_nodes` function in `rvest` allows us to retrieve these nodes.

```
message.data <- thread %>% html_nodes(".message-body")
message.data[1:3]
```

```
## {xml_nodeset (3)}
## [1] <article class="message-body js-selectToQuote"><div class="bbWra
## [2] <article class="message-body js-selectToQuote"><div class="bbWra
## [3] <article class="message-body js-selectToQuote"><div class="bbWra
```

How to scrape a web page

Collecting messages

Next we use `html_text()` to extract the text from the HTML.

```
messages <- thread %>% html_nodes(".message-body") %>%
  html_text() %>% str_trim()
```

How to scrape a web page

Collecting messages

As expected, there are twenty messages. We can verify the content is correct by printing one out.

```
print(length(messages))
```

```
## [1] 20
```

```
print(substr(messages[[1]], 1, 250))
```

```
## [1] "Hi all,\nI'm new to the forum and have been reading all of your
```

How to scrape a web page

Getting user names

Next we collect the name of each user using the same logic. User information is found by parsing the `.message-userDetails` node.

```
users <- thread %>% html_nodes(".message-userDetails") %>%
  html_text() %>% str_trim()
print(length(users))
```

```
## [1] 20
```

```
users[[1]]
```

```
## [1] "Furmama22\nTCS Member\nThread starter\nYoung Cat"
```

How to scrape a web page

Getting user names

Let's add some more elements to the pipe to extract the user name from the string. Note how the elements in the string returned in the previous chunk are separated by the newline symbol (\n).

```
users <- thread %>% html_nodes(".message-userDetails") %>%
  html_text() %>% str_trim() %>% str_split('\n') %>% pluck(1)
users[[1]]
```

```
## [1] "Furmama22"
```

```
class(users)
```

```
## [1] "list"
```

How to scrape a web page

Collecting timestamps

Finally, we also want to get the time-stamp of each message. While the forum only displays dates, we can actually get the full timestamp. What's the problem here?

```
dates <- thread %>% html_nodes("time.u-dt")
print(dates[1])
```

```
## {xml_nodeset (1)}
## [1] <time class="u-dt" dir="auto" datetime="2020-12-22T11:26:12-0800
```

```
length(dates)
```

```
## [1] 27
```

How to scrape a web page

Collecting timestamps

I went back to the HTML and found this CSS selector `.u-concealed .u-dt` is selected instead. It returns the datetime for each post in the thread, along with the date time at the top indicating when the thread was created.

```
dates <- thread %>% html_nodes(".u-concealed .u-dt")
length(dates)
```

```
## [1] 21
```

```
dates <- dates[-1]
dates[1]
```

```
## {xml_nodeset (1)}
## [1] <time class="u-dt" dir="auto" datetime="2020-12-22T11:26:12-0800
```

How to scrape a web page

Collecting timestamps

Each HTMl node contains several different attributes related to the time. In this case we can select the `datetime` attribute using the `html_attr` function.

```
dates <- thread %>% html_nodes(".u-concealed .u-dt") %>% html_attr("dat
dates[1]
```

```
## [1] "2020-12-22T11:26:12-0800"
```

How to scrape a web page

Collecting timestamps

Finally, its often useful to clean up timestamps. We can do this using the `lubridate` package. In this case we extract the year, month, day, hour, minutes, and seconds, converted to EST. The result is a special type of object used to represent dates and times.

```
library(lubridate)
dates <- dates %>% ymd_hms(tz = "EST")
dates[1]
```

```
## [1] "2020-12-22 14:26:12 EST"
```

```
class(dates)
```

```
## [1] "POSIXct" "POSIXt"
```

How to scrape a web page

Exercise

Write code to get the date each user joined the forum. This should return 20 elements on each page. Use `lubridate` to parse the object.

```
joined <- thread %>% # your solution here

joined[1]
length(joined)
class(joined)
```

How to scrape a web page

Putting it all together

```
class(users)
```

```
## [1] "list"
```

```
length(users)
```

```
## [1] 20
```

```
class(messages)
```

```
## [1] "character"
```

```
length(messages)
```

```
## [1] 20
```

```
class(dates)
```

```
## [1] "POSIXct" "POSIXt"
```

```
length(dates)
```

```
## [1] 21
```

How to scrape a web page

Putting it all together

```
data <- as_tibble(cbind(messages, unlist(users), dates[-1]))
colnames(data) <- c("message", "user", "timestamp")
head(data)
```

```
## # A tibble: 6 x 3
##   message                                                  user
##   <chr>                                                    <chr>
## 1 "Hi all,\nI'm new to the forum and have been reading a~ Furmama22
## 2 "Furmama22 said:\n\n\n\nHi all,\nI'm new to the forum ~ calicosrsp
## 3 "Thank you SO much for taking the time to reply. I rea~ Furmama22
## 4 "I don't think I can add a thing to \nC\n calicosrspec~ Mamanyt195
## 5 "Thanks so much for your thoughts and comments! And th~ Furmama22
## 6 "You certainly came to the right place! And, in my exp~ Mamanyt195
```

How to scrape a web page

Creating a function to collect and store data

```r
get.posts <- function(thread) {
  messages <- thread %>% html_nodes(".message-body") %>%
    html_text() %>% str_trim()
  users <- thread %>% html_nodes(".message-userDetails") %>%
    html_text() %>% str_trim() %>% str_split('\n') %>% pluck(1)
  timestamps <- thread %>% html_nodes(".u-concealed .u-dt") %>%
    html_attr("datetime") %>% ymd_hms(tz="EST")
  timestamps <- timestamps[-1] # remove first timestamp
  data <- as_tibble(cbind(messages, unlist(users), timestamps))
  colnames(data) <- c("message","user", "timestamp")
  return(data)
}
```

How to scrape a web page

Using the function

We can now easily run all the code to extract information using a single function call:

```
results <- get.posts(thread)
head(results)
```

```
## # A tibble: 6 x 3
##   message                                                  user
##   <chr>                                                    <chr>
## 1 "Hi all,\nI'm new to the forum and have been reading a~ Furmama22
## 2 "Furmama22 said:\n\n\n\nHi all,\nI'm new to the forum ~ calicosrsp
## 3 "Thank you SO much for taking the time to reply. I rea~ Furmama22
## 4 "I don't think I can add a thing to \nC\n calicosrspec~ Mamanyt195
## 5 "Thanks so much for your thoughts and comments! And th~ Furmama22
## 6 "You certainly came to the right place! And, in my exp~ Mamanyt195
```

How to scrape a web page

Pagination

The next step is to figure out how we can navigate the different pages of the thread. Inspection of the HTML shows the CSS element pageNav-jump contains the relevant information.

```
thread %>% html_nodes(".pageNav-jump")
```

```
## {xml_nodeset (2)}
## [1] <a href="/threads/advice-on-cat-introductions-feeling-a-bit-lost
## [2] <a href="/threads/advice-on-cat-introductions-feeling-a-bit-lost
```

How to scrape a web page

Pagination

In this case I want both the links *and* the descriptions.

```
links <- thread %>% html_nodes(".pageNav-jump") %>%
  html_attr("href")
desc <- thread %>% html_nodes(".pageNav-jump") %>%
  html_text()
pagination.info <- data.frame(links, desc) %>%
  filter(str_detect(desc, "Next")) %>% distinct()
head(pagination.info)
```

```
##                                                                          li
## 1 /threads/advice-on-cat-introductions-feeling-a-bit-lost.422848/pag
```

How to scrape a web page

Pagination

We can then use the base URL to get the link to the next page.

```r
base <- "https://thecatsite.com"
next.page <- paste(base, pagination.info$links, sep = '')
print(next.page)
```

```
## [1] "https://thecatsite.com/threads/advice-on-cat-introductions-feel
```

How to scrape a web page

Pagination

Let's verify this works by using the `get.posts` function.

```
results <- get.posts(read_html(next.page))
results[1:5,]
```

```
## # A tibble: 5 x 3
##   message                                                user
##   <chr>                                                  <chr>
## 1 "Thank you all for responding! Merry Christmas to all of ~ Furmama
## 2 "Sounds like a reason to be merry to me!"              Mamanyt
## 3 "Well I suppose it's always one step forward two steps ba~ Furmama
## 4 "AWWWWWWWWW! She is adorable! And that really wasn't even~ Mamanyt
## 5 "Thank you!"                                           Furmama
```

How to scrape a web page

Pagination function

```
get.next.page <- function(thread){
  links <- thread %>% html_nodes(".pageNav-jump") %>%
    html_attr("href")
  desc <- thread %>% html_nodes(".pageNav-jump") %>%
    html_text()
  pagination.info <- data.frame(links, desc) %>%
    filter(str_detect(desc, "Next")) %>% distinct()
  base <- "https://thecatsite.com"
  next.page <- paste(base, pagination.info$links, sep = '')
  return(next.page)
}
get.next.page(thread)
```

```
## [1] "https://thecatsite.com/threads/advice-on-cat-introductions-feel
```

How to scrape a web page

Testing the pagination function

We can easily use this function to paginate. In this case we use `get.next.page` to get the link to page 2, read the HTML for page 2, then use `get.next.page` to extract the link to page 3.

```r
thread.2 <- read_html(get.next.page(thread))
page.3 <- get.next.page(thread.2)
page.3
```

```
## [1] "https://thecatsite.com/threads/advice-on-cat-introductions-feel
```

How to scrape a web page

Testing the pagination function

What happens when we run out of pages? In this case there is no link to the next page. The `get.next.page` function does not produce an error, but only returns the base URL.

```
get.next.page(read_html("https://thecatsite.com/threads/advice-on-cat-i
```

```
## [1] "https://thecatsite.com"
```

How to scrape a web page

Improving the function

```
get.next.page <- function(thread){
  links <- thread %>% html_nodes(".pageNav-jump") %>%
    html_attr("href")
  desc <- thread %>% html_nodes(".pageNav-jump") %>%
    html_text()
  pagination.info <- data.frame(links, desc) %>%
    filter(str_detect(desc, "Next")) %>% distinct()
  if (dim(pagination.info)[1] == 1) {
    base <- "https://thecatsite.com"
    next.page <- paste(base, pagination.info$links, sep = '')
  return(next.page)
    } else {
    return("Final page")
  }
}
```

How to scrape a web page

Testing the pagination function

We now get this message when we try to paginate on the final page.

```
get.next.page(read_html("https://thecatsite.com/threads/advice-on-cat-i
```

```
## [1] "Final page"
```

How to scrape a web page

Paginate and scrape

```
paginate.and.scrape <- function(url){
  thread <- read_html(url)
  posts <- get.posts(thread)
  next.page <- get.next.page(thread)
  while (!str_detect(next.page, "Final page"))
  {
    thread <- read_html(next.page)
    posts <- rbind(posts, get.posts(thread))
    next.page <- get.next.page(thread)
    Sys.sleep(1) # wait 1 second
  }
  return(posts)
}
```

How to scrape a web page

Paginate and scrape

```
full.thread <- paginate.and.scrape(url)
dim(full.thread)
```

```
## [1] 118   3
```

```
print(head(full.thread))
```

```
## # A tibble: 6 x 3
##   message                                                  user
##   <chr>                                                    <chr>
## 1 "Hi all,\nI'm new to the forum and have been reading a~ Furmama22
## 2 "Furmama22 said:\n\n\n\nHi all,\nI'm new to the forum ~ calicosrsp
## 3 "Thank you SO much for taking the time to reply. I rea~ Furmama22
## 4 "I don't think I can add a thing to \nC\n calicosrspec~ Mamanyt195
## 5 "Thanks so much for your thoughts and comments! And th~ Furmama22
## 6 "You certainly came to the right place! And, in my exp~ Mamanyt195
```

How to scrape a web page

Crawling a website

- Now we have a function we can use to paginate and scrape the data from threads on the website
- The next goal is to write a crawler to traverse the website and retrieve information from all of the threads we are interested in.
- Fortunately, these threads are organized in a similar way
    - Each page contains 20 threads and links to the next page

How to scrape a web page

Crawling a website

```
get.threads <- function(url) {
  f <- read_html(url)
  title <- f %>% html_nodes(".structItem-title") %>%
    html_text() %>% str_trim()
  link <- f %>% html_nodes(".structItem-title a") %>%
    html_attr("href")  %>% str_trim()
  link <- data.frame(link)
  link <- link %>% filter(str_detect(link, "/threads/"))
  threads <- data.frame(title, link)
  return(threads)
}
```

How to scrape a web page

Crawling a website

```r
forum.url <- "https://thecatsite.com/forums/cat-behavior.5/"

threads <- get.threads(forum.url)
```

How to scrape a web page

Crawling a website

```
print(threads$title)
```

```
##  [1] "Ellie won’t stop growling at me."
##  [2] "Bullying"
##  [3] "I need help"
##  [4] "Featured\nFighting kitties"
##  [5] "New cat mixed messages?"
##  [6] "HELP so frustrated"
##  [7] "Cat loves water, too much"
##  [8] "How to stop my cat from being so anxious"
##  [9] "Newly rescued cat won’t stop meowing at bight"
## [10] "cat introductions going *so* bad"
## [11] "Cat stopped sitting in lap after first month home"
## [12] "Fighting or playing?"
## [13] "My dominant Cat Leo keeps picking on other cats and beats them
## [14] "1 FERAL CAT ATTACKING KITTEN"
## [15] "Cats hate each other."
## [16] "Older Cat Not Getting Along with New Cat"
```

How to scrape a web page

Crawling a website

```
print(threads$link)
```

```
##  [1] "/threads/ellie-wont-stop-growling-at-me.425056/"
##  [2] "/threads/bullying.425054/"
##  [3] "/threads/i-need-help.425085/"
##  [4] "/threads/fighting-kitties.424924/"
##  [5] "/threads/new-cat-mixed-messages.424545/"
##  [6] "/threads/help-so-frustrated.425020/"
##  [7] "/threads/cat-loves-water-too-much.424572/"
##  [8] "/threads/how-to-stop-my-cat-from-being-so-anxious.425035/"
##  [9] "/threads/newly-rescued-cat-wont-stop-meowing-at-bight.425055/"
## [10] "/threads/cat-introductions-going-so-bad.425058/"
## [11] "/threads/cat-stopped-sitting-in-lap-after-first-month-home.425
## [12] "/threads/fighting-or-playing.425044/"
## [13] "/threads/my-dominant-cat-leo-keeps-picking-on-other-cats-and-b
## [14] "/threads/1-feral-cat-attacking-kitten.425013/"
## [15] "/threads/cats-hate-each-other.424971/"
## [16] "/threads/older-cat-not-getting-along-with-new-cat.424738/"
```

How to scrape a web page

Crawling a website

Exercise: Write code to iterate over the first 5 pages of threads. You will need to use `get.threads`, `paginate.and.scrape`, and `get.next.page`. Store the results as a tibble in an object called `results`. Make sure to also retain the name of each thread. *Note that this may take a while to run. You should test it on a small subset to verify it works*.

```
# Complete code here
```

How to scrape a web page

Storing the results

The results should consist of a few thousand messages and associated metadata. Save the results of this crawl to as a CSV file.

```
library(readr)
write_csv(results, "cat_crawl.csv")
```

How to scrape a web page

Data storage

- If you try to collect all the data you need before saving it, you run the risk of data loss if you script crashes
  - This risk increases as you collect more data
    - More memory on your computer is being used
    - Increased likelihood of encountering anomalies that cause errors
- Reasonable solutions
  - Continuously save results to disk (e.g. concatenate each thread to a CSV)
  - Store results in chunks (e.g. each thread in a new CSV)

How to scrape a web page

Data storage

- A more robust solution
  - Write output to a relational database
    - This helps to organize the data and makes it easier to query and manage, particularly with large datasets
    - I recommend PostgreSQL, a free open-source, SQL-compatible relational database

How to scrape a web page

Data storage

- If collecting a lot of data, I recommend use a server to run the code and to store scraped data
- Requirements
  - Access to a server ($)
    - But most universities have free computing clusters
  - Command line knowledge
  - Database knowledge
- It is beyond the scope of this class to cover this material, but I highly recommend you develop this infrastructure if you continue to work in this area

How to scrape a web page

Logging

- Log the progress of your webscraper
  - Simple option:
    - Print statements in code
  - Better option:
    - Use a log file
  - To keep yourself updated:
    - Use a Slack App to send yourself messages

How to scrape a web page

Javascript and browser automation

- Many websites use Javascript, which cause problems for web-scrapers as it cannot directly be parsed to HTML
- We can get around this by doing the following
  - Automatically to open a browser (e.g. Google Chrome)
  - Load a website in the browser
  - Read the HTML from the browser into R
- We can also use browser automation to click buttons, fill in forms, or enter login info

How to scrape a web page

Selenium

- Selenium WebDriver and the package `RSelenium` (https://github.com/ropensci/RSelenium) is the most popular approach
- **However**, `RSelenium` requires a complicated set up using a Docker container
  - This is a little technical and I've had trouble getting it to work
  - It may be easier to use `selenium` in Python then read the data into R
    - https://python-bloggers.com/2020/07/rvspython-3-setting-up-selenium-limitations-with-the-rselenium-package-getting-past-them/

How to scrape a web page

Using reticulate to run selenium in Python

This Python code uses selenium to open up a Chrome browser, visit a website, and collect the HTML. It then closes the browser.

```
from selenium import webdriver
driver = webdriver.Chrome()
driver.get('https://www.sociology.rutgers.edu')
html = driver.page_source
driver.close()
```

This will only work if the Chrome driver has been downloaded and is in your PATH. See https://chromedriver.chromium.org/getting-started

How to scrape a web page

Using reticulate to run selenium in Python

I saved the code in the previous chunk as a file called `get_html.py`. We can use `reticulate` to run the Python code then pass objects from Python to R. In this case we use Python to run selenium and get the HTML, then read it into R using `rvest`.

```
library(reticulate)

#py_install("selenium") # uncomment to install selenium.py
source_python('get_html.py') # run python script

html.text <- read_html(py$html) %>% html_text()
```

Questions