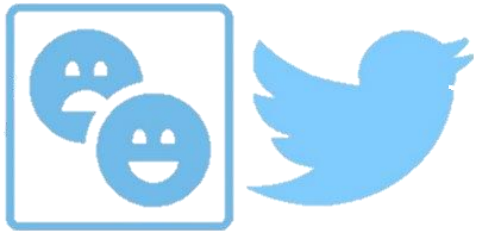
Part II-1: Scraping, Text Normalization & Static Feature Extraction



Outline

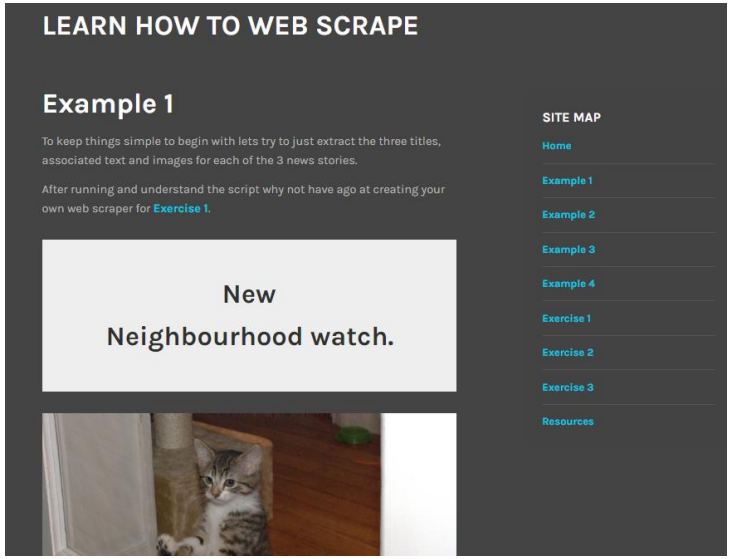
i. Scraping
    i. General Web Scraping
    ii. Scraping Twitter
ii. Text Normalization
    i. Regular Expressions
    ii. Stemming, Lemmatization
iii. Static Feature Extraction

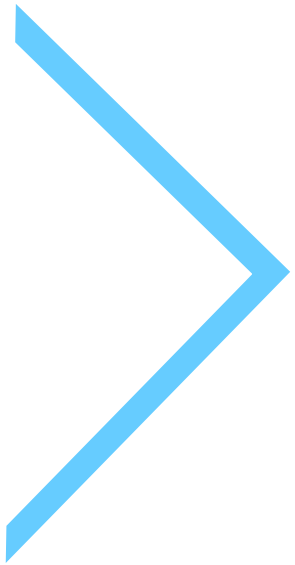
Part II-1: Scraping, Text Normalization & Static Feature Extraction

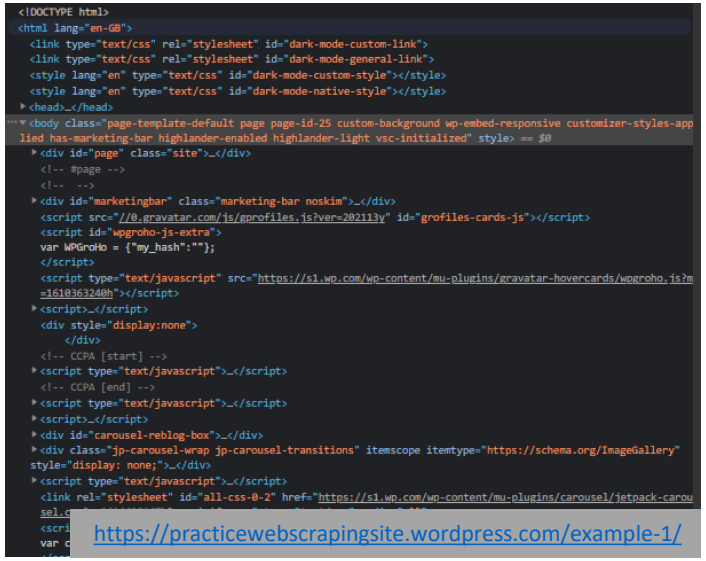
Scraping

Scraping **Idea**

- **Goal**: access, use & analyze data available on the internet
- **Problem**: unstructured, HTML-formatted, non-downloadable data







Scraping **Learning to Scrape**

- Sorry, but: it’s a tedious thing
  - Highly manual, time-consuming process
  - Need for adjustment every time the website source code changes
- Harder with more complex websites optimized for UX
- Examples
  - Text data from Wikipedia, labeled image data from Google
  - Social media data from Twitter, Facebook, ...
  - Reviews, feedbacks from Amazon

https://practicewebscrapingsite.wordpress.com/

Scraping **Steps**

- **Basic steps**
  1. Parse (static) website content
  2. Grasp page set-up

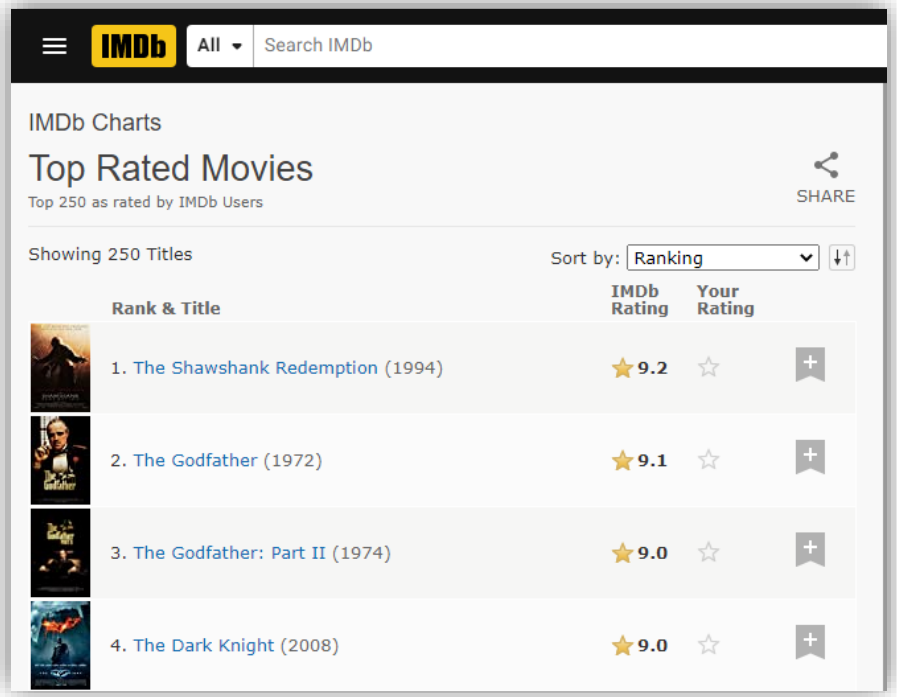
     requiring CSS selectors – easier with [*https://selectorgadget.com/*](https://selectorgadget.com/)

  3. Extract information

- **Advanced**: actual website navigation, i.e., clicking buttons and jumping to pages, with a remotely controlled browser

Scraping **Example**

- **Goal:** get TOP 250 movie rankings and ratings from IMDb http://www.imdb.com/chart/top?ref_=nv_mv_250_6

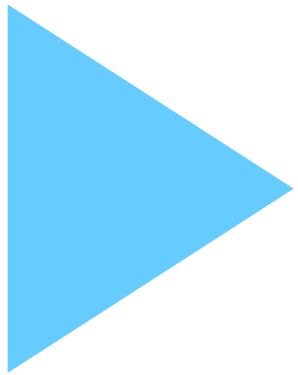



```
##    ranking                 title year rating
## 1:       1       Die Verurteilten 1994    9.2
## 2:       2              Der Pate 1972    9.1
## 3:       3            Der Pate 2 1974    9.0
## 4:       4       The Dark Knight 2008    9.0
## 5:       5 Die zwölf Geschworenen 1957    8.9
## 6:       6       Schindlers Liste 1993    8.9
```

Scraping **Example**

- **Guide**
  1. Install and load package `rvest`: `install.packages("rvest"); library(rvest)`
  2. Parse webpage: `read_html()`
  3. Explore contents using Chrome's **developer tab** (clicking F12) or some helper tool, e.g., **SelectorGadget** (does not require technical knowledge of HTML and CSS)
  4. Extract information from the webpage: `html_nodes()`
  5. Store extracted information in desired format: `html_text()`

Scraping **Example**



Demo 1: Web Scraping Example

Scraping **Twitter Data**

- **Guide**
  1. Install and load package `rtweet`
  2. Set up **Twitter API**
     1. Create Twitter account: http://twitter.com/signup
     2. Apply for a developer account by filling out a short application form: https://developer.twitter.com/en/apply-for-access.html
     3. Click on „key and access token“ and get your API access: consumer key (API key), consumer secret (API secret), access token, access token secret

keep somewhere safe

  3. Use the keys as arguments: `rtweet::create_token(consumer_key, consumer_secret, access_token, access_secret)`

Scraping **Twitter Data – Limitations**

- Using the **standard** (free) search API
  - Tweets only for a 6-9 days period (for more information see https://developer.twitter.com/en/docs/tweets/search/api-reference/get-search-tweets.html)
  - Scraping of up to 18,000 tweets possible
  - Package documentation: https://cran.r-project.org/web/packages/rtweet/rtweet.pdf

useful tutorial on https://rtweet-workshop.mikewk.com/

- Worth considering: scraping in Python using `beautifulsoup`

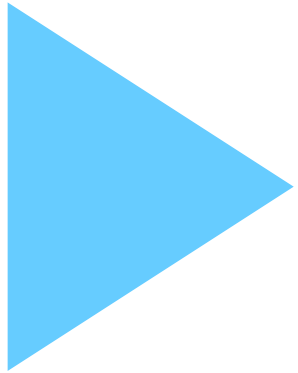
Scraping **Twitter Data – Example**

- **Goal:** scrape tweets and associated information

Screenshot from: https://twitter.com/JKasek/status/1377285533274083343

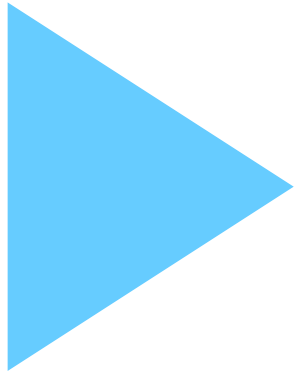
	created_at	screen_name	text	retweet_count	status_id	favourites_count
1	2021-03-31 15:43:54	JKasek	#Sachsen: die #CDU stimmt in #Plauen gemeinsam mit der #AF...	638	1377285533274083343	1731

Scraping Twitter Data



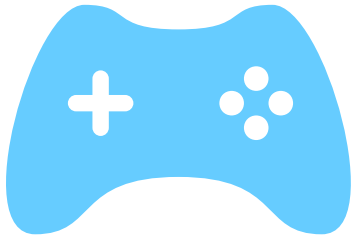
Demo 2: Twitter Scraping Example

Scraping Twitter Data



Demo 3: Twitter Scraping Python

Scraping **Exercise**



Exercise 1: Scraping

Part II-1: Scraping, Text Normalization & Static Feature Extraction

Text Normalization

Text Normalization **Purpose**

- Series of steps to clean and standardize textual data
- **Goal**: representation of texts by meaningful tokens that co-occur across documents as much as possible
- **Basic techniques**:
  - Removing stopwords: words with little or no significance
  - Removing special characters (symbols, punctuation, HTML entities etc.)
  - Stemming, lemmatization

Die Ausgrenzung von MigrantInnen von der #EssenerTafel ist inakzeptabel und rassistisch. Wir dürfen nicht zulassen, dass die Ärmsten gegeneinander ausgespielt werden.

Text Normalization **Regular Expressions**

- Focus of NLP in general: analysis and understanding of (unstructured) text
- **Regular expression (regex):** pattern (= sequence of characters) defined to search text with a common structure
- Used for
  - searching for a specific file name,
  - finding a text with a specific pattern,
  - replacing a specific pattern in a text, etc.
- Standardized across many programming languages

Text Normalization **Regular Expressions**

- `stringr`: useful R package to deal with all kinds of text wrangling
- Important commands in `base & stringr:`

	base	**stringr**
Identify	`grep(., value = FALSE)`	`str_detect()`
Extract	`grep(., value = TRUE)`	`str_extract()`
Locate	`gregexpr()`	`str_locate()`
Replace	`gsub()`	`str_replace()`
Split	`strsplit()`	`str_split()`

Text Normalization **Useful Regex Patterns**

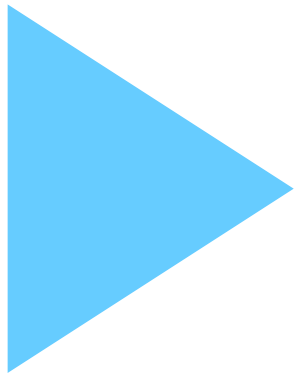
Pattern	Function
\d or [:digit:] or [0-9]	Matches any digit
[:alpha:] or [A-Za-z]	Matches any character
[a-z] or [:lower:]	Matches any lowercase character
[A-Z] or [:upper:]	Matches any uppercase character
[abc]	Matches a, b or c
[^abc]	Matches anything except a, b, or c.
[:punct:]	Matches punctuation characters: ! " # $ % & ’ ( ) * + , - . / : ; < = > ? @ [ ] ^ _ ` { | } ~
a(b|c)d	Matches abd or acd
^x	Matches x if string begins with x
x$	Matches x if string ends with x

Text Normalization **Useful Regex Patterns**

Pattern	Function
x?	Matches 0 or 1 occurrences of x
x*	Matches 0 or more occurrences of x
x+	Matches 1 or more occurrences of x
x{n}	Matches exactly *n* occurrences of x
x{n,}	Matches *n* or more occurrences of x
x{,m}	Matches at most *m* occurrences of x
x{n,m}	Matches between *n* and *m* occurrences of x
x(?=...)	Matches x if followed by ... (for negation, replace = by !)
(?<=...)x	Matches x if preceded by ... (for negation, replace = by !)

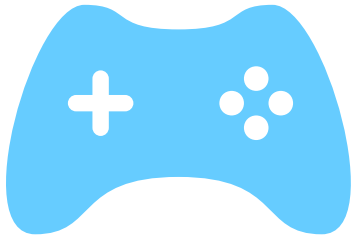
https://cran.r-project.org/web/packages/stringr/vignettes/regular-expressions.html

Text Normalization **Regular Expressions**



Demo 4: Regular Expressions

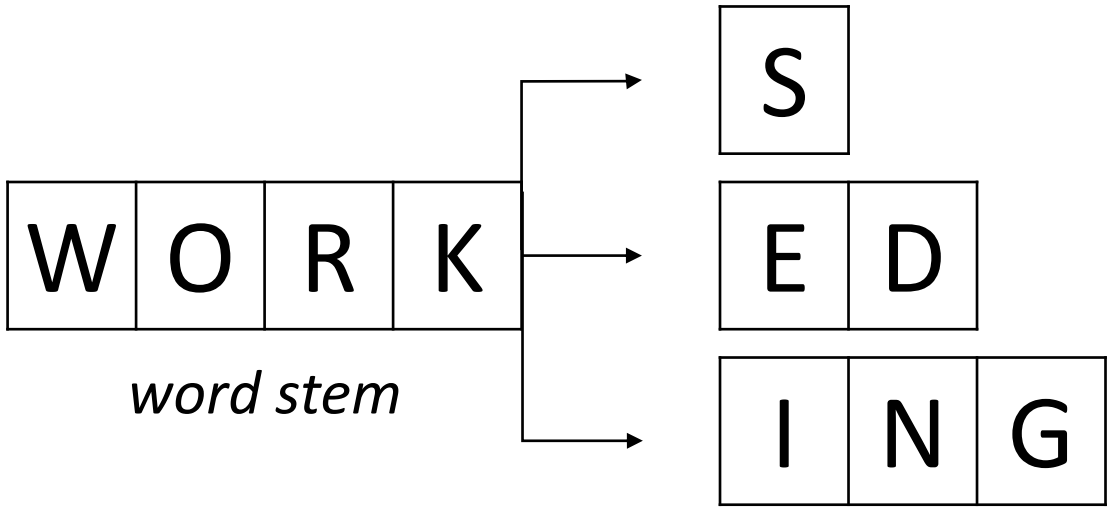
Text Normalization **Exercise**



Exercise 2: Regular Expressions

Text Normalization **Stemming**

- **Idea**: retrieve base form, the root stem



- Example in German: Bruder – Bruders – brüderlich/e/n/r/s – Brüderlichkeit/en → ***bruder***

Text Normalization **Lemmatization**

- **Problem with stemming**
  - Potentially erroneous
  - Overstemming: *politics* → ***polit***
  - Understemming: *travels* → ***trav*** but *travelled* → ***travel***

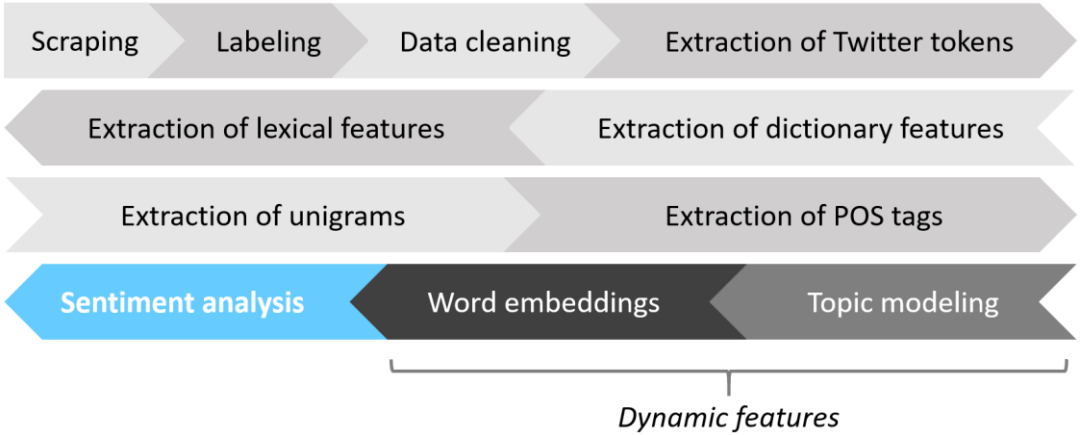
- Alternative: **lemmatization**
  - Retrieving the root **word** (not root stem)
  - Difference: the lemma will always be present in the dictionary (lexicographically correct word)
  - Slower than stemming
  - Potentially more difficult for grammatically complex languages

Part II-1: Scraping, Text Normalization & Static Feature Extraction

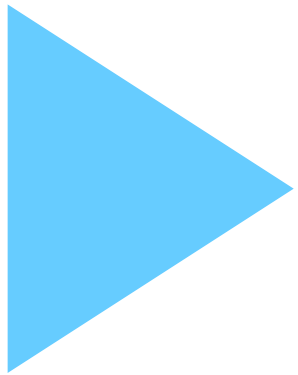
Static Feature Extraction

Static Feature Extraction **Basic Text Cleaning**

- **Now, back at our task**
- We need to
  - Perform basic text cleaning
  - Extract all static features we wish to use for sentiment classification



Static Feature Extraction **Basic Text Cleaning**

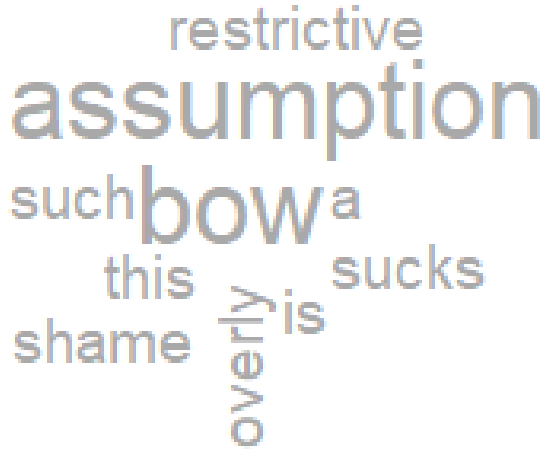


Demo 5: Basic Text Cleaning

Static Feature Extraction **Features**

- One **central assumption** in sentiment analysis with standard machine learning techniques: **bag-of-words (BOW)**

- Why?
  - Standard machine learning only built for tabular data
  - Consequence: discarding all information about word order, sentence structure, ...
  - **Eye-watering simplification**, but it is what it is



Static Feature Extraction **Features**

- **Useful (static) features in sentiment analysis**
  - Polarity clues
  - Negations, intensifications, punctuations, repetitions
  - Word/character *n*-grams
  - Part-of-speech (POS) tags
  - Twitter-specific features

- **Recall our goal:** numeric representation of texts by tokens that co-occur across documents

Static Feature Extraction **Features**

- **Polarity clues**
  - **Idea**: find sentiment-bearing tokens
  - **Details**
    - Presence/absence or count
    - Positive/negative, positive/negative/neutral, more fine-grained emotions, ...
  - **Computation**: look-up using publicly available dictionaries

if useful: modify/enrich

What a **despicable** thing to do, I **hate** him! → *positive: 0, negative: 2*

Static Feature Extraction **Features**

- **Negations, intensifications, punctuations, repetitions**
  - **Idea**: capture meaning modifiers (lost with BOW assumption!)
  - **Assumptions**
    - Negations might flip sentiments.
    - Intensifications might indicate/strengthen sentiments.
    - Punctuations/repetitions might indicate sentiments.
  - **Computation**: look-up using regular expressions

I **cannot** recommend this movie**.....**

A **truly** grand and **deeply** moving plot.

Static Feature Extraction **Features**

- **Word/character *n*-grams**
  - **Idea**: count general tokens to represent texts
  - **Details**
    - *n*-gram: sequence of *n* words/characters – somewhat mitigating BOW effect
    - Unigrams, bigrams, trigrams, ...
    - The larger *n*, the lower the probability of *n*-grams occurring in multiple documents
  - **Computation**: count using available functionalities (e.g., in `quanteda`)

Bello the dog is a good boy.

bello	dog	good	boy	a	b	d	e	g	h	i	l	o	s	t	y
1	1	1	1	1	2	2	2	2	1	1	2	5	1	1	1

Static Feature Extraction **Features**

- **POS tags**
  - **Idea**: capture grammatical structure
  - **Details**
    - Computed on full text
    - Assign each word a grammatical role (18 universal tags)
  - **Assumption**: presence of many adverbs/adjectives indicative of sentiments
  - **Computation**: use available parsers (e.g., in spacyR)

https://universaldependencies.org/u/pos/all.html

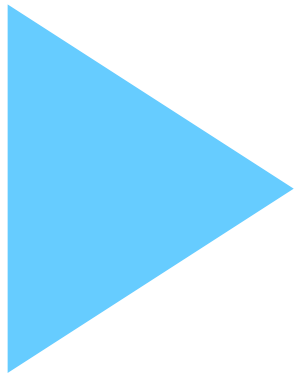
Bello	the	dog	is	a	good	boy	.
PROPN	DET	NOUN	AUX	DET	ADJ	NOUN	PUNCT

Static Feature Extraction **Features**

- **Twitter-specific features**
  - **Idea**: exploit Twitter-inherent tokens
  - **Details**
    - Emojis: count/assign polarity
    - Hashtags: count/mine (for topics, meaning, ...)
    - Tags: count/mine
    - …
  - **Computation**: look-up using regular expressions

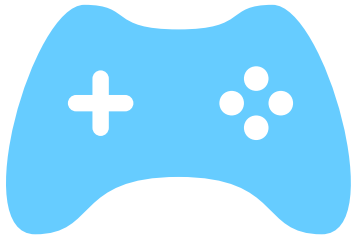
I love doing dishes #not 😒

Static Feature Extraction **Features**



Demo 6: Static Feature Extraction

Static Feature Extraction **Exercise**



Exercise 3: Static Feature Extraction

Part II-1: Scraping, Text Normalization & Static Feature Extraction

Literature and References

Berry, M., and Kogan, J. (2010): Text Mining. Applications and Theory, John Wiley & Sons, Inc.

Kearney, M., Heiss, A., and Briatte, F. (2020): rtweet. Collecting Twitter Data, R package version 0.7.0, URL: https://CRAN.R-project.org/package=rtweet

Miner, G., Elder IV, J., Fast, A., Hill, T., Nisbet, R. and Delen, D. (2012): Practical Text Mining and Statistical Analysis for Non-Structured Text Data Applications, Academic Press.

Munzert, S., Rubba, C., Meißner, P., and Nyhuis, D. (2015): Automated Data Collection with R : A Practical Guide to Web Scraping and Text Mining, John Wiley & Sons, Inc.

Silge, J. (2017): Text Mining with R. A Tidy Approach, O'Reilly.

Wickham, H (2019): stringr. Simple, Consistent Wrappers for Common String Operations, R package version 1.4.0, URL: https://CRAN.R-project.org/package=stringr

Wickham, H (2021): rvest. Easily Harvest (Scrape) Web Pages, R package version 1.0.0, URL: https://CRAN.R-project.org/package=rvest