上課前，同學可以先.....

- 安裝套件
- install.packages(c(“tm”, “gutenbergr”))
- devtools::install_github("hrbrmstr/hottopic")

- 想想期末報告分組與主題

R 語言
文字資料 前處理

王貿

國立臺灣大學行為與資料科學研究中心助理研究員

國立臺灣大學政治學系博士、兼任講師

maowang01@gmail.com

課程主題重點

- 語料庫
- 常用的文字資料前處理（preprocessing）套件介紹
  tm, stringr [quanteda]
- 正規表示法（regular expression）

文字資料分析流程

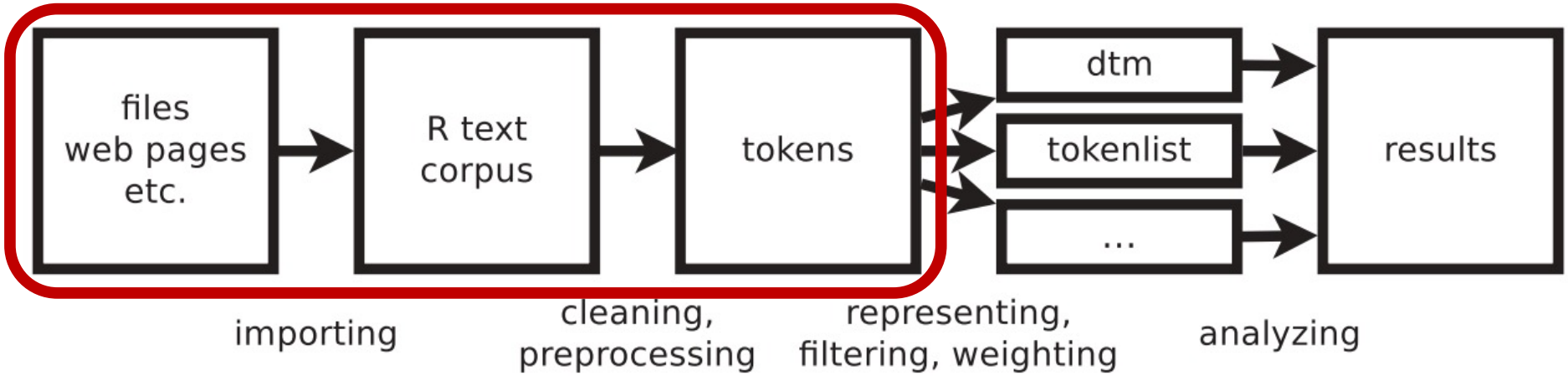
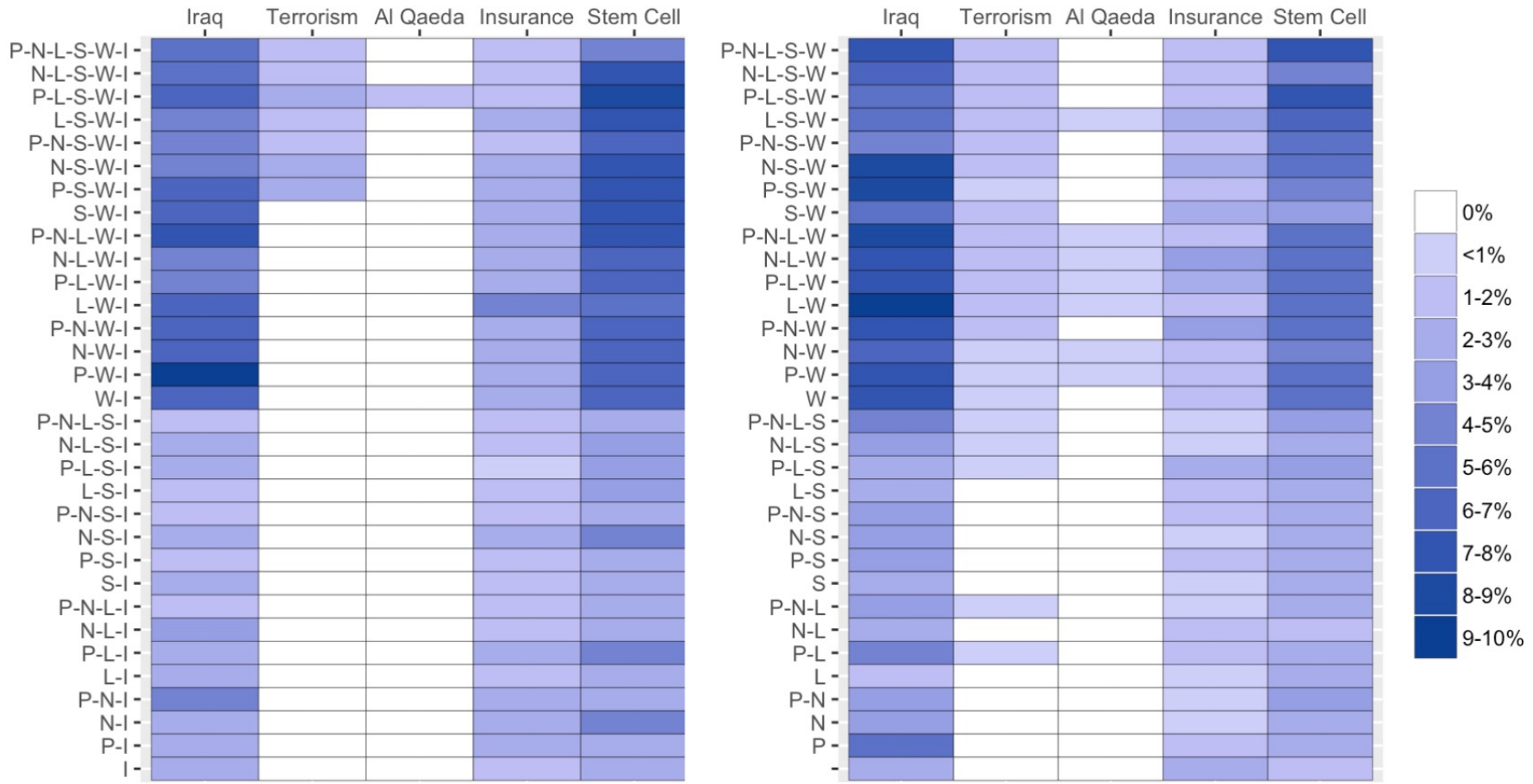


Figure 1. Order of text analysis operations for data preparation and analysis.

Welbers, K., Van Atteveldt, W., & Benoit, K. (2017). Text Analysis in R. *Communication Methods and Measures, 11*(4), 245-265.

資料前處理為什麼重要？



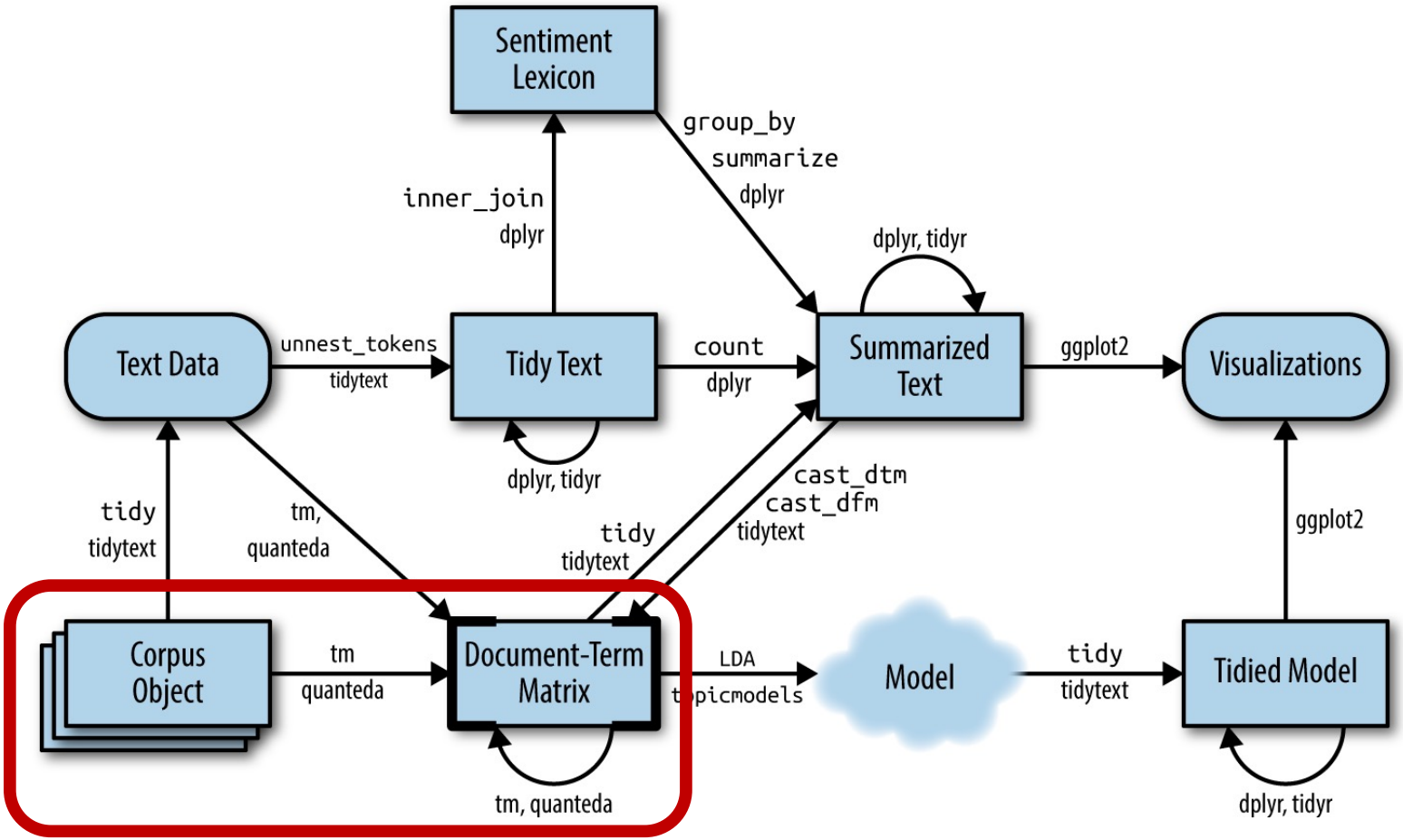
Denny, M. J., & Spirling, A. (2018). Text Preprocessing For Unsupervised Learning: Why It Matters, When It Misleads, And What To Do About It. *Political Analysis, 26*(02), 168-189.

語料庫（corpus）

- 指大量的文本，通常經過整理，具有既定格式與標記。

- Project Gutenberg（https://www.gutenberg.org/）
- Manifesto Project（https://manifesto-project.wzb.eu/）
- HKBU Corpus of Political Speeches（https://digital.lib.hkbu.edu.hk/corpus/）
- MPQA（http://mpqa.cs.pitt.edu/）

tm 套件



https://www.tidytextmining.com/images/tmwr_0601.png

stringr

String manipulation with stringr : : CHEAT SHEET

The **stringr** package provides a set of internally consistent tools for working with character strings, i.e. sequences of characters surrounded by quotation marks.

Detect Matches

str_detect(string, **pattern**) Detect the presence of a pattern match in a string.
str_detect(fruit, "a")

str_which(string, **pattern**) Find the indexes of strings that contain a pattern match.
str_which(fruit, "a")

str_count(string, **pattern**) Count the number of matches in a string.
str_count(fruit, "a")

str_locate(string, **pattern**) Locate the positions of pattern matches in a string. Also **str_locate_all**. *str_locate(fruit, "a")*

Subset Strings

str_sub(string, start = 1L, end = -1L) Extract substrings from a character vector.
str_sub(fruit, 1, 3); str_sub(fruit, -2)

str_subset(string, **pattern**) Return only the strings that contain a pattern match.
str_subset(fruit, "b")

str_extract(string, **pattern**) Return the first pattern match found in each string, as a vector. Also **str_extract_all** to return every pattern match. *str_extract(fruit, "[aeiou]")*

str_match(string, **pattern**) Return the first pattern match found in each string, as a matrix with a column for each ( ) group in pattern. Also **str_match_all**.
str_match(sentences, "(a|the) ([^]+)")

Manage Lengths

str_length(string) The width of strings (i.e. number of code points, which generally equals the number of characters). *str_length(fruit)*

str_pad(string, width, side = c("left", "right", "both"), pad = " ") Pad strings to constant width. *str_pad(fruit, 17)*

str_trunc(string, width, side = c("right", "left", "center"), ellipsis = "...") Truncate the width of strings, replacing content with ellipsis.
str_trunc(fruit, 3)

str_trim(string, side = c("both", "left", "right")) Trim whitespace from the start and/or end of a string. *str_trim(fruit)*

Mutate Strings

str_sub() **<-** value. Replace substrings by identifying the substrings with str_sub() and assigning into the results.
str_sub(fruit, 1, 3) <- "str"

str_replace(string, **pattern**, replacement) Replace the first matched pattern in each string. *str_replace(fruit, "a", "-")*

str_replace_all(string, **pattern**, replacement) Replace all matched patterns in each string. *str_replace_all(fruit, "a", "-")*

str_to_lower(string, locale = "en")[1] Convert strings to lower case.
str_to_lower(sentences)

str_to_upper(string, locale = "en")[1] Convert strings to upper case.
str_to_upper(sentences)

str_to_title(string, locale = "en")[1] Convert strings to title case. *str_to_title(sentences)*

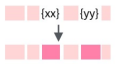
Join and Split

str_c(..., sep = "", collapse = NULL) Join multiple strings into a single string.
str_c(letters, LETTERS)

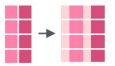
str_c(..., sep = "", **collapse = NULL**) Collapse a vector of strings into a single string.
str_c(letters, collapse = "")

str_dup(string, times) Repeat strings times times. *str_dup(fruit, times = 2)*

str_split_fixed(string, **pattern**, n) Split a vector of strings into a matrix of substrings (splitting at occurrences of a pattern match). Also **str_split** to return a list of substrings.
str_split_fixed(fruit, " ", n=2)



str_glue(..., .sep = "", .envir = parent.frame()) Create a string from strings and {expressions} to evaluate. *str_glue("Pi is {pi}")*



str_glue_data(.x, ..., .sep = "", .envir = parent.frame(), .na = "NA") Use a data frame, list, or environment to create a string from strings and {expressions} to evaluate.
str_glue_data(mtcars, "{rownames(mtcars)} has {hp}hp")

Order Strings

str_order(x, decreasing = FALSE, na_last = TRUE, locale = "en", numeric = FALSE, ...)[1] Return the vector of indexes that sorts a character vector. *x[str_order(x)]*

str_sort(x, decreasing = FALSE, na_last = TRUE, locale = "en", numeric = FALSE, ...)[1] Sort a character vector.
str_sort(x)

Helpers

str_conv(string, encoding) Override the encoding of a string. *str_conv(fruit,"ISO-8859-1")*

str_view(string, **pattern**, match = NA) View HTML rendering of first regex match in each string. *str_view(fruit, "[aeiou]")*

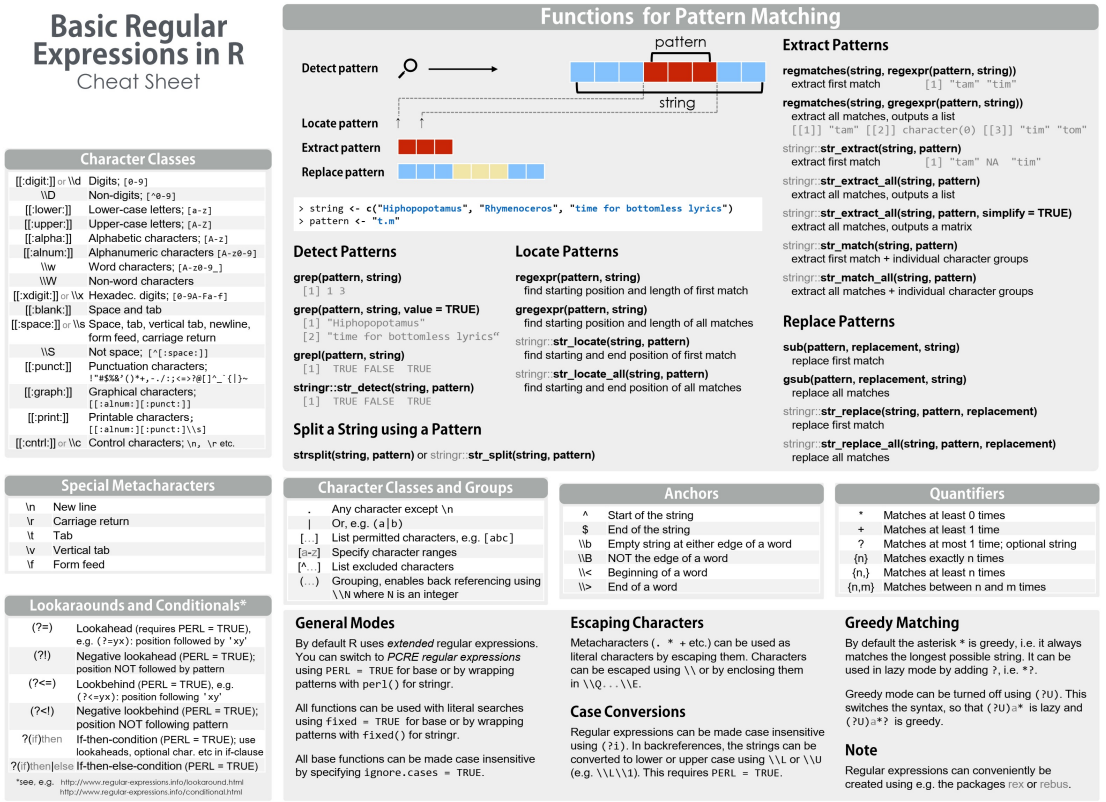
str_view_all(string, **pattern**, match = NA) View HTML rendering of all regex matches.
str_view_all(fruit, "[aeiou]")

str_wrap(string, width = 80, indent = 0, exdent = 0) Wrap strings into nicely formatted paragraphs. *str_wrap(sentences, 20)*

https://raw.githubusercontent.com/rstudio/cheatsheets/master/strings.pdf

Regular Expression (regex)

- 正規表示式，又稱正則表達式。
- 表示文字的模式（pattern）
- RStudio cheatsheet
- R regex 練習網站
  （https://regexr.com）



Basic Regular Expressions in R
Cheat Sheet

Functions for Pattern Matching

Character Classes

[[:digit:]] or \\d	Digits; `[0-9]`
\\D	Non-digits; `[^0-9]`
[[:lower:]]	Lower-case letters; `[a-z]`
[[:upper:]]	Upper-case letters; `[A-Z]`
[[:alpha:]]	Alphabetic characters; `[A-z]`
[[:alnum:]]	Alphanumeric characters `[A-z0-9]`
\\w	Word characters; `[A-z0-9_]`
\\W	Non-word characters
[[:xdigit:]] or \\x	Hexadec. digits; `[0-9A-Fa-f]`
[[:blank:]]	Space and tab
[[:space:]] or \\s	Space, tab, vertical tab, newline, form feed, carriage return
\\S	Not space; `[^[:space:]]`
[[:punct:]]	Punctuation characters; `!"#$%&'()*+,-./:;<=>?@[]^_`{|}~`
[[:graph:]]	Graphical characters; `[[:alnum:][:punct:]]`
[[:print:]]	Printable characters; `[[:alnum:][:punct:]\\s]`
[[:cntrl:]] or \\c	Control characters; `\n, \r` etc.

Special Metacharacters

\n	New line
\r	Carriage return
\t	Tab
\v	Vertical tab
\f	Form feed

Lookaraounds and Conditionals*

(?=)	Lookahead (requires PERL = TRUE), e.g. `(?=yx)`: position followed by 'xy'
(?!)	Negative lookahead (PERL = TRUE); position NOT followed by pattern
(?<=)	Lookbehind (PERL = TRUE), e.g. `(?<=yx)`: position following 'xy'
(?<!)	Negative lookbehind (PERL = TRUE); position NOT following pattern
?(if)then	If-then-condition (PERL = TRUE); use lookaheads, optional char. etc in if-clause
?(if)then|else	If-then-else-condition (PERL = TRUE)

*see, e.g. http://www.regular-expressions.info/lookaround.html http://www.regular-expressions.info/conditional.html

Detect pattern
Locate pattern
Extract pattern
Replace pattern
pattern
string

```
> string <- c("Hiphopopotamus", "Rhymenoceros", "time for bottomless lyrics")
> pattern <- "t.m"
```

Detect Patterns

grep(pattern, string)
`[1] 1 3`

grep(pattern, string, value = TRUE)
`[1] "Hiphopopotamus"`
`[2] "time for bottomless lyrics"`

grepl(pattern, string)
`[1] TRUE FALSE TRUE`

stringr::str_detect(string, pattern)
`[1] TRUE FALSE TRUE`

Locate Patterns

regexpr(pattern, string)
find starting position and length of first match

gregexpr(pattern, string)
find starting position and length of all matches

stringr::**str_locate(string, pattern)**
find starting and end position of first match

stringr::**str_locate_all(string, pattern)**
find starting and end position of all matches

Split a String using a Pattern

strsplit(string, pattern) or stringr::**str_split(string, pattern)**

Extract Patterns

regmatches(string, regexpr(pattern, string))
extract first match `[1] "tam" "tim"`

regmatches(string, gregexpr(pattern, string))
extract all matches, outputs a list
`[[1]] "tam" [[2]] character(0) [[3]] "tim" "tom"`

stringr::**str_extract(string, pattern)**
extract first match `[1] "tam" NA "tim"`

stringr::**str_extract_all(string, pattern)**
extract all matches, outputs a list

stringr::**str_extract_all(string, pattern, simplify = TRUE)**
extract all matches, outputs a matrix

stringr::**str_match(string, pattern)**
extract first match + individual character groups

stringr::**str_match_all(string, pattern)**
extract all matches + individual character groups

Replace Patterns

sub(pattern, replacement, string)
replace first match

gsub(pattern, replacement, string)
replace all matches

stringr::**str_replace(string, pattern, replacement)**
replace first match

stringr::**str_replace_all(string, pattern, replacement)**
replace all matches

Character Classes and Groups

.	Any character except \n
|	Or, e.g. `(a|b)`
[...]	List permitted characters, e.g. `[abc]`
[a-z]	Specify character ranges
[^...]	List excluded characters
(...)	Grouping, enables back referencing using `\\N` where N is an integer

Anchors

^	Start of the string
$	End of the string
\\b	Empty string at either edge of a word
\\B	NOT the edge of a word
\\<	Beginning of a word
\\>	End of a word

Quantifiers

*	Matches at least 0 times
+	Matches at least 1 time
?	Matches at most 1 time; optional string
{n}	Matches exactly n times
{n,}	Matches at least n times
{n,m}	Matches between n and m times

General Modes

By default R uses *extended* regular expressions. You can switch to *PCRE regular expressions* using `PERL = TRUE` for base or by wrapping patterns with `perl()` for stringr.

All functions can be used with literal searches using `fixed = TRUE` for base or by wrapping patterns with `fixed()` for stringr.

All base functions can be made case insensitive by specifying `ignore.cases = TRUE`.

Escaping Characters

Metacharacters (`. * +` etc.) can be used as literal characters by escaping them. Characters can be escaped using `\\` or by enclosing them in `\\Q...\\E`.

Case Conversions

Regular expressions can be made case insensitive using `(?i)`. In backreferences, the strings can be converted to lower or upper case using `\\L` or `\\U` (e.g. `\\L\\1`). This requires `PERL = TRUE`.

Greedy Matching

By default the asterisk * is greedy, i.e. it always matches the longest possible string. It can be used in lazy mode by adding `?`, i.e. `*?`.

Greedy mode can be turned off using `(?U)`. This switches the syntax, so that `(?U)a*` is lazy and `(?U)a*?` is greedy.

Note

Regular expressions can conveniently be created using e.g. the packages rex or rebus.