A brief introduction to regular expressions

Data Wrangling: Session 5

Kieran Healy
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Load the packages, as always

```r
library(here)      # manage file paths
library(socviz)    # data and some useful functions
```

```r
library(tidyverse) # your friend and mine
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.1 ──

## ✓ ggplot2 3.3.5     ✓ purrr   0.3.4
## ✓ tibble  3.1.6     ✓ dplyr   1.0.8
## ✓ tidyr   1.2.0     ✓ stringr 1.4.0
## ✓ readr   2.1.2     ✓ forcats 0.5.1

## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## x readr::edition_get()   masks testthat::edition_get()
## x dplyr::filter()        masks stats::filter()
## x purrr::is_null()       masks testthat::is_null()
## x dplyr::lag()           masks stats::lag()
## x readr::local_edition() masks testthat::local_edition()
## x dplyr::matches()       masks tidyr::matches(), testthat::matches()
```

```r
library(gapminder) # gapminder data
library(stringr)
```

Regular Expressions

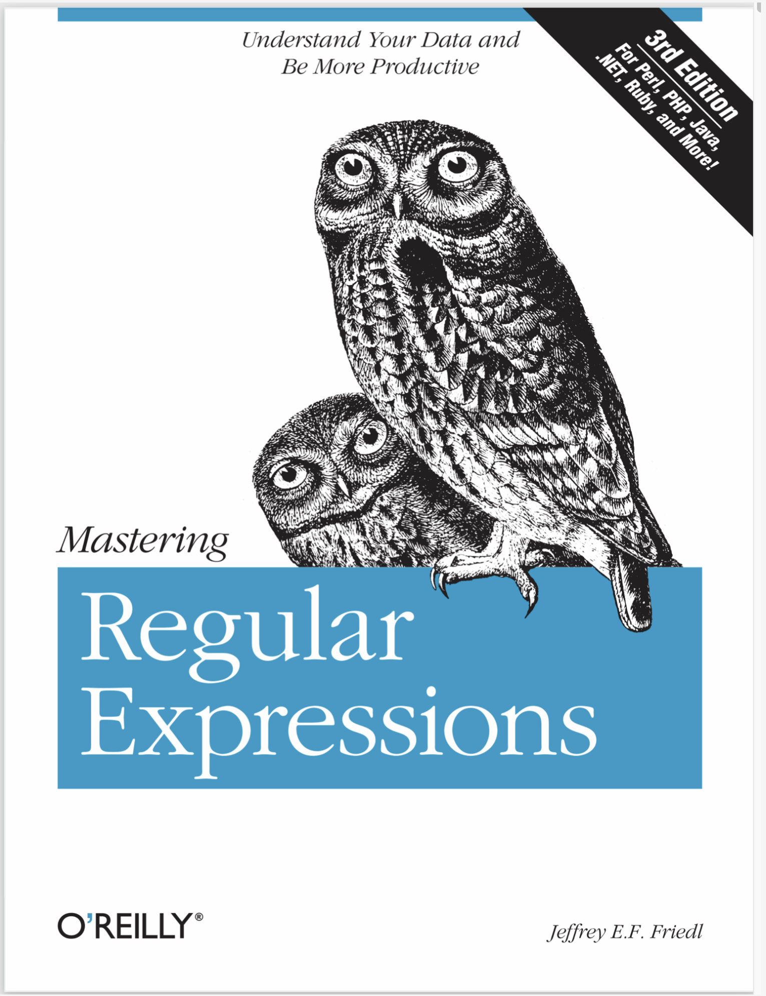
Or, waiter, there appears to be a language inside my language

stringr is your gateway to regexps

```r
library(stringr)
```

Part of the tidyverse, but not loaded by default.

regexps are their own whole world



This book is a thing of beauty.

Searching for patterns

A regular expression is a way of searching for a piece of text, or *pattern*, inside some larger body of text, called a *string*.

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Every pattern-searching function in `stringr` has the same basic form:

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```

(If you think about it, `<STRING>`, `<PATTERN>` and `<REPLACEMENT>` above are all kinds of pattern: they are meant to "stand for" all kinds of text, not be taken literally.)

Searching for patterns

Here I'll follow the exposition in Wickham & Grolemund (2017).

```
x <- c("apple", "banana", "pear")

str_view(x, "an")
```

```
apple
banana
pear
```

Searching for patterns

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Regular expressions get their real power from *wildcards*, i.e. tokens that match more than just literal strings, but also more general and more complex patterns.

The most general pattern-matching token is, "Match everything!" This is represented by the period, or `.`]

But ... if “`.`” matches any character, how do you specifically match the character “`.`”?

Escaping

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You have to "escape" the period to tell the regex you want to match it exactly, rather than interpret it as meaning "match anything".

regexs use the backslash, `\`, to signal "escape the next character".

To match a ".", you need the regex "`\.`"

Hang on, I see a further problem

We use strings to represent regular expressions. `\` is also used as an escape symbol in strings. So to create the regular expression `\.` we need the string `"\\."`

```
# To create the regular expression, we need \\
dot <- "\\."

# But the expression itself only contains one:
writeLines(dot)
```

```
## \.
```

```
# And this tells R to look for an explicit .
str_view(c("abc", "a.c", "bef"), "a\\.c")
```

abc

a.c

bef

But ... then how do you match a literal \ ?

```
x <- "a\\b"
writeLines(x)
```

```
## a\b
```

```
#> a\b

str_view(x, "\\\\") # you need four!
```

a\b

But … then how do you match a literal \?

This is the price we pay for having to express searches for patterns using a language containing these same characters, which we may also want to search for.

I *promise* this will pay off

Use `^` to match the start of a string.

Use `$` to match the end of a string.

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Use ^ to match the start of a string.

Use $ to match the end of a string.

```
x <- c("apple", "banana", "pear")
str_view(x, "^a")
```

```
apple
banana
pear
```

I *promise* this will pay off

Use **^** to match the start of a string.

Use **$** to match the end of a string.

```
x <- c("apple", "banana", "pear")
str_view(x, "^a")
```

```
apple
banana
pear
```

```
str_view(x, "a$")
```

```
apple
banana
pear
```

Matching start and end

To force a regular expression to only match a complete string, anchor it with both `^` and `$`

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To force a regular expression to only match a complete string, anchor it with both **^** and **$**

```
x <- c("apple pie", "apple", "apple cake")
str_view(x, "apple")
```

```
apple pie
apple
apple cake
```

Matching start and end

To force a regular expression to only match a complete string, anchor it with both ^ and $

```r
x <- c("apple pie", "apple", "apple cake")
str_view(x, "apple")
```

```
apple pie
apple
apple cake
```

```r
str_view(x, "^apple$")
```

```
apple pie
apple
apple cake
```

Matching character classes

`\d` matches any digit.

`\s` matches any whitespace (e.g. space, tab, newline).

`[abc]` matches a, b, or c.

`[^abc]` matches anything except a, b, or c.

Matching the *special* characters

Look for a literal character that normally has special meaning in a regex

```
str_view(c("abc", "a.c", "a*c", "a c"), "a[.]c")
```

```
abc
a.c
a*c
a c
```

Matching the *special* characters

Look for a literal character that normally has special meaning in a regex

```
str_view(c("abc", "a.c", "a*c", "a c"), "a[.]c")
```

```
abc
a.c
a*c
a c
```

```
str_view(c("abc", "a.c", "a*c", "a c"), ".[*]c")
```

```
abc
a.c
a*c
a c
```

Alternation

Use parentheses to make the precedence of | clear:

```
str_view(c("groy", "grey", "griy", "gray"), "gr(e|a)y")
```

```
groy
grey
griy
gray
```

Repeated patterns

? is 0 or 1

+ is 1 or more

***** is 0 or more

```
x <- "1888 is the longest year in Roman numerals: MDCCCLXXXVIII"
str_view(x, "CC?")
```

```
1888 is the longest year in Roman numerals: MDCCCLXXXVIII
```

Repeated patterns

? is 0 or 1

+ is 1 or more

***** is 0 or more

```
str_view(x, "CC+")
```

```
1888 is the longest year in Roman numerals: MDCCCLXXXVIII
```

Repeated patterns

? is 0 or 1

+ is 1 or more

***** is 0 or more

```
x <- "1888 is the longest year in Roman numerals: MDCCCLXXXVIII"
str_view(x, 'C[LX]+')
```

```
1888 is the longest year in Roman numerals: MDCCCLXXXVIII
```

Exact numbers of repetitions

`{n}` is exactly n

`{n,}` is n or more

`{,m}` is at most m

`{n,m}` is between n and m

```
str_view(x, "C{2}")
```

```
1888 is the longest year in Roman numerals: MDCCCLXXXVIII
```

Exact numbers of repetitions

`{n}` is exactly n

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`{n,m}` is between n and m

```
str_view(x, "C{2,}")
```

```
1888 is the longest year in Roman numerals: MDCCCLXXXVIII
```

Exact numbers of repetitions

`{n}` is exactly n

`{n,}` is n or more

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`{n,m}` is between n and m

By default these are *greedy* matches. You can make them “lazy”, matching the shortest string possible by putting a **?** after them. **This is often very useful!**

```
str_view(x, 'C[LX]+?')
```

```
1888 is the longest year in Roman numerals: MDCCCLXXXVIII
```

And finally ... backreferences

```r
fruit # built into stringr
```

```
##  [1] "apple"             "apricot"           "avocado"
##  [4] "banana"            "bell pepper"       "bilberry"
##  [7] "blackberry"        "blackcurrant"      "blood orange"
## [10] "blueberry"         "boysenberry"       "breadfruit"
## [13] "canary melon"      "cantaloupe"        "cherimoya"
## [16] "cherry"            "chili pepper"      "clementine"
## [19] "cloudberry"        "coconut"           "cranberry"
## [22] "cucumber"          "currant"           "damson"
## [25] "date"              "dragonfruit"       "durian"
## [28] "eggplant"          "elderberry"        "feijoa"
## [31] "fig"               "goji berry"        "gooseberry"
## [34] "grape"             "grapefruit"        "guava"
## [37] "honeydew"          "huckleberry"       "jackfruit"
## [40] "jambul"            "jujube"            "kiwi fruit"
## [43] "kumquat"           "lemon"             "lime"
## [46] "loquat"            "lychee"            "mandarine"
## [49] "mango"             "mulberry"          "nectarine"
## [52] "nut"               "olive"             "orange"
## [55] "pamelo"            "papaya"            "passionfruit"
## [58] "peach"             "pear"              "persimmon"
## [61] "physalis"          "pineapple"         "plum"
## [64] "pomegranate"       "pomelo"            "purple mangosteen"
## [67] "quince"            "raisin"            "rambutan"
## [70] "raspberry"         "redcurrant"        "rock melon"
## [73] "salal berry"       "satsuma"           "star fruit"
## [76] "strawberry"        "tamarillo"         "tangerine"
## [79] "ugli fruit"        "watermelon"
```

Grouping and backreferences

Find all fruits that have a repeated pair of letters:

```
str_view(fruit, "(..)\\1", match = TRUE)
```

```
banana
coconut
cucumber
jujube
papaya
salal berry
```

Grouping and backreferences

Backreferences and grouping will be very useful for string *replacements*.

OK that was a lot

Learning and testing regexps

Practice with a tester like https://regexr.com

Or an app like Patterns

The regex engine or "flavor" used by `stringr` is Perl- or PCRE-like.

What was the point of that?

We use basic or slightly fancy regexps *very often* when importing and cleaning data.

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We use basic or slightly fancy regexps *very often* when importing and cleaning data.

As we'll soon see! It's time to read in a bunch of data.