A brief introduction to regular expressions

Session 5

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Load the packages, as always

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

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

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.0 ──
## ✓ ggplot2 3.3.3     ✓ purrr   0.3.4
## ✓ tibble  3.1.0     ✓ dplyr   1.0.5
## ✓ tidyr   1.1.3     ✓ stringr 1.4.0
## ✓ readr   1.4.0     ✓ forcats 0.5.1
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## x dplyr::filter()  masks stats::filter()
## x purrr::is_null() masks testthat::is_null()
## x dplyr::lag()     masks stats::lag()
## x dplyr::matches() masks tidyr::matches(), testthat::matches()
```

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

Regular Expressions

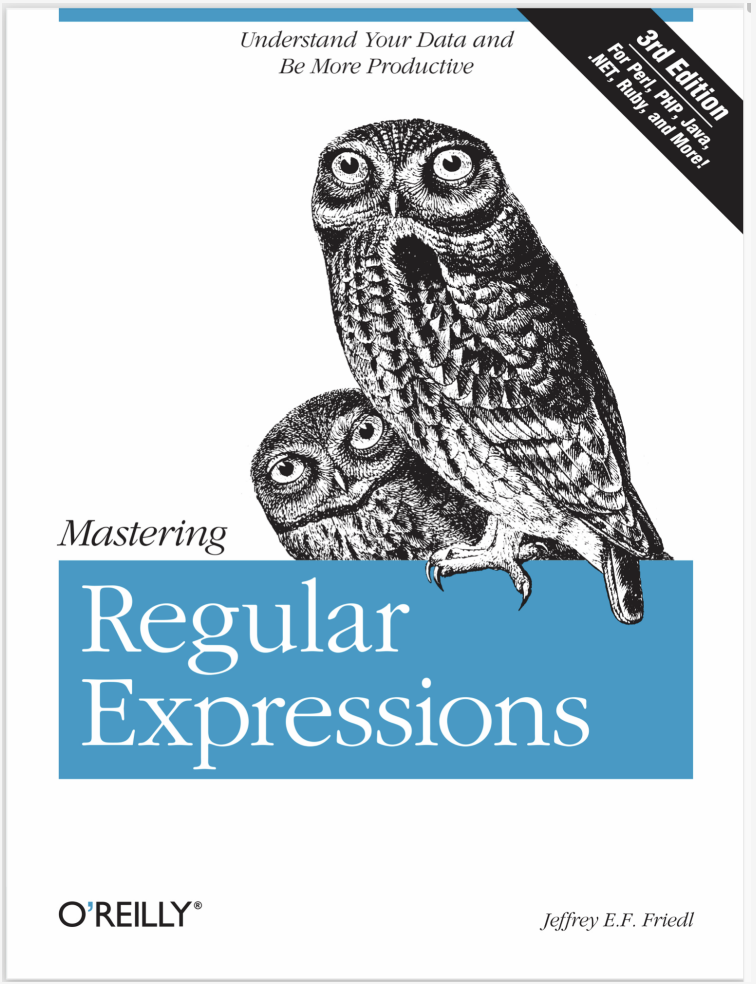
Or, waiter, there appears to be a language inside my language

stringr is your gateway to regexps

```
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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(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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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 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

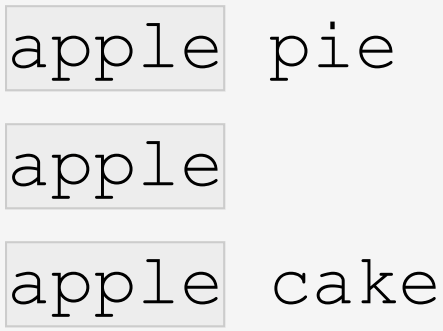
`apple`

`apple` cake

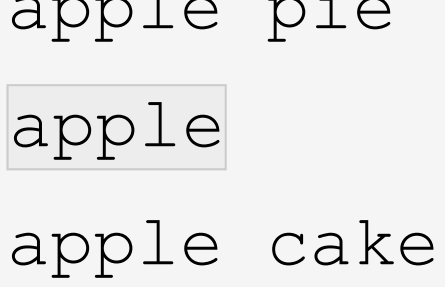
Matching start and end

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

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




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



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

```
1888 is the longest year in Roman numerals:
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Exact numbers of repetitions

{n} is exactly n

{n,} is n or more

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By default these are *greedy* matches. You can make them "lazy", matching the shortest string possible by putting a **?** after them.

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

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

And finally ... backreferences

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