Regular Expressions

Data Wrangling, Session 5

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Code Horizons

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A brief introduction to regular expressions

Load the packages, as always

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

```
library(tidyverse) # your friend and mine
library(gapminder) # gapminder data
library(stringr)
```

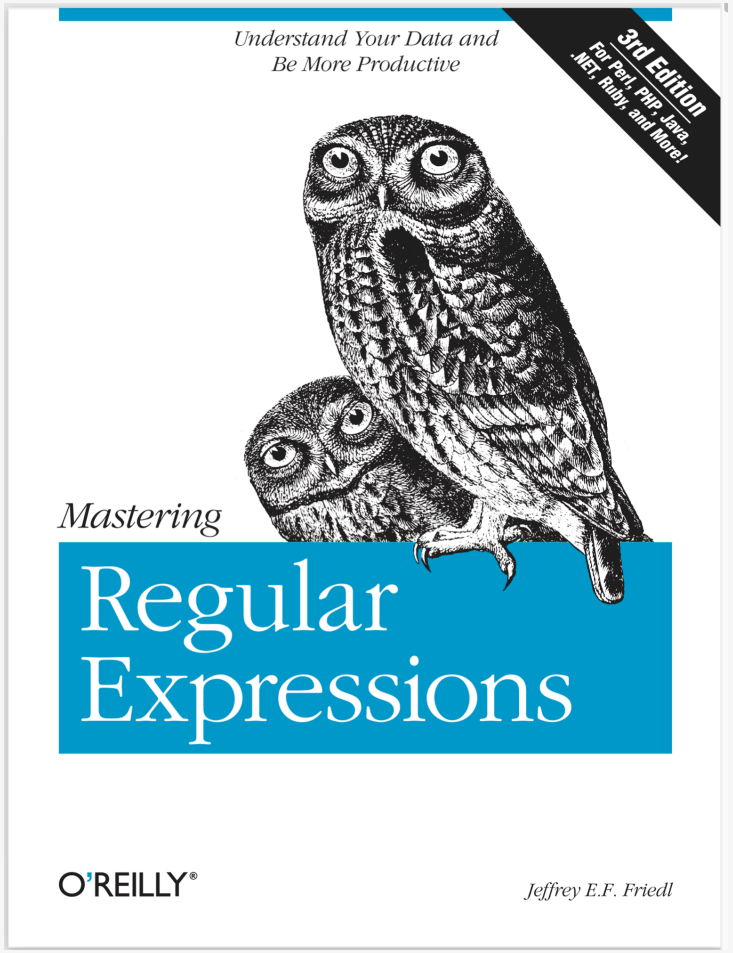
Regular Expressions

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

stringr is your gateway to regexps

```
library(stringr) # It's loaded by default with library(tidyverse)
```

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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The simplest sort of search is like the “Find” functionality in a Word Processor. The pattern is a literal letter, number, punctuation mark, word or series of words; the text is a document searched one line at a time. The next step up is “Find and Replace”.

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

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str_view(<STRING>, <PATTERN>, [...]) # where [...] means "maybe some options"
```

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Functions that *replace* as well as *detect* strings all have this form:

```
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```

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

```
str_view(<STRING>, <PATTERN>, [...]) # where [...] means "maybe some options"
```

Functions that *replace* as well as *detect* strings all have this form:

```
str_replace(<STRING>, <PATTERN>, <REPLACEMENT>)
```

(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", html=FALSE)
```

```
[2] │ b<an><an>a
```

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.

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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 literal 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”.

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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")
```

```
[2] │ <a.c>
```

But … how do you match a literal \?

```
x ← "a\\b"
writeLines(x)
```

```
a\b
```

```
#> a\b

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

```
[1] │ a<\>b
```

But … 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

Matching start and end

Use ^ to match the start of a string.

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

```
[1] | <a>pple
```

Matching start and end

Use ^ to match the start of a string.

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

```
[1] | <a>pple
```

Use $ to match the end of a string.

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

```
[2] | banan<a>
```

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")
```

```
[1] │ <apple> pie
[2] │ <apple>
[3] │ <apple> cake
```

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

```
[2] │ <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")
```

```
[2] | <a.c>
```

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

```
[3] | <a*c>
```

This works for most (but not all) regex metacharacters: $. | ? * + ( ) [{. Unfortunately, a few characters have special meaning even inside a character class and must be handled with backslash escapes. These are] \ ^ and -

Alternation

Use parentheses to make the precedence of the ‘or’ operator | clear:

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

```
[2] │ <grey>
[4] │ <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?")
```

```
[1] │ 1888 is the longest year in Roman numerals: MD<CC><C>LXXXVIII
```

Repeated patterns

? is 0 or 1

+ is 1 or more

* is 0 or more

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

```
[1] │ 1888 is the longest year in Roman numerals: MD<CCC>LXXXVIII
```

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]+')
```

```
[1] │ 1888 is the longest year in Roman numerals: MDCC<CLXXX>VIII
```

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}")
```

```
[1] │ 1888 is the longest year in Roman numerals: MD<CC>CLXXXVIII
```

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,}")
```

```
[1] │ 1888 is the longest year in Roman numerals: MD<CCC>LXXXVIII
```

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{2,3}")
```

```
[1] │ 1888 is the longest year in Roman numerals: MD<CCC>LXXXVIII
```

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

By default regexps use *greedy* matches. You can make them match the *shortest* string possible by putting a ? after them. **This is often very useful!**

```
str_view(x, 'C{2,3}?')
```

```
[1] │ 1888 is the longest year in Roman numerals: MD<CC>CLXXXVIII
```

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

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]+?')
```

```
[1] │ 1888 is the longest year in Roman numerals: MDCC<CL>XXXVIII
```

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"
```

Grouping and backreferences

Find all fruits that have a repeated pair of letters:

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

```
 [4] │ b<anan>a
[20] │ <coco>nut
[22] │ <cucu>mber
[41] │ <juju>be
[56] │ <papa>ya
[73] │ s<alal> 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 https://regex101.com

Or an app like Patterns

The regex engine or “flavor” used by `stringr` is Perl- or PCRE2-like.

Regexps in practice

Example: Politics and Placenames

```
library(ukelection2019)
```

Example: Politics and Placenames

```
library(ukelection2019)

ukvote2019
```

```
# A tibble: 3,320 × 13
   cid     constituency electorate party_name candidate votes vote_share_percent
   <chr>   <chr>              <int> <chr>      <chr>     <int>              <dbl>
 1 W07000… Aberavon           50747 Labour     Stephen … 17008               53.8
 2 W07000… Aberavon           50747 Conservat… Charlott… 6518               20.6
 3 W07000… Aberavon           50747 The Brexi… Glenda D… 3108                9.8
 4 W07000… Aberavon           50747 Plaid Cym… Nigel Hu… 2711                8.6
 5 W07000… Aberavon           50747 Liberal D… Sheila K… 1072                3.4
 6 W07000… Aberavon           50747 Independe… Captain … 731                 2.3
 7 W07000… Aberavon           50747 Green      Giorgia … 450                 1.4
 8 W07000… Aberconwy          44699 Conservat… Robin Mi… 14687               46.1
 9 W07000… Aberconwy          44699 Labour     Emily Ow… 12653               39.7
10 W07000… Aberconwy          44699 Plaid Cym… Lisa Goo… 2704                8.5
```

Example: Politics and Placenames

```
library(ukelection2019)

ukvote2019 ▷
  group_by(constituency)
```

```
# A tibble: 3,320 × 13
# Groups:   constituency [650]
   cid     constituency electorate party_name candidate votes vote_share_percent
   <chr>   <chr>             <int> <chr>      <chr>     <int>              <dbl>
 1 W07000… Aberavon          50747 Labour     Stephen … 17008               53.8
 2 W07000… Aberavon          50747 Conservat… Charlott… 6518                20.6
 3 W07000… Aberavon          50747 The Brexi… Glenda D… 3108                9.8
 4 W07000… Aberavon          50747 Plaid Cym… Nigel Hu… 2711                8.6
 5 W07000… Aberavon          50747 Liberal D… Sheila K… 1072                3.4
 6 W07000… Aberavon          50747 Independe… Captain … 731                 2.3
 7 W07000… Aberavon          50747 Green      Giorgia … 450                 1.4
 8 W07000… Aberconwy         44699 Conservat… Robin Mi… 14687               46.1
 9 W07000… Aberconwy         44699 Labour     Emily Ow… 12653               39.7
10 W07000… Aberconwy         44699 Plaid Cym… Lisa Goo…
```

Example: Politics and Placenames

```
library(ukelection2019)

ukvote2019 ▷
  group_by(constituency) ▷
  slice_max(votes)
```

```
# A tibble: 650 × 13
# Groups:   constituency [650]
   cid     constituency electorate party_name candidate
votes vote_share_percent
   <chr>   <chr>              <int> <chr>      <chr>
<int>               <dbl>
 1 W07000… Aberavon           50747 Labour     Stephen …
17008                53.8
 2 W07000… Aberconwy          44699 Conservat… Robin Mi…
14687                46.1
 3 S14000… Aberdeen No…       62489 Scottish … Kirsty B…
20205                54
 4 S14000… Aberdeen So…       65719 Scottish … Stephen …
20388                44.7
 5 S14000… Aberdeenshi…       72640 Conservat… Andrew B…
22752                42.7
 6 S14000… Airdrie & S…       64008 Scottish … Neil Gray
17929                45.1
 7 E14000… Aldershot          72617 Conservat… Leo Doch…
27980                58.4
 8 E14000… Aldridge-Br…       60138 Conservat… Wendy Mo…
27850                70.8
 9 E14000… Altrincham …       73096 Conservat… Graham B…
26311                48
10 W07000… Alyn & Dees…       62783 Labour     Mark Tami
```

Example: Politics and Placenames

```
library(ukelection2019)

ukvote2019 ▷
  group_by(constituency) ▷
  slice_max(votes) ▷
  ungroup()
```

```
# A tibble: 650 × 13
   cid     constituency electorate party_name candidate
votes vote_share_percent
   <chr>   <chr>              <int> <chr>      <chr>
<int>              <dbl>
 1 W07000… Aberavon           50747 Labour     Stephen …
17008               53.8
 2 W07000… Aberconwy          44699 Conservat… Robin Mi…
14687               46.1
 3 S14000… Aberdeen No…       62489 Scottish … Kirsty B…
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17929               45.1
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27980               58.4
 8 E14000… Aldridge-Br…       60138 Conservat… Wendy Mo…
27850               70.8
 9 E14000… Altrincham …       73096 Conservat… Graham B…
26311               48
10 W07000… Alyn & Dees…       62783 Labour     Mark Tami
18271               42.5
```

Example: Politics and Placenames

```
library(ukelection2019)

ukvote2019 ▷
  group_by(constituency) ▷
  slice_max(votes) ▷
  ungroup() ▷
  select(constituency, party_name)
```

```
# A tibble: 650 × 2
   constituency                    party_name
   <chr>                           <chr>
 1 Aberavon                        Labour
 2 Aberconwy                       Conservative
 3 Aberdeen North                  Scottish National
Party
 4 Aberdeen South                  Scottish National
Party
 5 Aberdeenshire West & Kincardine Conservative
 6 Airdrie & Shotts                Scottish National
Party
 7 Aldershot                       Conservative
 8 Aldridge-Brownhills             Conservative
 9 Altrincham & Sale West          Conservative
10 Alyn & Deeside                  Labour
# ℹ 640 more rows
```

Example: Politics and Placenames

```
library(ukelection2019)

ukvote2019 ▷
  group_by(constituency) ▷
  slice_max(votes) ▷
  ungroup() ▷
  select(constituency, party_name) ▷
  mutate(shire = str_detect(constituency, "shire"),
         field = str_detect(constituency, "field"),
         dale = str_detect(constituency, "dale"),
         pool = str_detect(constituency, "pool"),
         ton = str_detect(constituency, "(ton$)|(ton )"),
         wood = str_detect(constituency, "(wood$)|(wood )"),
         saint = str_detect(constituency, "(St )|(Saint)"),
         port = str_detect(constituency, "(Port)|(port)"),
         ford = str_detect(constituency, "(ford$)|(ford )"),
         by = str_detect(constituency, "(by$)|(by )"),
         boro = str_detect(constituency, "(boro$)|(boro )|(borough$)|(borough )"),
         ley = str_detect(constituency, "(ley$)|(ley )|(leigh$)|(leigh )"))
```

```
# A tibble: 650 × 14
   constituency party_name shire field dale  pool  ton
wood  saint port  ford
   <chr>        <chr>      <lgl> <lgl> <lgl> <lgl> <lgl>
<lgl> <lgl> <lgl> <lgl>
 1 Aberavon     Labour     FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 2 Aberconwy    Conservat… FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 3 Aberdeen No… Scottish … FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 4 Aberdeen So… Scottish … FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 5 Aberdeenshi… Conservat… TRUE  FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 6 Airdrie & S… Scottish … FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 7 Aldershot    Conservat… FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 8 Aldridge-Br… Conservat… FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
 9 Altrincham … Conservat… FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
10 Alyn & Dees… Labour     FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE
```

Example: Politics and Placenames

```
library(ukelection2019)

ukvote2019 ▷
  group_by(constituency) ▷
  slice_max(votes) ▷
  ungroup() ▷
  select(constituency, party_name) ▷
  mutate(shire = str_detect(constituency, "shire"),
         field = str_detect(constituency, "field"),
         dale = str_detect(constituency, "dale"),
         pool = str_detect(constituency, "pool"),
         ton = str_detect(constituency, "(ton$)|(ton )"),
         wood = str_detect(constituency, "(wood$)|(wood )"),
         saint = str_detect(constituency, "(St )|(Saint)"),
         port = str_detect(constituency, "(Port)|(port)"),
         ford = str_detect(constituency, "(ford$)|(ford )"),
         by = str_detect(constituency, "(by$)|(by )"),
         boro = str_detect(constituency, "(boro$)|(boro )|(borough$)|(borough )"),
         ley = str_detect(constituency, "(ley$)|(ley )|(leigh$)|(leigh )")) ▷
  pivot_longer(shire:ley, names_to = "toponym")
```

```
# A tibble: 7,800 × 4
   constituency party_name toponym value
   <chr>        <chr>      <chr>   <lgl>
 1 Aberavon     Labour     shire   FALSE
 2 Aberavon     Labour     field   FALSE
 3 Aberavon     Labour     dale    FALSE
 4 Aberavon     Labour     pool    FALSE
 5 Aberavon     Labour     ton     FALSE
 6 Aberavon     Labour     wood    FALSE
 7 Aberavon     Labour     saint   FALSE
 8 Aberavon     Labour     port    FALSE
 9 Aberavon     Labour     ford    FALSE
10 Aberavon     Labour     by      FALSE
# ℹ 7,790 more rows
```

Example: Politics and Placenames

```
place_tab ← ukvote2019 ▷
  group_by(constituency) ▷
  slice_max(votes) ▷
  ungroup() ▷
  select(constituency, party_name) ▷
  mutate(shire = str_detect(constituency, "shire"),
         field = str_detect(constituency, "field"),
         dale = str_detect(constituency, "dale"),
         pool = str_detect(constituency, "pool"),
         ton = str_detect(constituency, "(ton$)|(ton )"),
         wood = str_detect(constituency, "(wood$)|(wood )"),
         saint = str_detect(constituency, "(St )|(Saint)"),
         port = str_detect(constituency, "(Port)|(port)"),
         ford = str_detect(constituency, "(ford$)|(ford )"),
         by = str_detect(constituency, "(by$)|(by )"),
         boro = str_detect(constituency, "(boro$)|(boro )|(borough$)|(borough )"),
         ley = str_detect(constituency, "(ley$)|(ley )|(leigh$)|(leigh )")) ▷
  pivot_longer(shire:ley, names_to = "toponym")
```

Example: Politics and Placenames

```
place_tab
```

```
# A tibble: 7,800 × 4
   constituency party_name toponym value
   <chr>        <chr>      <chr>   <lgl>
 1 Aberavon     Labour     shire   FALSE
 2 Aberavon     Labour     field   FALSE
 3 Aberavon     Labour     dale    FALSE
 4 Aberavon     Labour     pool    FALSE
 5 Aberavon     Labour     ton     FALSE
 6 Aberavon     Labour     wood    FALSE
 7 Aberavon     Labour     saint   FALSE
 8 Aberavon     Labour     port    FALSE
 9 Aberavon     Labour     ford    FALSE
10 Aberavon     Labour     by      FALSE
# ℹ 7,790 more rows
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym)
```

```
# A tibble: 7,800 × 4
# Groups:   party_name, toponym [120]
   constituency party_name toponym value
   <chr>        <chr>      <chr>   <lgl>
 1 Aberavon     Labour     shire   FALSE
 2 Aberavon     Labour     field   FALSE
 3 Aberavon     Labour     dale    FALSE
 4 Aberavon     Labour     pool    FALSE
 5 Aberavon     Labour     ton     FALSE
 6 Aberavon     Labour     wood    FALSE
 7 Aberavon     Labour     saint   FALSE
 8 Aberavon     Labour     port    FALSE
 9 Aberavon     Labour     ford    FALSE
10 Aberavon     Labour     by      FALSE
# ℹ 7,790 more rows
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym) ▷
  filter(party_name %in% c("Conservative", "Labour"))
```

```
# A tibble: 6,816 × 4
# Groups:   party_name, toponym [24]
   constituency party_name toponym value
   <chr>        <chr>      <chr>   <lgl>
 1 Aberavon     Labour     shire   FALSE
 2 Aberavon     Labour     field   FALSE
 3 Aberavon     Labour     dale    FALSE
 4 Aberavon     Labour     pool    FALSE
 5 Aberavon     Labour     ton     FALSE
 6 Aberavon     Labour     wood    FALSE
 7 Aberavon     Labour     saint   FALSE
 8 Aberavon     Labour     port    FALSE
 9 Aberavon     Labour     ford    FALSE
10 Aberavon     Labour     by      FALSE
# ℹ 6,806 more rows
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym) ▷
  filter(party_name %in% c("Conservative", "Labour")) ▷
  group_by(toponym, party_name)
```

```
# A tibble: 6,816 × 4
# Groups:   toponym, party_name [24]
   constituency party_name toponym value
   <chr>        <chr>      <chr>   <lgl>
 1 Aberavon     Labour     shire   FALSE
 2 Aberavon     Labour     field   FALSE
 3 Aberavon     Labour     dale    FALSE
 4 Aberavon     Labour     pool    FALSE
 5 Aberavon     Labour     ton     FALSE
 6 Aberavon     Labour     wood    FALSE
 7 Aberavon     Labour     saint   FALSE
 8 Aberavon     Labour     port    FALSE
 9 Aberavon     Labour     ford    FALSE
10 Aberavon     Labour     by      FALSE
# ℹ 6,806 more rows
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym) ▷
  filter(party_name %in% c("Conservative", "Labour")) ▷
  group_by(toponym, party_name) ▷
  summarize(freq = sum(value))
```

```
# A tibble: 24 × 3
# Groups:   toponym [12]
   toponym party_name    freq
   <chr>   <chr>        <int>
 1 boro    Conservative     7
 2 boro    Labour           1
 3 by      Conservative     6
 4 by      Labour           2
 5 dale    Conservative     3
 6 dale    Labour           1
 7 field   Conservative    10
 8 field   Labour          10
 9 ford    Conservative    17
10 ford    Labour          12
# ℹ 14 more rows
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym) ▷
  filter(party_name %in% c("Conservative", "Labour")) ▷
  group_by(toponym, party_name) ▷
  summarize(freq = sum(value)) ▷
  mutate(pct = freq/sum(freq))
```

```
# A tibble: 24 × 4
# Groups:   toponym [12]
   toponym party_name    freq   pct
   <chr>   <chr>        <int> <dbl>
 1 boro    Conservative     7 0.875
 2 boro    Labour           1 0.125
 3 by      Conservative     6 0.75
 4 by      Labour           2 0.25
 5 dale    Conservative     3 0.75
 6 dale    Labour           1 0.25
 7 field   Conservative    10 0.5
 8 field   Labour          10 0.5
 9 ford    Conservative    17 0.586
10 ford    Labour          12 0.414
# ℹ 14 more rows
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym) ▷
  filter(party_name %in% c("Conservative", "Labour")) ▷
  group_by(toponym, party_name) ▷
  summarize(freq = sum(value)) ▷
  mutate(pct = freq/sum(freq)) ▷
  filter(party_name == "Conservative")
```

```
# A tibble: 12 × 4
# Groups:   toponym [12]
   toponym party_name    freq   pct
   <chr>   <chr>        <int> <dbl>
 1 boro    Conservative     7 0.875
 2 by      Conservative     6 0.75
 3 dale    Conservative     3 0.75
 4 field   Conservative    10 0.5
 5 ford    Conservative    17 0.586
 6 ley     Conservative    26 0.722
 7 pool    Conservative     2 0.286
 8 port    Conservative     3 0.333
 9 saint   Conservative     3 0.5
10 shire   Conservative    37 0.974
11 ton     Conservative    37 0.507
12 wood    Conservative     7 0.636
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym) ▷
  filter(party_name %in% c("Conservative", "Labour")) ▷
  group_by(toponym, party_name) ▷
  summarize(freq = sum(value)) ▷
  mutate(pct = freq/sum(freq)) ▷
  filter(party_name == "Conservative") ▷
  arrange(desc(pct))
```

```
# A tibble: 12 × 4
# Groups:   toponym [12]
   toponym party_name    freq   pct
   <chr>   <chr>        <int> <dbl>
 1 shire   Conservative    37 0.974
 2 boro    Conservative     7 0.875
 3 by      Conservative     6 0.75
 4 dale    Conservative     3 0.75
 5 ley     Conservative    26 0.722
 6 wood    Conservative     7 0.636
 7 ford    Conservative    17 0.586
 8 ton     Conservative    37 0.507
 9 field   Conservative    10 0.5
10 saint   Conservative     3 0.5
11 port    Conservative     3 0.333
12 pool    Conservative     2 0.286
```

Example: Politics and Placenames

```
place_tab ▷
  group_by(party_name, toponym) ▷
  filter(party_name %in% c("Conservative", "Labour")) ▷
  group_by(toponym, party_name) ▷
  summarize(freq = sum(value)) ▷
  mutate(pct = freq/sum(freq)) ▷
  filter(party_name == "Conservative") ▷
  arrange(desc(pct))
```

```
# A tibble: 12 × 4
# Groups:   toponym [12]
   toponym party_name    freq   pct
   <chr>   <chr>        <int> <dbl>
 1 shire   Conservative    37 0.974
 2 boro    Conservative     7 0.875
 3 by      Conservative     6 0.75
 4 dale    Conservative     3 0.75
 5 ley     Conservative    26 0.722
 6 wood    Conservative     7 0.636
 7 ford    Conservative    17 0.586
 8 ton     Conservative    37 0.507
 9 field   Conservative    10 0.5
10 saint   Conservative     3 0.5
11 port    Conservative     3 0.333
12 pool    Conservative     2 0.286
```