

Regular Expressions in R

ISAAK short lesson

Clemens Schmid

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Motivation

```
last_names <- c("Maier", "Meyer", "Tietze", "Mayr", "Rinne")
```

```
## [1] "Maier" "Meyer" "Tietze" "Mayr" "Rinne"
```

```
grep(pattern = "M[ae][iy]e?r", last_names)
```

```
## [1] 1 2 4
```

```
last_names[grep(pattern = "M[ae][iy]e?r", last_names)]
```

```
## [1] "Maier" "Meyer" "Mayr"
```

Regular Expressions

Definition

- ▶ Regular Expressions (Regex) are sign sequences that define specific search patterns
- ▶ They are pretty much universal: Many programming languages provide functions to use them and many gui/cli text editors allow to use them.
- ▶ Standards:
 - ▶ POSIX: Basic Regular Syntax (BRE)
 - ▶ **POSIX: Extended Regular Syntax (ERE)**
 - ▶ Perl regexes

Symbols

Expression	Meaning	Example
c	Individual signs	c
.	One sign, except linebreak	.
[sign]	One of these signs	[123ufg]
[sign1 - sign2]	One sign from this sequence	[0-9]
[^sign]	One sign that is NOT one of these	[^a]
[^sign1 - sign2]	One sign NOT from this sequence	[^B-T]

Quantifiers

Expression	Meaning
?	sign before ? zero times or once
*	sign before * zero times or or any number of times
+	sign before + once or any number of times
{n}	sign before {n} n times
{n,m}	sign before {n,m} n to m times
{n,}	sign before {n,} minimum n times
{,m}	sign before {,m} maximum n times

Other Expressions

Expression	Meaning
<code>^</code>	Start of the line
<code>\$</code>	End of line
<code>\<</code>	Start of word
<code>\></code>	End of word
<code>(...)</code>	Definition of a subexpression
<code> </code>	Logical OR
<code>\</code>	Avoid special meaning of operators after \

Regular Expressions in R

Pattern Matching and Replacement in Base R (?grep)

```
grep(pattern, x, ignore.case = FALSE, perl = FALSE, value = FALSE,  
      fixed = FALSE, useBytes = FALSE, invert = FALSE)
```

```
grepl(pattern, x, ignore.case = FALSE, perl = FALSE,  
      fixed = FALSE, useBytes = FALSE)
```

```
sub(pattern, replacement, x, ignore.case = FALSE, perl = FALSE,  
    fixed = FALSE, useBytes = FALSE)
```

```
gsub(pattern, replacement, x, ignore.case = FALSE, perl = FALSE,  
    fixed = FALSE, useBytes = FALSE)
```

```
regexpr(pattern, text, ignore.case = FALSE, perl = FALSE,  
        fixed = FALSE, useBytes = FALSE)
```

```
gregexpr(pattern, text, ignore.case = FALSE, perl = FALSE,  
        fixed = FALSE, useBytes = FALSE)
```

```
regexec(pattern, text, ignore.case = FALSE, perl = FALSE,  
        fixed = FALSE, useBytes = FALSE)
```

Pattern Matching and Replacement in Base R (?grep)

- ▶ **grep** & **grepl**: Search a character vector and return the indices of the matching elements. **grep** returns a vector of the indices. **grepl** returns a logical vector (TRUE/FALSE).
- ▶ **sub** & **gsub**: Replace. Search a character vector for regular expression matches and replace that match with another string. **sub** replaces the first occurrence of a pattern, **gsub** replaces all occurrences.
- ▶ **regexpr** & **gregexpr** & **regexec**: Search a character vector for matches and return the indices of the string where the match begins and the length of the match. **gregexpr** returns result as a list object. **regexec** additionally returns the locations of any parenthesized sub-expressions.

Pattern Matching and Replacement in Base R (?grep)

```
grep(pattern, x, ignore.case = FALSE, perl = FALSE, value = FALSE,  
      fixed = FALSE, useBytes = FALSE, invert = FALSE)
```

- ▶ **pattern**: Pattern to be matched. Can be regular expression or normal string (if **fixed** == TRUE).
- ▶ **x, text**: Character vector where matches are sought.
- ▶ **ignore.case**: Should the pattern matching be case sensitive?
- ▶ **perl**: Should Perl-compatible regexps be used?
- ▶ **value**: Should indices or matching elements be returned?
- ▶ **fixed**: Is the pattern a string to be matched as is?
- ▶ **useBytes**: Should encoding problems be ignored?
- ▶ **invert**: Should the result contain everything that does NOT match?

Example Code

Get Data

```
library(magrittr)

radon <- c14bazAAR::get_RADON()[,c("labnr", "shortref")] %>%
  tibble::as.tibble()

## # A tibble: 20,325 x 2
##   labnr      shortref
##   <chr>      <chr>
## 1 AAR-1847 Koch 1998, 307; Aud 1995, 319
## 2 KN-2506 Breunig 1987, 142, 166
## 3 K-1983  Davidsen 1978, 55
## 4 Ua-104  <NA>
## 5 <NA>     <NA>
## 6 OxA-3197 Lanting et al. 1999/2000
## 7 KN-1988 Breunig 1987, 18
## 8 UtC-5711 Raemaekers2011, 488
## 9 ALG-33  Breunig 1987, 79
## 10 BM-1104 Breunig 1987, 96
## # ... with 20,315 more rows
```

Search for “Breunig 1987”

```
radon %>% dplyr::filter(  
  shortref == "Breunig 1987"  
)
```

```
## # A tibble: 3 x 2  
##   labnr   shortref  
##   <chr>   <chr>  
## 1 KN-1885 Breunig 1987  
## 2 OWU-59  Breunig 1987  
## 3 KN-1910 Breunig 1987
```

Search for "Breunig 1987"

```
radon %>% dplyr::filter(  
  grepl("Breunig 1987", .$shortref)  
)
```

```
## # A tibble: 1,297 x 2  
##   labnr      shortref  
##   <chr>      <chr>  
## 1 KN-2506    Breunig 1987, 142, 166  
## 2 KN-1988    Breunig 1987, 18  
## 3 ALG-33     Breunig 1987, 79  
## 4 BM-1104    Breunig 1987, 96  
## 5 KN-2985    Breunig 1987, 128  
## 6 M-2166     Breunig 1987, 161  
## 7 UCLA-1750B Breunig 1987, 102  
## 8 Bln-1447   Breunig 1987, 172  
## 9 Gro-265    Breunig 1987, 126  
## 10 KN-3066   Breunig 1987, 183  
## # ... with 1,287 more rows
```

Search for "Breunig 1987" from page 74-88

```
radon %>% dplyr::filter(grepl(paste0(
  "Breunig 1987,?\s+", # + 0 or 1 ", " + 1 or more " "
  "(7[4-9]([0-9]|$)|", # + 7 + 4-9 + no number or EOL
  "8[0-8]([0-9]|$))"   # or 8 + 0-8 + no number or EOL
), .$shortref)
)
```

```
## # A tibble: 11 x 2
##   labnr shortref
##   <chr> <chr>
## 1 ALG-33 Breunig 1987, 79
## 2 M-2011 Breunig 1987, 84, 124f.
## 3 M-2165 Breunig 1987, 84, 124f.
## 4 MOC-70 Breunig 1987, 84, 123
## 5 M-2314 Breunig 1987, 84, 124f.
## 6 MOC-69 Breunig 1987, 84, 123
## 7 MOC-91 Breunig 1987, 84, 123
## 8 M-1896 Breunig 1987, 84, 123f.
## 9 M-1897 Breunig 1987, 84, 123f.
## 10 M-1986 Breunig 1987, 84, 124f.
## 11 M-2320 Breunig 1987, 84, 124f.
```


Search for "Breunig 1987" from page 74 without upper limit

```
radon %>% dplyr::filter(grepl(paste0(
  "Breunig 1987,?\s+",
  "([1-9]\\d{2,})|",      # + 1-9 + at least 2 more numbers
  "7[4-9](^[0-9]|$)|",   # or 7 + 4-9 + no number or EOL
  "[8-9]\\d(^[0-9]|$))" # or 8-9 + 0-9 + no number or EOL
), .$shortref)
)
```

```
## # A tibble: 1,279 x 2
##   labnr      shortref
##   <chr>      <chr>
## 1 KN-2506    Breunig 1987, 142, 166
## 2 ALG-33     Breunig 1987, 79
## 3 BM-1104    Breunig 1987, 96
## 4 KN-2985    Breunig 1987, 128
## 5 M-2166     Breunig 1987, 161
## 6 UCLA-1750B Breunig 1987, 102
## 7 Bln-1447   Breunig 1987, 172
## 8 Gro-265    Breunig 1987, 126
## 9 KN-3066    Breunig 1987, 183
## 10 KN-1596   Breunig 1987, 102
## # ... with 1,269 more rows
```

Resources

Resources

- ▶ Regex test and build environments:
 - ▶ <https://regexr.com>
 - ▶ <http://buildregex.com>
 - ▶ <https://regex101.com>
 - ▶ **<https://txt2re.com>**
- ▶ Fan pages:
 - ▶ <https://www.rexegg.com>
 - ▶ <https://www.regular-expressions.info>
- ▶ Short Introduction to Regex in R:
 - ▶ <https://bookdown.org/rdpeng/rprogdatascience/regular-expressions.html>