Regular Expressions in R ISAAK short lesson

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Motivation

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

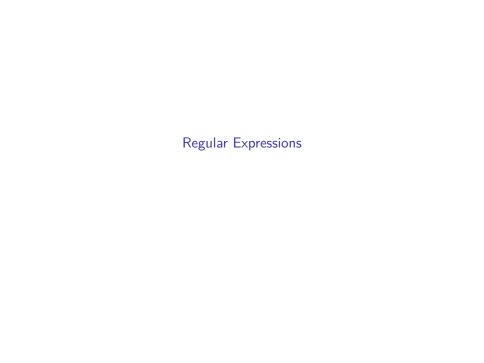
## [1] "Maier" "Meyer" "Tietze" "Mayr" "Rinne"

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"</pre>
```



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

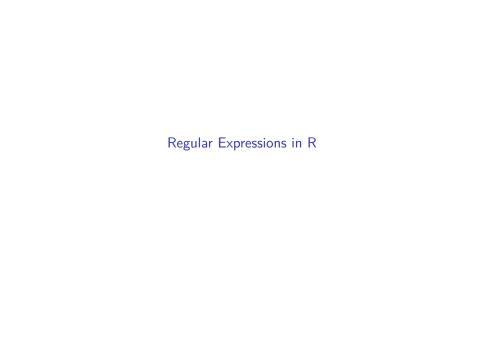
Expression	Meaning	Example
С	Individual signs	С
•	One sign, except linebreak	•
[sign]	One of these signs	[123ufg]
[sign1 - sign2]	One sign from this sequence	[0-9]
[^sign]	One sign that is NOT one of these	[^a]
[^sign1 - sign2]	One sign NOT from this sequence	[^B-T]

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
^	Start of the line
\$	End of line
\<	Start of word
\>	End of word
()	Definition of a subexpression
	Logical OR
\	Avoid special meaning of operators after \setminus



Pattern Matching and Replacement in Base R (?grep)

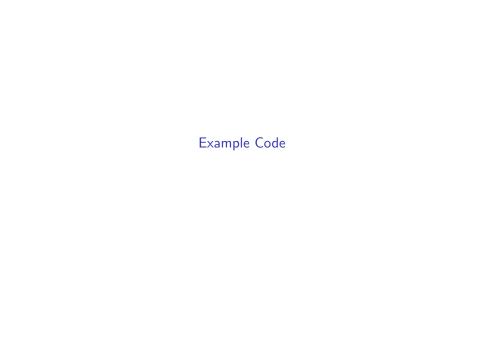
```
grep(pattern, x, ignore.case = FALSE, perl = FALSE, value = FALSE,
    fixed = FALSE, useBytes = FALSE, invert = FALSE)
grepl(pattern, x, ignore.case = FALSE, perl = FALSE,
     fixed = FALSE, useBytes = FALSE)
sub(pattern, replacement, x, ignore.case = FALSE, perl = FALSE,
    fixed = FALSE, useBytes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

- 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?



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"

1 KN-1885 Breunig 1987 ## 2 OWU-59 Breunig 1987 ## 3 KN-1910 Breunig 1987

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

## # A tibble: 3 x 2
## labnr shortref
## <chr> <chr>
```

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

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.

##

```
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]|^s))" # or 8 + 0-8 + no number or EOL
   ), .$shortref)
## # A tibble: 11 \times 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.
```

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]|^{0}], # 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
               Breunig 1987, 183
## 9 KN-3066
## 10 KN-1596
               Breunig 1987, 102
## # ... with 1,269 more rows
```



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