The ABC of computational Text Analysis

06: Learning Regular Expressions

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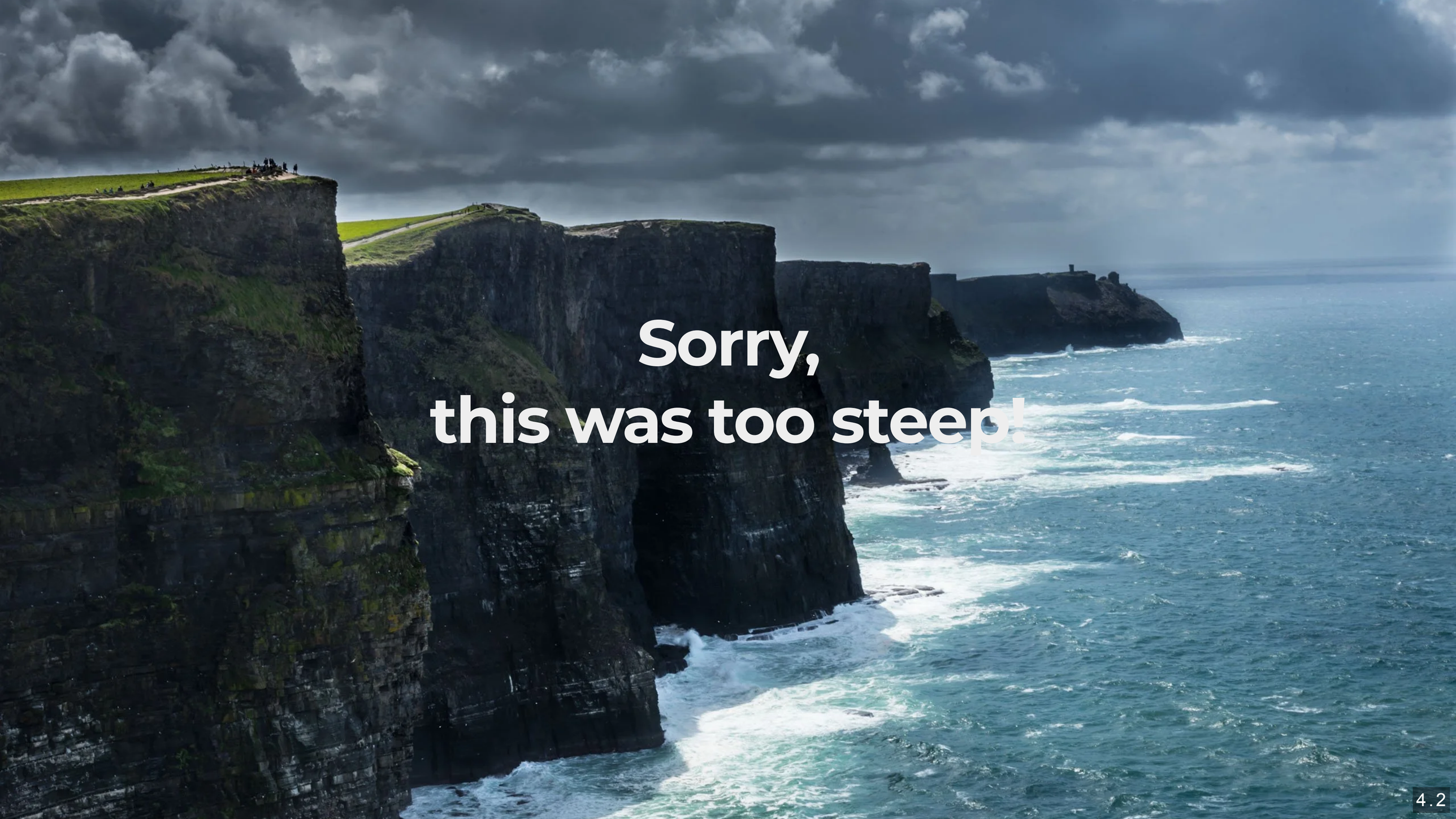
Recap last Lecture

- counting words
    - *particular or all words*
- preprocessing steps

Outline

- discussion assignment
- introduction regular expression ✨
- Practicing RegEx

Assignment #1


Sorry,
this was too steep!

Feedback Assignment #1

example solution

👍

- great dedication
- creative solutions I didn't show

😤

- make sure folder exists

  check with `ls` or in GUI
- Home on Windows

  `/mnt/c/Users/YOUR_WINDOWS_USERNAME/`
- use operators `>` `>>` `|` anytime

  files don't need to preexist
- wildcard `*` saves you work

  `*2015*.txt`

Review beyond the Shell

- too brief to be clear
- missing parts

  feedback, second task

- `locate` didn’t work

Writing runnable Scripts

Requirements

- use text editor, not Word

  Mac: TextWrangler
  Win: Notepad++

- no prompt, just commands
- `#` precedes any non-commands
- file suffix `.sh`

The beauty of scripting is automation. ⚡

Assignment #2

- get/submit via OLAT

  starting tonight
  deadline 16. April 2020, 23:59

- use forum on OLAT

  subscribe to get notifications

- ask friends for support, not solutions

Questions

Text as Pattern

Generalized Pattern

Problem 🔴

How to find **any** email addresses in a document?

```
Please contact us via info@organization.org.
For specific questions ask Mrs. Green (a.green@mail.com).
```

Solution 🔵

Writing a generalized pattern

```
[\w._-]+@[\w._-]+       # matches any valid email address
```

What are patterns for?

- finding
- extracting
- removing
- replacing

... any textual parts

What is RegEx?

RegEx = Regular Expressions ~ Patterns

- fixed string of characters

  word, phrases, dates etc.

- abstract, highly flexible expressions

  `[Cc]o+l` → *Col, col, Cool, coool ...*

  literal + meta-characters

- akin to regular languages

Finding + Extracting

globally search for regular expression and print (grep)

- tool to filter to keep certain lines only
- allow extended regex patterns

use `egrep` instead of `grep`

```
egrep 'yes' file.txt     # search in a specific file
egrep -r 'yes' folder    # search recursively within folder

egrep 'yes'              # keep lines containing pattern (yes)
egrep -i 'yes'           # dito, ignore casing (Yes, yes, YES ...)
egrep -v 'noisy'         # do NOT keep lines containing noisy

# prepare for counting by extracting raw match only
egrep -o 'only'          # print match only, not entire line
egrep -h 'only'          # suppress file name
```

Quantifiers

repeat preceding character *X* times

- `?` zero or one
- `+` one or more
- `*` zero or any number
- `{n}`, `{m,n}` a specified number of times

```
egrep -r "Bundesrath?es"          # matches old and new spelling of
egrep -r "aa+"                    # matches two or more "a"
egrep -r "e{2}"                   # match sequences of three vowels
```

Do not confuse regex with wildcards!

Character Sets

- `[...]` any of these character

  any vowel: `[auoei]`
  any digit: `[0-9]`
  any letter: `[A-Za-z]`

- `[^...]` any character but none of these

  anything but the vowels: `[^auoei]`

```
# match the capitalized and non-capitalized form
egrep -r '[Gg]rüne'

# match sequences of 3 vowels
egrep -r [aeiou]{3}

# extract all bigrams (sequence of two words)
egrep -roshi '[a-z]+ [a-z]+'
```

Special Symbols

- `.` any character (excl. newline)
- `\` escaping to match literal

  `\.` *means the actual* `.`*, not "any symbol"*
- `\w` any alpha-numeric character

  same as `[A-Za-z0-9_]`
- `\s` any whitespace (space, newline, tab)

  same as `[ \t\n]`

```
# match anything between brackets
egrep -r '\(.*\)'
```

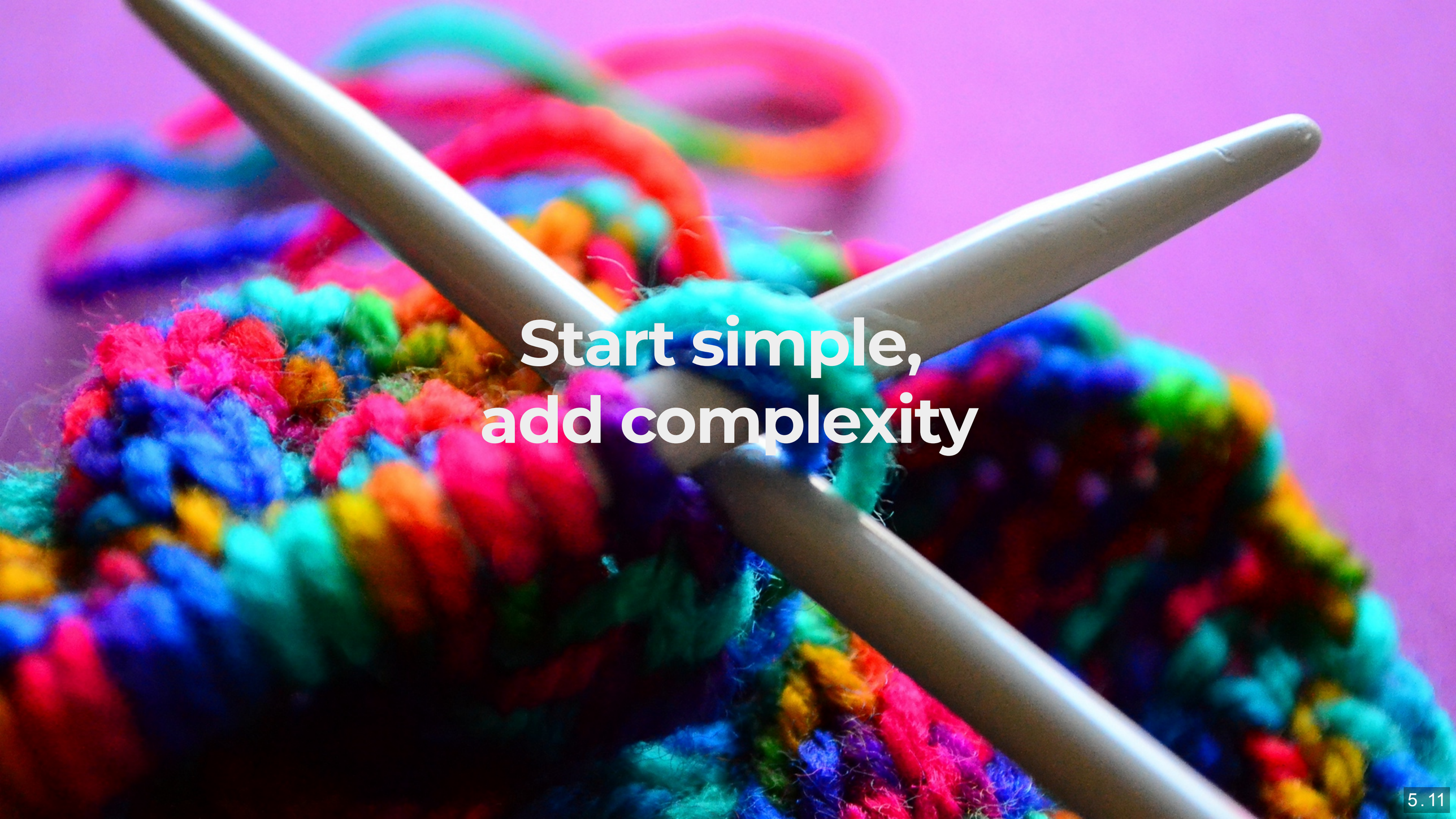
The power of ...

`.*` matches *any character any number of times*

More complex Examples

```
# extract websites
egrep -ro "www\.\w+\.\w+"

# extract emails
egrep -ro "[\w._-]+@[\w._-]+" */*.txt
```


Start simple,
add complexity

Replacing + Removing

stream editor (sed)

- advanced find + replace using regex

  `sed "s/WHAT/WITH/g" FILE`

- `sed` replaces any sequence, `tr` only single symbols

```
echo "hello" | sed "s/llo/y/g"      # replace "llo" with a "y"

# by setting the g flag in "s/llo/y/g",
# sed replaces all occurences, not only the first one
```

Contextual Replacing

- reuse match with grouping
  - `\1` *equals the expression inside first pair of parentheses*
  - `\2` *expression of second pair*
  - ...

```
# swap order of name (last first -> first last)
echo "Lastname Firstname" | sed -E "s/(.*) (.*)/\2 \1/"

# matching also supports grouping
# match any pair of digits (two identical digits)
egrep -r "([0-9])\1([0-9])\2"
```

Something actually useful

combining regular expressions with frequency analysis

```
# count political areas by looking up words ending with "politik"
egrep -rioh '\w*politik' */*.txt | sort | uniq -c | sort -h

# count ideologies/concepts by looking up words ending with -ismu
egrep -rioh '\w*ismus' */*.txt | sort | uniq -c | sort -h
```

In-class: Exercises I

In-class: Self-Check

equivalent patterns

```
a+ == aa*                    # "a" once or more than once
a? == (a|_)                  # "a" once or nothing
a{3} == aaa                  # three "a"
a{2,3} == (aa|aaa)           # two or three "a"
[ab] == (a|b)                # "a" or "b"
[0-9] == (0|1|2|3|4|5|6|7|8|9)  #any digit
```

In-class: Exercise II

1. Since you know about RegEx, we can use a more sophisticated tokenizer to split a text into words. What is the difference between the old and new approach? Test it and check the helper page with `man`.

```
# new, improved approach
cat text.txt | tr -sc "[a-zäöüA-ZÄÖÜ0-9-]" "\n"

# old approach
cat text.txt | tr ' ' '\n'
```

More Resources

required

- Ben Schmidt. 2019. Regular Expressions. online

highly recommended

- Nikolaj Lindberg. egrep for Linguists. online