UNIVERSITY OF LUCERNE

The ABC of Computational Text Analysis

#5 Basic NLP with Command-line

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Recap last lecture

- understand the filesystem 🌲
- perform shell commands

  create/copy/move/remove files 🕹️

  pipe output into other command ⏩

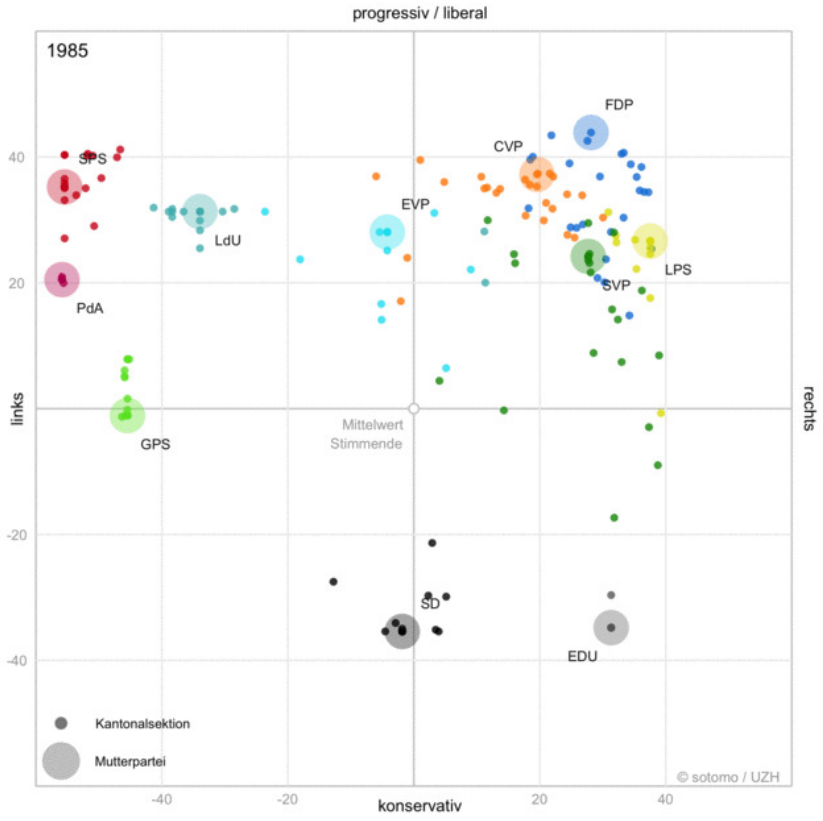
Outline

- performing corpus linguistic using the shell 🔪

  counting, finding, comparing

- analyzing programmes of Swiss parties 📊

When politics changes, language changes.



Historical development of Swiss party politics (Tagesanzeiger)

How to process a text collection

1. each document as individual file (`.txt`)

   use Shell for quick analysis

2. a dataset of documents (`.csv`, `.tsv`, `.xml`)

   use Python for in-depth analysis

Counting Things

Measuring relevance by frequency

Bag of words approach

- counting words regardless of context
- simple (and simplistic)
- powerful
- fast

Representation of text as a bag of words

Get key figures of texts

```
wc *.txt    # count number of lines, words, characters
```

Get all word occurrences

Show phrase in context

```
egrep -ir "data" FOLDER/    # search in all files in given folder

# common egrep options:
# -i              search case-insensitive
# -r              search recursively in all subfolders
# --colour        highlight matches
# --context 2     show 2 lines above/below match
```

Count word occurrences

Get counts per file

```
egrep -ic "big data" *.txt      # count across all txt-files, ignor
```

Word frequencies

Steps of the algorithm

1. split text into one word per line (tokenize)
2. sort words alphabetically
3. count how often each word appears

...

```
# piping steps to get word frequencies
cat text.txt | tr " " "\n" | sort | uniq -c | sort -h > wordfreq.tx

# explanation of individual steps:
tr " " "\n"      # replace spaces with newline
sort -h          # sort lines alphanumerically
uniq -c          # count repeated lines
```

Convert stats into dataset

- convert to `.tsv` file
- useful for further processing

  e.g., import in Excel

```
# convert word frequencies into tsv-file
# additional step: replace a sequence of spaces with a tabulator
cat text.txt | tr " " "\n" | sort | uniq -c | sort -h | \
tr -s " " "\t"  > test.tsv
```

Two kinds of word frequencies

- absolute frequency

  `= n_occurrences`

- relative frequency

  `= n_occurrences / n_total_words`

  allows to compare corpora of different sizes

In-class: Matching and counting I

1. Print the following sentence in your command line using `echo`.

```
echo "There are related computational fields: \
NLP, Computational Linguistics, and computational text analysis."
```

2. How many words are in this sentence? Use the pipe operator `|` to pass the output above to the command `wc`.
3. Match the words `computational` and colorize its occurences in the sentence using `egrep`.

🔁 Continue on the next slide.

In-class: Matching and counting II

4. Get the frequencies of each word in this sentence using `tr` and other commands.
5. Save the frequencies into a tsv-file, open it in a spreadsheet programm (e.g., Excel, Numbers) and compute the relative frequency per word.
6. Are there some words that, although different, should be considered as the same?

Preprocess your data

refine the results with

- lowercasing
- replacing symbols
- joining lines
- trimming header + footer
- splitting into multiple files
- patterns to remove/extract parts

Text as Pattern

Searching with patterns

We searched for exact matches until now. But …

How to find all words starting with the letter A?

```
egrep -r "A\w+" **/*.txt
```

How to find any dates?

```
egrep -r "[0-9]{1,2}\.[0-9]{1,2}\.[0-9]{4}"
```

When using patterns?

- finding 🔎
- extracting 🛠️
- removing/cleaning 🗑️
- replacing 🔁

… specific parts in texts

An introduction to Regular Expressions (RegEx)

RegEx builds on two classes of symbols

- **literal** characters and strings

  letters, digits, words, phrases, dates etc.

- **meta** expressions with special meaning

  e.g., `\w` represents all alphanumeric characters

Combining RegEx with frequency analysis

Something actually useful

```
# 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 "ismus"
egrep -rioh "\w*ismus" **/*.txt | sort | uniq -c | sort -h
```

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 "a+"                    # match one or more "a"
egrep -r "e{2}"                  # match sequence of two "e"
```

⚠️ Do not confuse regex with Bash wildcards!

Character sets

- `[...]` any of the characters between brackets
  - any vowel: `[auoei]`
  - any digit: `[0-9]`
  - any uppercased letter: `[A-Z]`
  - any lowercased letter: `[a-z]`

```
egrep -r "[Gg]rüne" # match both `grüne` and `Grüne`

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

Special symbols

- `.` matches any character (excl. newline)
- `\` escapes to match literal
  - `\.` means the literal `.` instead of “any symbol”
- `\w` matches any alpha-numeric character
  - same as `[A-Za-z0-9_]`
- `\s` matches any whitespace (space, newline, tab)
  - same as `[ \t\n]`

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

The power of `.*` 💪

Match ***any character any times***

In-class: Getting ready

1. Go to the website https://www.swissinfo.ch/ger and copy a few paragraphs of any article.
2. After that, go to the website https://regex101.com/and paste the text into the big white field.
3. Write a regex in the small field to match
    - all uppercased words (~nouns)
    - words with 5 characters
    - all words at the beginning of a sentence
    - match everything between quotes
4. Come up with your own challenge


Questions?

Additional resources for using Bash

When you look for useful primers on Bash, consider the following resources:

- Tutorial Basic Text Analysis by W. Turkel
- Tutorial Pattern Matching + KWIC by W. Turkel
- Cheatsheet of this course

Additional Resource for using Regex

- online regular expression editor regex101

  to write and check patterns
- Amit Chaudhary. 2021. A Visual Guide to Regular Expression
- Ben Schmidt. 2019. Regular Expressions.
- interactive regex tutorial regexone

Optional exercise: Get the programmes of Swiss parties

1. Change into your local copy of the GitHub course repository KED2024 and update it with `git pull`. When you haven't cloned the repository, follow section 5 of the installation guide .
2. You find some party programmes (Grüne, SP, SVP) in `ked2024/materials/data/swiss_party_programmes/txt`. Change into that directory using `cd`.
3. The programmes are provided in plain text which I have extracted from the publicly available PDFs. Have a look at the content of some of these text files using `more`.

Optional exercise: Analyzing Swiss party programmes

1. Compare the absolute frequencies of single terms or multi-word phrases of your choice (e.g., Ökologie, Sicherheit, Schweiz)…

   across parties

   historically within a party

   Use the file names as filter to get various aggregation of the word counts.

2. Pick terms of your interest and look at their contextual use by extracting relevant passages. Does the usage differ across parties or time?