Using DIACOLLO for Historical Research

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Overview

- Collaborative software development
- Corpora & collocations
- DiaCollo: diachronic collocation profiling
- Use case: Education policy in Die Grenzboten
- Summary & conclusion
Software Development Cycle

Planning
- identify desiderata & bugs
- sketch next steps

Evaluation
- testing “in the wild”
- user feedback

Implementation
- coding & documentation
- release & deployment
Corpora & Collocations

Diachronic Text Corpora

- heterogeneous with respect to date of origin
- should expose temporal effects of e.g. semantic shift, discourse trends
- problematic for conventional NLP tools (which assume homogeneity)

Collocation Profiling  

(Church & Hanks 1990; Manning & Schütze 1999; Evert 2005)

“You shall know a word by the company it keeps” — J. R. Firth

- prompt user for target collocant term(s) of interest ($w_1$)
- lookup all candidate collocates ($w_2$) co-occurring with $w_1$
- rank candidates by association score
  - score function $\phi(f_1, f_2, f_{12}, N)$ approximates relevance of $w_2$ to $w_1$
  - “chance” co-occurrences with high-frequency $w_2$ should be filtered out!
  - statistical method $\mapsto$ requires large data sample
Diachronic Collocation Profiling

The Problem: (temporal) heterogeneity
- conventional collocation extractors assume corpus homogeneity
- co-occurrence frequencies are computed only for word-pairs \((w_1, w_2)\)
- influence of occurrence date (and other document properties) is irrevocably lost

A Solution (sketch)
- represent terms as \(n\)-tuples of independent attributes, including occurrence date
- partition corpus on-the-fly into user-specified intervals ("date slices", "epochs")
- collect independent epoch-wise profiles into final result set

Advantages
- full support for diachronic axis
- variable query-level granularity
- flexible attribute selection
- multiple association scores

Drawbacks
- sparse data requires larger corpora
- computationally expensive
- large index size
- no syntactic relations (yet)
DiaCollo: Development

Planning & Evaluation
- in collaboration with DWDS lexicographers & CLARIN-D historians

Implementation
- Perl+PDL API, CLI, client/server
  - RESTful D* web-service + GUI
- various output & visualization formats, e.g.
  - TSV, JSON, HTML, Highcharts, d3-cloud, ...
- batteries not included
  - tokenization, annotation, full-text search, ...
- garbage in ⇝ garbage out
  - “messy” corpora ⇝ unsatisfying results

Deployment
- successfully applied to 70 distinct curated corpora at the BBAW, including:
  - Royal Society Philosophical Transactions (1665–1869, 9.8K documents, 35M tokens)
  - Deutsches Textarchiv (1600–1900, 3.6K documents, 205M tokens)
  - DWDS Zeitungen (1946–2019, 16M documents, 6.3G tokens)
DiaCollo: Scoring & Comparison Functions

Selected Score Functions

- **f**: raw collocation frequency
  \[ f_{12} \]

- **If**: collocation log-frequency
  \[ \log_2 (f_{12} + \varepsilon) \]

- **mi**: pointwise MI × log-frequency
  \[ \log_2 \left( \frac{f_{12} \times N}{f_1 \times f_2} \right) \times \log_2 f_{12} \]

- **ll**: log-likelihood (Dunning 1993)
  \[ \text{sgn}(f_{12}|f_1, f_2) \times \log \frac{L(H_0)}{L(H_1)} \]

- **ld**: log-Dice coefficient (Rychlý 2008)
  \[ 14 + \log_2 \frac{2 \times f_{12}}{f_1 + f_2} \]

Selected Diff Operations

- **diff**: raw score difference
  \[ s_a - s_b \]

- **adiff**: absolute score difference
  \[ |s_a - s_b| \]

- **avg**: arithmetic average
  \[ \frac{s_a + s_b}{2} \]

- **max**: maximum
  \[ \max\{s_a, s_b\} \]

- **min**: minimum
  \[ \min\{s_a, s_b\} \]

- **havg**: harmonic average
  \[ \approx \frac{2s_as_b}{s_a + s_b} \]
Use Case: Education Policy in *Die Grenzboten*
‘Schule’: DiaCollo Query (DTA)

Target as:
LEMMA(s), e.g. Maske
/REGEX/, e.g. /^Masken.*/
DDC QUERY

Target date(s):
DATE(s), e.g. 1900:1999 or *:* or 1900:*
/REGEX/, e.g. /^18\{345\}/
association with religious institutions

- *Kloster* ("cloister")
- *Pfarrherr* ("pastor")
- *Kirche* ("church")
## ‘Schule’: DiaCollo Collocates (DTA: HTML)

### 1560–1569

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- association with religious institutions
  - Kloster (“cloister”)
  - Pfarrherr (“pastor”)
  - Kirche (“church”)

### 1710–1719

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- stronger secular associations
  - Inspektor (“inspector”)
  - preußisch (“prussian”)
  - Universität (“university”)

- trend continues as time progresses
‘Schule’: DiaCollo Collocates (DTA: lemma-cloud)

1560s:
- Pfarrherr
- partikular
- Ordnung
- Schule
- Flecken
- Schulmeister
- Knabe
- Kloster

1710s:
- mechanisch
- Schule
- Lehrer
- Jugend
- Universität
- Kirche
- Besuchung
- preußisch
- Besserung
- Inspektor
Die Grenzboten (“the messengers from the border(s)”) was a bi-weekly national-liberal German language periodical published 1841–1922.

Covered a wide range of politics, literature, and the arts throughout the ‘long’ nineteenth Century.

270 volumes (ca. 187,000 pages) digitized, OCR’ed, and structured by the SuUB Bremen in the context of a DFG-Project. Integrated into the corpus research infrastructure of the Deutsches Textarchiv at the BBAW CLARIN Service Center.
Are *Die Grenzboten* concerned with education?

**Step 1: query corpus vocabulary database (LexDB)**

- identify relevant terms in the corpus, e.g. *Schule* (“school”), 1840–1899
  - ... in the *Deutsches Textarchiv*: 101.52 per million tokens
  - ... in *Die Grenzboten*: 237.29 per million tokens

**Step 2: query DiaCollo**

- identify strong collocates for *Schule* (“school”)
- identify possible debates in the corpus via query results
- close reading in the texts via “keyword-in-context” (KWIC) hyperlinks
Collocate ‘Kirche’ (‘church’)

- persistently prominent throughout the entire Grenzboten corpus
- 1850s–1880s: konfessionell (‘confessional’)
- 1890s–1910s: Religionsunterricht (‘religious education’)

Refining the Search

- restrict to attributive adjective collocates (GROUPBY: l,p=ADJA)
  - protestantisch (‘protestant’) 1860s
  - katholisch (‘Catholic’) 1860s-1870s
  - evangelisch (‘Protestant, Evangelical’) 1860s-1870s
  - konfessionell (‘confessional’) 1860s-1880s
  - kirchlich (‘churchly’) 1870s

- collocates related to church & religious confession peak in the 1860s–1870s
- also prominent: öffentlich (‘public’; 1840s, 1870s–1900s)
  - KWIC ⇝ stance of publicly funded schools w.r.t. church influence in education
Education Policy: *Kulturkampf*

**Kulturkampf** (“cultural struggle”)
- rights & influences of state (Prussia) vs. church (Pope Pius IX)
- *ultramontan* (“ultramontane”) ↳ staunch supporters of the Catholic Church

![Graph showing frequency of *ultramontan* and *Kulturkampf*](image)

**Refining the Search: GermaNet thesaurus + paragraph search window**
(Hamp & Feldweg 1997; Henrich & Hinrichs 2010)
- corpus hits show evidence for anti-Catholic opinions in debates on education
  - who should be in charge of education and curricula?
  - how to deal with different religious denominations in schools?

**Upshot**
- some important aspects of debate are not apparent from initial naïve DiaCollo queries
- informed curiosity & focused investigation leads to very satisfying results
Summary & Conclusion

Collaborative Development

- cyclic process
- elusive common ground

\[ \Rightarrow \text{feedback loop} \]
\[ \Rightarrow \text{terminology, research methodology} \]

DiaCollo

- diachronic text corpora
- conventional tools
- diachronic profiling

\[ \Rightarrow \text{semantic shift, discourse trends} \]
\[ \Rightarrow \text{implicit assumptions of homogeneity} \]
\[ \Rightarrow \text{date-dependent lexemes} \]

... as a tool for historical research

- fluent “blended”/“scalable” reading
- digital corpora (sources)

\[ \Rightarrow \text{distant ↔ close reading} \]
\[ \Rightarrow \text{quantity, quality, legal issues} \]
Thank you for listening!

http://kaskade.dwds.de/~jurish/diacollo
http://metacpan.org/release/DiaColloDB
References
References


